HINDUSTAN ZINC LIMITED

Udaipur, Rajasthan

ENVIRONMENTAL IMPACT ASSESSMENT

FOR

PROPOSED MELTING & CASTING FACILITIES FOR ZINC, 465,000 TPA, AND LEAD, 150,000 TPA, AT SIDCUL, PANTNAGAR VILLAGE, KICHHA TEHSIL, UDHAM SINGH NAGAR DISTRICT, UTTARAKHAND

For and on behalf of VIMTA Labs Limited

Approved by : **M. Janardhan**

Signed :

Position : **Vice President (Env)**

Date :January 12, 2011

The report has been prepared inline with the prescribed TORs issued vide letter J-11011/327/2010-IA-II (I) dated 25th October, 2010 of MoEF, New Delhi.

This report has been prepared by Vimta Labs Limited with all reasonable skill, care and diligence within the terms of the contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.

Table of Contents

Chapter #	Title	Page #
	Table of Contents	TC-1
	List of Figures	TC-4
	List of Tables	TC-5
	Executive Summary	
1.0	**Introduction**	
1.1	Purpose of the Report	C1-1
1.2	Identification of Project and Project Proponent	C1-1
1.3	Brief Description of Project	C1-2
1.4	Scope of the Study	C1-7
2.0	**Project Description**	
2.1	Type of Project	C2-1
2.2	Need for the Project	C2-1
2.3	Location of the Project	C2-1
2.4	Magnitude of Operation	C2-5
2.5	Proposed Schedule and Approval for Implementation	C2-9
2.6	Project Details of Existing Silver Plant (Under Implementation)	C2-9
2.7	Technology and Process Description	C2-13
2.8	Project Description	C2-14
2.9	Raw Material Requirement	C2-18
2.10	Infrastructure	C2-20
3.0	**Baseline Environmental Status**	
3.1	Introduction	C3-1
3.2	Geology and Hydrogeology	C3-2
3.3	Land Use Studies	C3-14
3.4	Soil Characteristics	C3-24
3.5	Meteorology	C3-31
3.6	Ambient Air Quality	C3-41
3.7	Water Quality	C3-50
3.8	Noise Level Survey	C3-61
3.9	Ecological Studies	C3-65
3.10	Demography and Socio-economics	C3-73
3.11	Traffic Density	C3-78
4.0	**Anticipated Environmental Impacts and Mitigation Measures**	
4.1	Introduction	C4-1
4.2	Impacts during Construction Phase	C4-2
4.3	Impacts during Operational Phase	C4-7
4.4	Impact on Topography and Drainage	C4-7

Table of Contents (contd.)

Chapter #		Title	Page #
	4.5	Impact on Landuse	C4-7
	4.6	Impact on Soil	C4-8
	4.7	Impact on Air Quality	C4-9
	4.8	Impact on Water Resources	C4-27
	4.9	Impact of Solid Wastes	C4-39
	4.10	Impact on Noise Levels	C4-40
	4.11	Biological Environment	C4-44
	4.12	Impact on Traffic	C4-47
	4.13	Plantation/Greenbelt Development	C4-52
	4.14	Socio-Economic Environment	C4-53
	4.15	Indirect Impacts	C4-54
	4.16	Occupational Health (Impacts & Mitigation measures)	C4-57
	4.17	Summary of Anticipated Environmental Impacts and Mitigation	C4-54
5.0	**Analysis of Alternative Technology & Site**		
	5.1	Selection of Technology	C5-1
	5.2	Description of Alternative Site	C5-1
6.0	**Environment Monitoring Programme**		
	6.1	Post Project Environment Monitoring	C6-1
	6.2	Institutional Arrangements for Pollution Control	C6-3
	6.3	Cost Provision for Environmental Measures	C6-3
7.0	**Additional Studies**		
	7.1	Hydrological, Hydrogeological and Land Use Mapping	C7-1
	7.2	Risk Assessment & Disaster Management Plan	C7-2
	7.3	Disaster Management Plan	C7-20
	7.4	Emergencies	C7-22
	7.5	Emergency Organization	C7-23
	7.6	Emergency Responsibilities	C7-23
	7.7	Emergency Facilities	C7-27
	7.8	Emergency Actions	C7-30
	7.9	General Information	C7-31
	7.10	Off-Site Emergency Preparedness Plan	C7-37
	7.11	Occupational Health (Impacts and Mitigation Measures)	C7-42
	7.12	Risk Assessment in Melting & Casting Section & Actions	C7-48
8.0	**Project Benefits**		
	8.1	Construction Phase	C8-1
	8.2	Operational Phase	C8-1

Table of Contents (contd.)

Chapter #	Title	Page #
9.0	**Administrative Aspects**	
9.1	Corporate Philosophy of HZL	C9-1
9.2	Infrastructure for Environmental Protection	C9-2
10.0	**Summary & Conclusion**	
10.1	Justification for Implementation of the Project	C10-1
10.2	Summary of Anticipated Environmental Impacts and Mitigation Measures	C10-1
10.3	Conclusions	C10-4
11.0	**Disclosure of Consultants**	
11.1	Introduction	C11-1
11.2	Vimta Labs Limited – Environment Consultant	C11-1

List of Annexes

Annexure-I : Terms of Reference
Annexure-II : Environmental Clearance Letter
Annexure-III : Land Allotment Letter
Annexure-IV : Central Ground Water Authority Letter
Annexure-V : Methodology For Sampling And Analysis
Annexure-VI : Applicable Environment Standards
Annexue-VII : Land Use Pattern
Annexue-VIII : Ambient Air Quality
Annexure-IX : Fauna And Flora
Annexure-X : Demographic Details
Annexure-XI : Emission Calculations

List of Figures

Figures #	Title	Page #
1.1	Location of the HZL Mines and Smelters in India	C1-3
1.2	Geographical Location of the Project	C1-6
1.3	Study Area Map	C1-8
1.4	Photographs of the Project Site	C1-9
2.1	Map of SIDCUL, Pantnagar	C2-7
2.2	Layout Plan of the Zinc and Lead Melting and Casting Plant	C2-8
2.3	Silver-Process Flow Sheet	C2-12
2.4	Process Flow Sheet of Zinc Melting and Casting	C2-16
2.5	Process Flow Sheet of Lead Melting and Casting	C2-19
2.6	Energy Balance – Electrical	C2-23
2.7(A)	Energy Balance - Fuel Energy – Lpg	C2-24
2.7(B)	Energy Balance - Fuel Energy – Lpg	C2-25
2.8(A)	Energy Balance - Fuel Energy – LSHS	C2-26
2.8(B)	Energy Balance - Fuel Energy – LSHS	C2-27
2.9(A)	Energy Balance - Fuel Energy – LDO	C2-28
2.9(B)	Energy Balance - Fuel Energy – LDO	C2-29
2.10	Energy Balance - Fuel Energy – HSD	C2-30
3.2.1	Hydrogeological Map of Core and Buffer Zone	C3-4
3.2.2	Contour Map of Core and Buffer Zone	C3-5
3.2.3	Lithological log of Tube well	C3-7
3.3.1	Satellite Image of Buffer Zone	C3-15
3.3.2	Base Map of Buffer Zone	C3-16
3.3.3	Drainage Map of Buffer Zone	C3-18
3.3.4	Geomorphological Map of Buffer Zone	C3-19
3.3.5	Digital Elevation Model of the Area	C3-20
3.3.6	Integrated Land Use Map of Buffer Zone	C3-22
3.4.1	Soil Sampling Locations	C3-27
3.5.1(A)	Site Specific Wind Rose (Pre Monsoon Season)	C3-33
3.5.1(B)	Site Specific Wind Rose (Post Monsoon Season)	C3-34
3.5.2(A)	Wind Rose Pre Monsoon & Monsoon (IMD-Bareilly)	C3-38
3.5.2(B)	Wind Rose Post Monsoon & Winter (IMD-Bareilly)	C3-39
3.5.2(C)	Wind Rose Annual (IMD-Bareilly)	C3-40
3.6.1	Ambient Air Quality Sampling Location	C3-43
3.7.1(A)	Water Sampling Locations- Pre Monsoon Season	C3-53
3.7.1(B)	Water Sampling Locations- Post Monsoon Season	C3-54
3.8.1	Noise Monitoring Locations	C3-62
3.9.1	Ecological Sampling Locations	C3-67
4.1A	Short Term 24 h Incremental GLCs of SPM- Pre Monsoon	C4-15
4.1B	Short Term 24 h Incremental GLCs of SO_2 Pre Monsoon	C4-16
4.1C	Short Term 24 h Incremental GLCs of NOx Pre Monsoon	C4-17
4.1D	Short Term 24 h Incremental GLCs of SPM Post Monsoon	C4-18
4.1E	Short Term 24 h Incremental GLCs of SO_2 Post Monsoon	C4-19
4.1F	Short Term 24 hourly Incremental GLCs of NOx Post Monsoon	C4-20
4.2	Water Balance for Silver Plant	C4-28
4.3	Water Balance for Zinc and Lead Melting and Casting Plant	C4-29
4.4	Schematic Flow Diagram of the ETP	C4-32
4.5	Sewage Treatment Plant	C4-33

List of Figures (Contd..)

Figures #	Title	Page #
4.6	Cross Section of Recharge Trench	C4-38
4.7	Recharge System for Water Treatment Plant & Compressor Dryer	C4-34
4.8	Noise Levels Around the Plant Sites	C4-42
4.9	Proposed Plantation in Plant Area	C4-49
7.1	Pool Fire : 400-KL LSHS	C7-18
7.2	Pool Fire : 100-KL HSD	C7-19
7.3	On Site Emergency	C7-33
9.1	Organization Structure of Environment Management	C9-3

List of Tables

Tables #	Title	Page #
1.1	Present & Proposed Production Capacity	C1-2
1.2	Compliance to Terms of Reference	C1-11
2.1	Environmental Setting of the Site	C2-1
2.2	List of Industries in 10 Km Radius	C2-3
2.3	Details of Proposed Project	C2-5
2.4	Raw Material and Product of Silver Plant	C2-9
2.5	Major Design Facilities of the Silver Plant	C2-10
2.6	Major Design Facilities of the Proposed Project	C2-13
2.7	Raw Material Reqmt for Zinc & Lead Melting and Casting Plant	C2-18
2.8	Zinc Balance	C2-18
2.9	Lead Balance	C2-18
2.10	Characteristics of Dross	C2-20
2.11	Consumables per Annum	C2-20
2.12	Land Use Proposed for the Plant	C2-20
2.13	Fuel Requirement	C2-21
2.14	Details of Plant Investment	C2-22
3.2.1	Lithological Log of the Tube well	C3-7
3.2.2	Pumping Test Report of Silver Refinery	C3-8
3.2.3	Hydrological Data of Key Wells of Core and Buffer Zone –Pre and Post Monsoon Period, 2010	C3-12
3.3.1	Area Under Different Geomorphological Units in the Study Area	C3-17
3.3.2	Area Under Different Land Use Classes in the Study Area	C3-21
3.3.3	Land Use Pattern in the Study Area (Ha)	C3-23
3.4.1	Analytical Techniques for Soil Analysis	C3-24
3.4.2	Details of Soil Sampling Locations	C3-25
3.4.3(A)	Soil Analysis Results-Premonsoon	C3-28
3.4.3(B)	Soil Analysis Results- Postmonsoon	C3-29
3.4.4	Standard Soil Classification	C3-30
3.5.1(A)	Summary of Meteorological Data at Site-Premonsoon	C3-31
3.5.1(B)	Summary of Meteorological Data at Site-Postmonsoon	C3-32
3.5.2(A)	Summary of Wind Pattern at the Study Area-Premonsoon	C3-35
3.5.2(B)	Summary of Wind Pattern at the Study Area-Postmonsoon	C3-35
3.5.3	Climatological Data Generated at IMD Station Bareilly	C3-36
3.5.4	Summary of Wind Pattern - IMD Station Bareilly	C3-36
3.6.1	Details of Ambient Air Quality Monitoring Locations	C3-42
3.6.2	Monitored Parameters and Frequency of Sampling	C3-44
3.6.3	Techniques Used for Ambient Air Quality Monitoring	C3-45
3.6.4(A)	Summary of Ambient Air Quality Results-Premonsoon	C3-46
3.6.4(B)	Summary of Ambient Air Quality Results-Postmonsoon	C3-46
3.6.4(C)	Summary of Ambient Air Quality Results-Postmonsoon	C3-47
3.6.4(D)	Summary of Dust Fall Concentration – Pre Monsoon	C3-48
3.6.4(E)	Summary of Dust Fall Concentration – Post Monsoon	C3-48
3.6.4(F)	RSPM Characterization – Post Monsoon	C3-48
3.7.1(A)	Details of Water Sampling Locations – Pre Monsoon	C3-51
3.7.1(B)	Details of Water Sampling Locations – Post Monsoon	C3-52
3.7.2(A)	Ground Water Quality – Pre Monsoon	C3-55
3.7.2(B)	Ground Water Quality – Post Monsoon	C3-56

List of Tables (contd.)

Tables #	Title	Page #
3.7.3(A)	Surface Water Quality – Pre Monsoon	C3-57
3.7.3(B)	Surface Water Quality – Post Monsoon	C3-58
3.8.1	Details of Noise Monitoring Locations	C3-61
3.8.2(A)	Ambient Noise Levels (dB (A)) in the Study Area – Pre Monsoon	C3-63
3.8.2(B)	Ambient Noise Levels (dB (A)) in the Study Area – Post Monsoon	C3-63
3.9.1	Details of Phyto-Sociological Sampling Locations	C3-66
3.9.2	List of Forest in Study Area	C3-68
3.9.3	Braun-Blanquet Classification	C3-69
3.9.4	Class Wise Distribution of Plant Species in the Study Area	C3-69
3.9.5	List of Recorded Wildlife in Study Area	C3-70
3.9.6	Details of Aquatic Sampling Location	C3-72
3.9.6	Details of Aquatic Fauna from Study Area	C3-73
3.9.7	List of Observed Planktonic Flora and Fauna	C3-73
3.10.1	Distribution of Population in Study Area	C3-74
3.10.2	Distribution of Population by Social Structure	C3-75
3.10.3	Distribution OF Literates and Literacy Rates	C3-75
3.10.4	Occupational Structure	C3-76
3.10.5	Educational Facilities in Study Area	C3-77
3.10.6	Health Facilities in Study Area	C3-77
3.11.1	Details of Traffic Monitoring Locations	C3-78
3.11.2(A)	Traffic Density (Vehicles/day) – Pre Monsoon	C3-79
3.11.2(B)	Traffic Density (Vehicles/day) – Post Monsoon	C3-79
3.11.3	Recommendations on Traffic Capacity-IRC	C3-79
4.1	Land Use Proposed for the Plant	C4-8
4.2	Details of Stack Emissions	C4-13
4.3	Short Term Incremental Concentrations (GLCs)	C4-14
4.4	Resultant Concentrations Due to Incremental GLCs	C4-21
4.5	Handling Raw Material, By-Products & Products	C4-22
4.6	Proposed Packing and Transport Measures	C4-24
4.7	Proposed Additional Traffic Due to the Project	C4-24
4.8	Emission Factors for Vehicular Impact Predictions	C4-26
4.9	Peak Hourly Predicted Incremental Concentrations	C4-27
4.10	ETP Processes	C4-31
4.11	Waste Water Parameters – Feed & Treated	C4-31
4.12	Solid Wastes Generated From the Plant	C4-39
4.13	Solid Waste Disposal	C4-40
4.14	Noise Generating Sources	C4-40
4.15	Estimated Noise Levels From the Plant	C4-40
4.16	Predicted Noise Levels at the Plant Boundary	C4-41
4.17	Incremental Concentration at Forest	C4-45
4.18	Existing and Proposed Traffic on National Highway	C4-46
4.19	Recommendations on Traffic Capacity – IRC	C4-46
4.20	Plantation Development Schedule	C4-47
4.21	Recommended Plant Species for Plantation	C4-50
4.22	Occupational Risks	C4-54

List of Tables (contd.)

Tables #	Title	Page #
4.23	Occupational Health Monitoring Details	C4-56
4.24	List of Material to be kept in Centralised Place	C4-57
4.27	Anticipated Environmental Impacts and Mitigation Measures	C4-57
6.1	Monitoring Schedule for Environmental Parameters	C6-1
6.2	Cost Provision for Environmental Measures	C6-3
7.1	Category Wise Schedule of Storage Tanks	C7-4
7.2	Applicability of GOI Rules to Fuel/Chemical Storage	C7-4
7.3	Fire Explosion and Toxicity Index	C7-5
7.4	Fire Explosion and Toxicity Index for Storage Facilities	C7-6
7.5	Preliminary Hazard Analysis for Storage Areas	C7-9
7.6	Preliminary Hazard Analysis for the Whole Plant in General	C7-9
7.7	Damage Due to Incident Radiation Intensities	C7-11
7.8	Radiation Exposure and Lethality	C7-12
7.9	Scenarios Considered for MCA Analysis	C7-13
7.10	Properties of Fuels Considered for Modeling	C7-14
7.11	Occurrence of Various Radiation Intensities-Pool Fire	C7-14
7.12	Occurrence of Various Radiation Intensities-Fire Ball	C7-16
7.13	Occurrence of Safe Radiation Intensity	C7-17
7.14	Firefighting Personnel	C7-28
7.15	Proposed Firefighting Facilities in PSP	C7-29
7.16	Key Personnel	C7-34
7.17	Off-Site Action Plan	C7-41
7.18	Occupational Risk	C7-43
7.19	Occupational Health Monitoring Plan	C7-45
7.20	List of Material to be kept in Centralized Place	C7-45
10.1	Anticipated Adverse Environmental Impacts and Mitigation Measures	C10-1

1.0 INTRODUCTION

1.1 Purpose of the Report

Hindustan Zinc Limited (HZL) proposes to set up melting and casting facilities for Zinc (465,000 TPA) and Lead (150,000 TPA capacity) within the premises of existing silver refinery plant site at notified industrial area of State Industrial Development Corporation Limited (SIDCUL), Pantnagar village, Kichha tehsil, Udham Singh Nagar district, Uttarakhand state.

The application for prior EC (Form-1) for the proposed project has been submitted to MoEF and was considered in the 14th meeting of Expert Appraisal Committee (Industry-1) held during September 23-25, 2010 in New Delhi to prescribe Terms of Reference (TORs) for the preparation of EIA/EMP report. The Expert Appraisal Committee prescribed the TORs for undertaking detailed EIA study vide letter No. J-11011/327/2010-IA-II (I) dated 25th October, 2010 which is enclosed as **Annexure-I**.

The silver refinery plant (presently under implementation) has received the environmental clearance from the SEIAA, Uttarakhand vide letter No. EC-5110265 dated 16th March 2010 and the Consent to Establish (CFE) vide letter dated 01st April 2010 which are enclosed as **Annexure-II**. The silver refinery plant is under advance stage of implementation and likely to be commissioned by March 2011.

1.2 Identification of Project & Project Proponent

1.2.1 Identification of Project

The proposed project is for setting up of melting and casting facilities for Zinc (465,000 TPA) and Lead (150,000 TPA capacity). The proposed project site is a part of the notified industrial area of State Industrial Development Corporation Uttarakhand Limited (SIDCUL) Pantnagar, Uttarakhand where HZL is in the process of setting up a Silver Refinery. Techno-economic considerations taking into account, factors like land availability, basic infrastructure, availability of utilities like water, power, the capital & operating cost have been evaluated and found qualified to set up the zinc and lead melting and casting units at Pantnagar, Uttarakhand.

1.2.2 Project Proponent

Hindustan Zinc Limited (HZL) is one of India's leading base metal producers and exceptional in the extent of its technological versatility coupled with vertical integration in several metals.

Hindustan Zinc is India's largest and the world's second largest integrated producer of zinc & lead, with a global share of approximately 6.0% in zinc.

HZL was incorporated in January 1966 after the take over of the erstwhile Metal Corporation of India (MCI), to develop mining and smelting capacities to substantially meet the domestic demand of zinc and lead metals.

HZL has broad-based operations. Its spectrum of activities range from exploration, mining and ore processing to smelting and refining of lead, zinc, cadmium, cobalt, copper and precious metals. It is also a major producer of sulphuric acid. HZL has achieved the following:

- Proven track record of 40 years in mining & smelting;
- 7 smelters at 4 locations and 7 mines at 4 locations;
- Ore treatment capacity 10.85 Million TPA;
- Zinc metal production capacity 931,000 TPA;
- Lead metal production capacity 95,000 TPA;
- Thermal power plants of capacity 429 MW; and
- Wind power generation capacity of 123.2 MW.

Most of the mining and smelting units of HZL are accredited with ISO 9001, 14001 & OHSAS 18001.

The company is moving ahead to become the World's largest integrated producer of zinc-lead by 2010 and will achieve its mission to produce one million tonne of metal as well. The operating locations of Hindustan Zinc mines and smelters in India with their capacities are shown in **Figure-1.1**.

1.3 Brief Description of Project

1.3.1 Nature of the Project

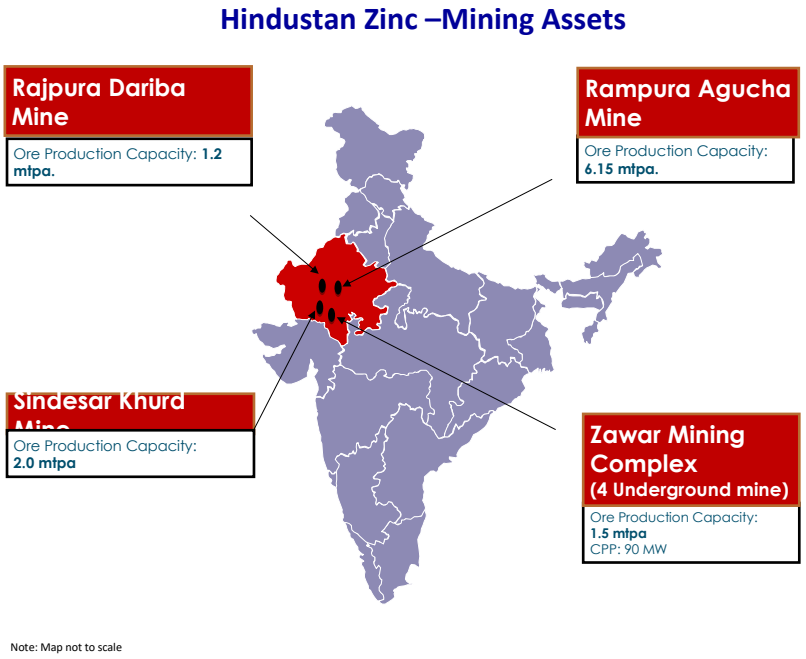
The objective of the project is to set up Zinc 465,000 TPA and Lead 150,000 TPA Melting & Casting Plant. The proposed project is classified as "**CATEGORY-A"** by Ministry of Environment & Forests, New Delhi as per the EIA Notification dated 14th September 2006 and the amendments thereof.

1.3.2 Size of the Project

The proposed project is planned within the premises of existing silver refinery plant site at SIDCUL, Pantnagar in an industrial plot owned by HZL admeasuring 10 ha and the land allotment letter is enclosed as **Annexure-III**. There will be no additional land acquisition. The present and proposed production capacities are given in **Table-1.1**.

TABLE-1.1
PRESENT & PROPOSED PRODUCTION CAPACITY

Sr. No.	Product/ By product	Present Capacities	Additional Capacities	Total Capacities
1	Silver	500 TPA	-	500 TPA
2	Antimony concentrate	1400 TPA	-	1400 TPA
3	Bismuth concentrate	140 TPA	-	140 TPA
4	Copper matte	140 TPA	-	140 TPA
5	Oxidation slag	840 TPA	-	840 TPA
6	Zinc Ingot	-	4,65,000 TPA	4,65,000 TPA
7	Lead Ingot	-	1,50,000 TPA	1,50,000 TPA



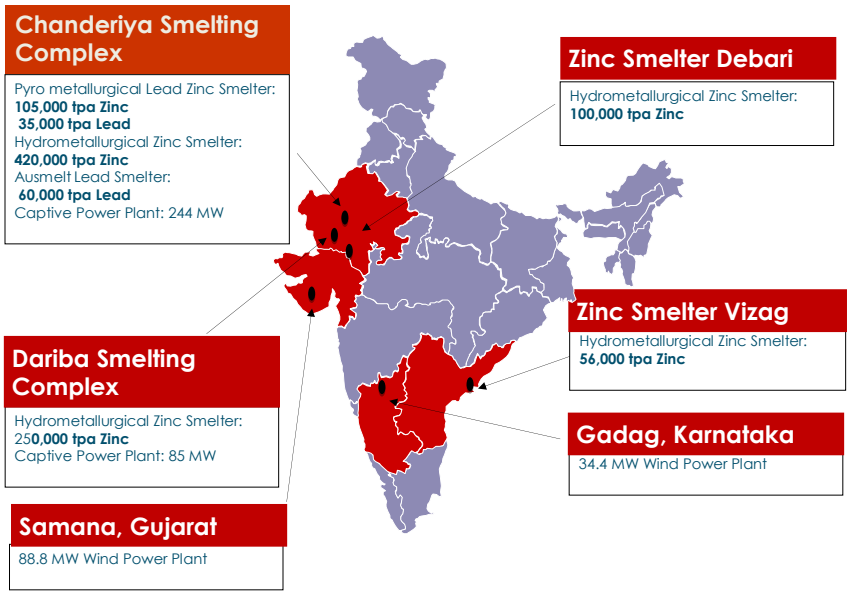


FIGURE-1.1
LOCATIONS OF THE HZL MINES AND SMELTERS IN INDIA

1.3.3 Cost of the Project and Anticipated Life of Project

Total cost of the proposed project is estimated to be Rs. 250 Crores. The projected life of the project is 20 years.

1.3.4 Location of the Project

The proposed project is located at Plot No-2, Sector-14, Integrated Industrial Estate (IIE) SIDCUL, Pantnagar, Uttarakhand where Silver plant of 500 TPA capacity is under implementation. The project site is part of Notified Industrial Area administered by State Industrial Development Corporation Limited (SIDCUL), Dept. of Industries, Govt. of Uttarakhand. The site is located at the intersection of latitude 29^0 02' 07'' N and longitude 79^0 24' 01'' E.

Geographical location of the project site is shown in **Figure-1.2**.

1.3.5 Importance to the Country & Region

By establishing the zinc and lead melting and casting plants, HZL will provide the country with increased Government earnings and revenues, transform the region's economy and accelerate the pace of industrial development in the region.

1.3.6 Supply and Demand

Domestic demand for zinc & lead grew by 25% & 5% respectively in 2009-10 vis-à-vis 2008-09 and further growing in 2010-11 wrt 2009-10.

1.3.6.1 Zinc

Demand in Indian market for refined Zinc increased by 25% to 525 kt in FY 2010, from 419 kt in the previous year. This was mainly driven by the demand created by the various infrastructure projects. The Indian Zinc demand is expected to grow in the coming years based on a positive GDP forecast. The key components for demand growth are the ongoing and upcoming infrastructure projects, telecom and power projects and automobile sector.

- **Applications of Zinc**

- Galvanizing

Zinc is one of the best forms of protection against corrosion and is used extensively in building, construction, infrastructure, household appliances, automobiles, steel furniture, and more. Galvanizing accounts for around 48% of global Zinc usage.

- Zinc Oxide

The most widely used Zinc compound, Zinc oxide is used in the vulcanization of rubber, as well as in ceramics, paints, animal feed, pharmaceuticals, and several other products and processes. A special grade of Zinc oxide has long been used in photocopiers. 10% of global Zinc usage is in this segment.

- Die Castings

Zinc is an ideal material for die casting and is extensively used in hardware, electrical equipments, automotive and electronic components.

17% of Zinc used in the world is through Die Castings Alloys. Zinc is extensively used in making alloys, especially brass, which is an alloy of copper and Zinc. Alloy accounts for around 11% of global Zinc usage.

1.3.6.2 Lead

Demand for lead increased by 5% to 355,000 tonnes in FY 2010 as compared to the previous year. The main driver was the increase in the battery demand in replacement market. Also, demand of auto sector fared much better in India and Industrial demand especially inverter battery has fuelled growth. Indian Lead demand is expected to increase in the coming years, at the back of Industrial and Inverter battery segment growth and replacement market especially in auto sector. The demand of the Indian Battery industry is estimated to be around 90% of Indian Lead demand. Our share in the domestic market is around 15%.

The identified zinc and lead resources of the HZL lease hold areas are estimated at 298.6 Mt containing 34.1 million tonnes of zinc-lead metal. The bulk of the lead-zinc deposits occur in Rajasthan and are under lease/exploitation by HZL.

➢ **Applications of Lead**

- *Batteries*

The battery sector is the single largest consumer of Lead, accounting for around three-quarters of the demand. It can be sub-divided into the following groups:

- SLI (Starting-Lighting Ignition) Batteries

SLI (Starting-Lighting Ignition) batteries, which currently accounts for around half of the total Lead demand. These are mainly used in cars and light vehicles, but are also found in other applications such as golf carts and boats. SLI battery demand in turn can be split into original equipment and replacement, with replacement demand outstripping original equipment demand by about 4:1 in mature markets.

- Industrial Batteries

Industrial batteries, which currently consumes around a quarter of the total Lead produced. This sector can be split roughly 50:50 into stationary and traction batteries. Stationary batteries are principally used in back up power supply systems; traction batteries are used for motive power in equipment such as forklift trucks and motorized wheelchairs. The remainder is used in non-battery applications.

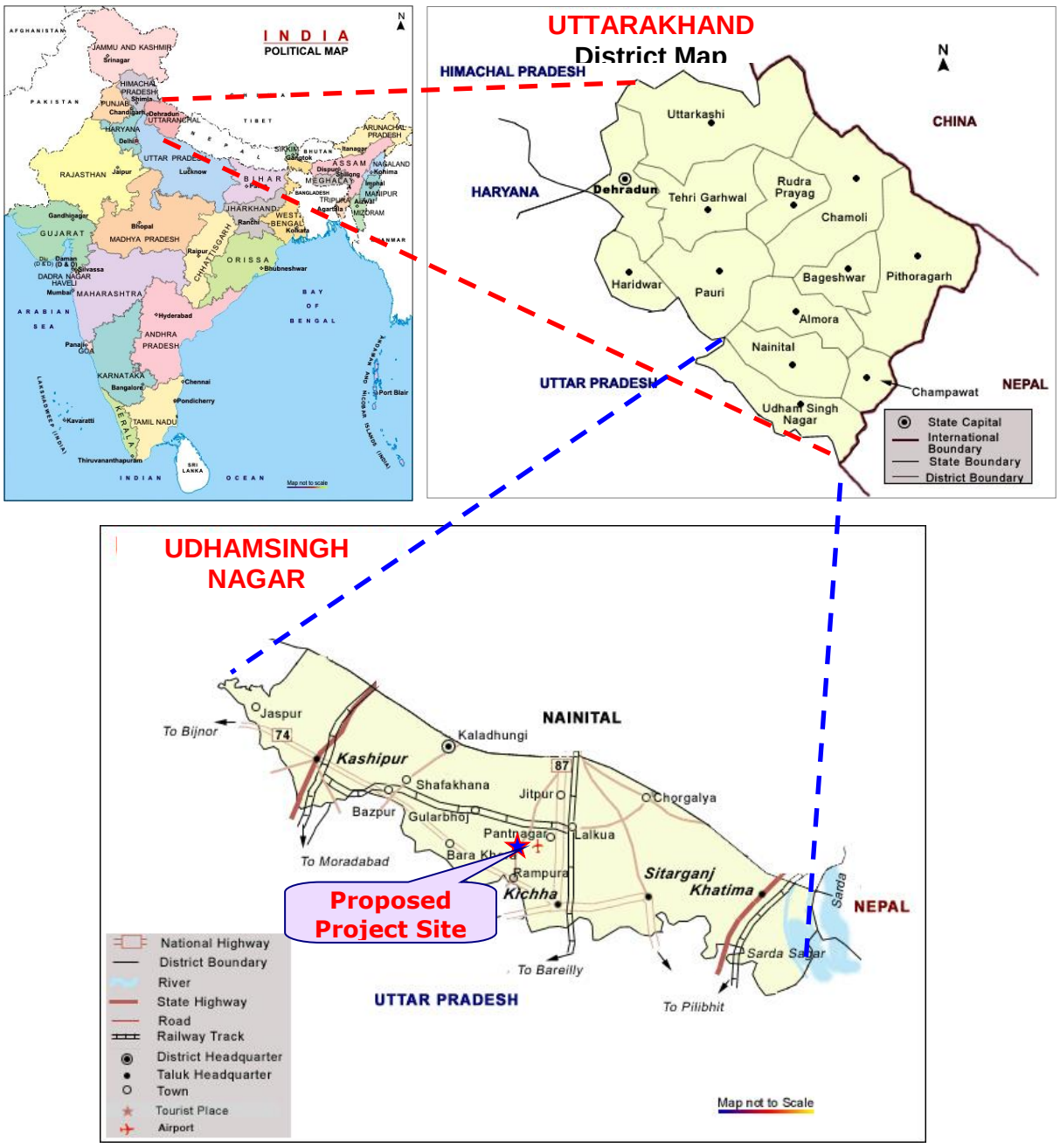


FIGURE-1.2
GEOGRAPHICAL LOCATION OF THE PROJECT

- Non-battery Applications

The second largest current end use of Lead for non-battery applications, accounting for around 8% of Lead consumption, is the chemical industry, in the form of Lead-based pigments and other compounds. Principal markets are for cathode ray tubes used in television screens and computer monitors, and for Poly Vinyl Chloride (PVC) stabilizers.

1.4 Scope of the Study

In line with the TOR prescribed by Expert Appraisal Committee, the zone comprising of 10 km radius around the plant site is considered as the study area. The study area map is shown in **Figure-1.3**. The photographs of the project site are shown in **Figure-1.4**.

The scope of study broadly includes:

- To conduct literature review and to collect data relevant to the study area;
- Establishing the baseline environmental aspects in and around the project area;
- Identifying various existing pollution loads;
- Predicting incremental levels of pollutants in the study area due to the proposed project;
- Evaluating the predicted impacts on various environmental attributes in the study area by using scientifically developed and widely accepted environmental impact assessment methodologies;
- To prepare an Environment Management Plan (EMP), outlining the measures for improving the environmental quality in view of proposed project & allied activities for environmentally sustainable development; and
- To conduct Risk Analysis and prepare Disaster Management Plan with recommendations on preventive measures to be taken to limit the impact on environment to the desired level.

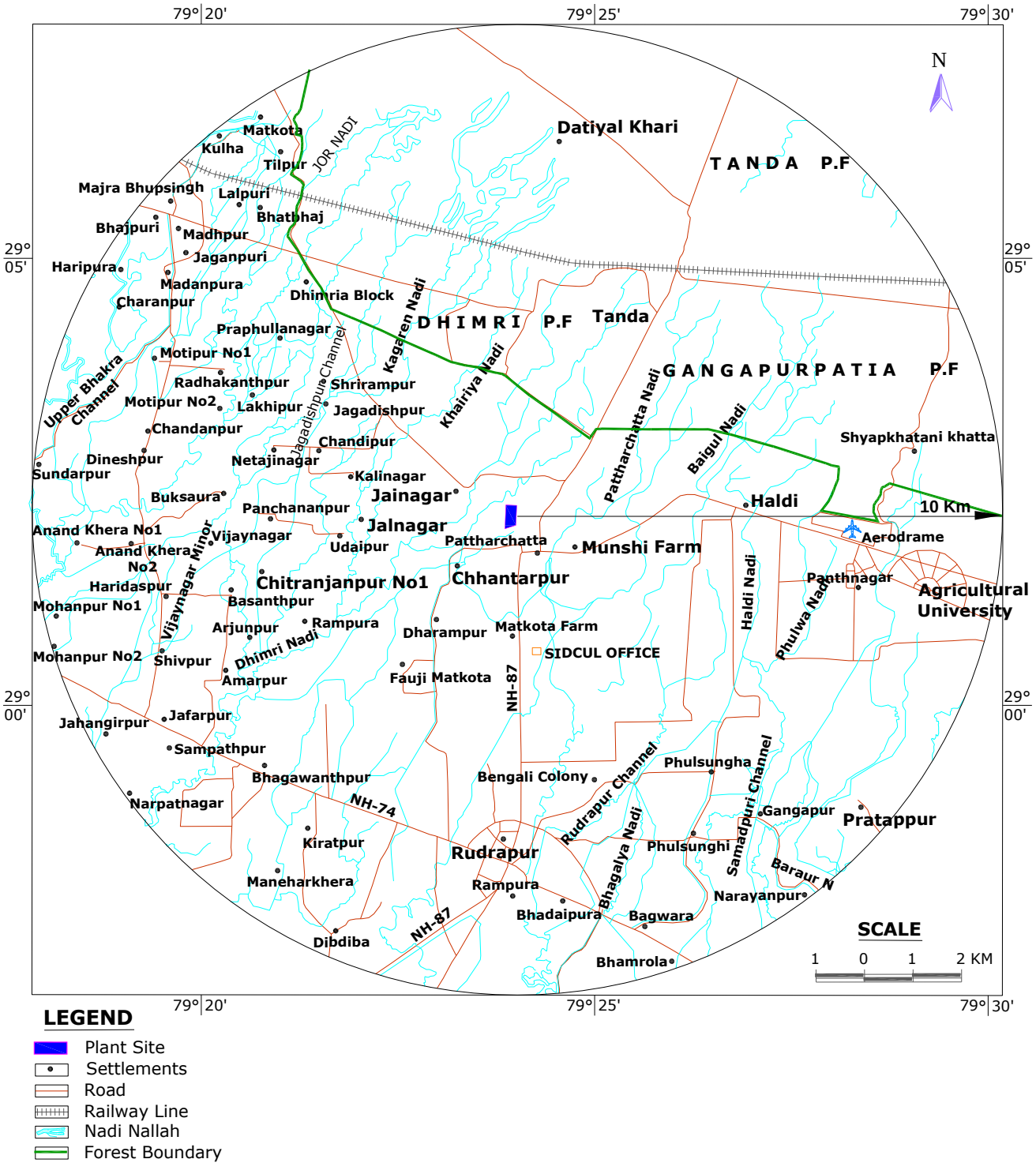


FIGURE-1.3
STUDY AREA MAP

BAG FILTER & COOLING TOWER

FIGURE-1.4 (A)
PHOTOGRAPHS OF THE PROJECT SITE

HYDRO-CELL HOUSE

SILVER ELECTRO REFINERY

FIGURE-1.4 (B)
PHOTOGRAPHS OF THE PROJECT SITE

- Identifying critical environmental attributes that are required to be monitored in the post-project scenario.

Hindustan Zinc Ltd (HZL) has retained the services of M/s. Vimta Labs Limited, Hyderabad to undertake EIA studies as per *Terms of Reference* (TOR) prescribed by the MoEF for assessing the impact of the proposed Zinc 465,000 TPA and Lead 150,000 TPA Melting & Casting Plant on various environmental parameters in the study area and to prepare an Environment Management Plan for negating the adverse impacts of the project to obtain Environment Clearance from Ministry of Environment and Forests (MoEF) Government of India, New Delhi and the Consent For Establishment (CFE) from Uttarakhand Environment Protection and Pollution Control Board for the project. This EIA report is prepared in the lines of EIA Notification dated 14th September, 2006. To determine condition of various environmental attributes, field studies have been conducted for the silver refinery plant during *1st March 2009 to 31st May 2009* representing p*re-monsoon* season and for the existing conditions the monitoring was conducted during 1st October 2010 to 31st December 2010 representing post monsoon and part of winter season. The scope also includes all the conditions outlined in the TOR issued by MOEF and the compliance to the ToR is given in **Table-1.2**.

TABLE-1.2
COMPLIANCE TO TERMS OF REFERENCE

Sr. No	Comments	Report Reference	
		Chapter	Section & Page
1	Executive summary of the project.	Enclosed	
2	Photographs of plant area.	Chapter-1	Section-1.4 & Page-C1-9, Figure-1.4
3	Proposal should be submitted to the Ministry for environment clearance only after acquiring total land. Necessary documents indicating acquisition of land should be included.	The proposed project is planned within the premises of existing silver refinery plant site at SIDCUL, Pantnagar in an industrial plot owned by HZL admeasuring 10 ha and the land allotment letter is given as **Annexure-III**. There will be no additional land acquisition. The details of land are given in Chapter-2	Section-2.10.1 & Page-C2-20
4	A site location map on Indian map of 1:10, 00,000 scale followed by 1:50,000/1:25,000 scale on an A3/A2 sheet with at least next 10 Kms of terrains i.e. circle of 10 kms and further 10 kms on A3/A2 sheets with proper longitude/latitude/heights with min. 100/200 m. contours should be included. 3-D view i.e. DEM (Digital Elevation Model) for the area in 10 km radius from the proposal site.	The site location map on Indian map of 1:50,000 is given in Chapter-1 The DEM (Digital Elevation Model) map is given in Chapter-3	Page-C1-8, Figure-1.3 Page-C3-20, Figure-3.3.5
5	Present land use should be prepared based on satellite imagery. High-resolution satellite image data having 1m-5m spatial resolution like quickbird, Ikonos, IRS P-6 pan sharpened etc. for the 10Km radius area from proposed site.	Based on the different themes prepared using satellite data, toposheet and field check, an integrated land use map is prepared and given in Chapter-3	Section-3.3.2 & Page-C3-15, Figure-3.3.1

Sr. No	Comments	Report Reference	
		Chapter	Section & Page
	The same should be used for land used/land-cover mapping of the area.		
6	Location of national parks / wildlife sanctuary / reserve forests within 10 km. radius should specifically be mentioned. A map showing landuse/landcover, reserved forests, wildlife sanctuaries, national parks, tiger reserve etc in 10 km of the project site.	The study area has 3 protected forests which are shown in Chapter-1 and mentioned in Chapter-2. Based on the different themes prepared using satellite data, toposheet and field check, an integrated land use map is prepared and given in Chapter-3	Figure-1.3 & Page-C1-8 Section-2.3 & Page-C2-1 Section-3.3.2 & Page-C3-22, Figure-3.3.6
7	A list of industries within 10 km radius of the plant area.	The list of the industries in 10 km radius of the plant area is given in Chapter-2	Section-2.3 & Page-C2-3 & Table-2.2
8	Details and classification of total land (identified and acquired) should be included.	The proposed project is planned within the premises of existing silver refinery plant site at SIDCUL, Pantnagar in an industrial plot owned by HZL admeasuring 10 ha and the land allotment letter is given as **Annexure-III**. There will be no additional land acquisition. The details of land are given in Chapter-2	Section-2.10.1 & Page-C2-20
9	Project site layout plan showing raw materials and other storage plans, bore well or water storage, aquifers (within 1 km.) dumping, waste disposal, green areas, water bodies, rivers/drainage passing through the project site should be included.	The plant layout with all the details are given in Chapter-2. No river/ water bodies are crossing the project site. The natural drainage of the project site will be maintained. The details are given in Chapter-2	Page-C2-7, Figure-2.1
10	List of raw material required and source along with mode of transportation should be included. All the trucks for raw material and finished product transportation must be Environmentally Compliant.	The details of raw material and source and mode of transportation are given in Chapter-2 and Chapter-4	Section-2.6.1 & Page-C2-9 Section-4.7.5 & Page-C4-23
11	Quantification & Characterization of solid /hazardous waste & its action plan for management should be included.	The details of solid/hazardous waste are given in Chapter-4	Section-4.9 & Page-C4-39
12	Mass balance for the raw material and products should be included.	The mass balance of raw material and products are given in Chapter-2	Section-2.9 & Page-C2-18
13	Energy balance data for all the components of plant should be incorporated.	The energy balance of raw material and products are given in Chapter-2	Section-2.9.7 & Page-C2-22
14	Design details of Plant and manufacturing process details should be included.	The technology, process and project description are given in Chapter-2	Section-2.6 & Section-2.7 & Page-C2-9
15	Site-specific micro-meteorological data using temperature, relative humidity, hourly wind speed and direction and rainfall is necessary.	Site-specific micro-meteorological data is given in Chapter-3	Section-3.5 Page-C3-31
16	Ambient air quality at 8 locations within	The details of AAQ monitoring	Section-3.6 Page-C3-

Sr. No	Comments	Report Reference	
		Chapter	Section & Page
	the study area of 10 km., aerial coverage from project site with one AAQMS in downwind direction should be carried out.	locations and results are given in Chapter-3	41
17	The suspended particulate matter present in the ambient air must be analyzed for the presence of poly-aromatic hydrocarbons (PAH), i.e. Benzene soluble fraction. Chemical characterization of RSPM and incorporating of RSPM data.	This EIA report contains the baseline data collected during Premonsoon season 2009 and post monsoon season 2010 and the details are given in Chapter-3	Section-3.6 Page-C3-41
18	Existing stack emission data.	The silver plant is under construction and will be commissioned by March 2011 hence there no running stacks in operation at present	-
19	Determination of atmospheric inversion level at the project site and assessment of ground level concentration of pollutants from the stack emission based on site-specific meteorological features.	The study has been conducted and the details are given in **Annexure-XI.** The air quality modeling details are given in Chapter-4	Section-4.7.3 Page-C4-11
20	Air quality modeling for plant for specific pollutants needs to be done. APCS for the control of emissions should also be included to control emissions within 50 mg/Nm^3.	The air quality modeling details are given in Chapter-4	Section-4.7.3 Page-C4-11
21	Ambient air quality as per National Ambient Air Quality Emission Standards issued by the Ministry vide G.S.R. No. 826(E) dated 16th November, 2009 should be included.	National Ambient Air Quality Emission Standards issued by the Ministry vide G.S.R. No. 826(E) dated 16th November, 2009 are given in **Annexure-VI**	-
22	Air Quality Impact Prediction Modelling based on ISCST-3 or the latest models.	Prediction of impacts on air environment has been carried out employing mathematical model based on Industrial Source Complex [ISC3] dispersion model and the details are given in **Chapter-4**	Section-4.7.3 Page-C4-11
23	Impact of the transport of the raw materials and end products on the surrounding environment should be assessed and provided.	Impact of off-site traffic on air quality is given in **Chapter-4**	Section-4.7.5 Page-C4-23
24	An action plan to control and monitor secondary fugitive emissions from all the sources as per the latest permissible limits issued by the Ministry vide G.S.R. 414(E) dated 30th May, 2008.	The details of secondary fugitive emissions are given in **Chapter-4**	Section-4.7.4 Page-C4-22
25	Presence of aquifer/aquifers within 1 km of the project boundaries and management plan for recharging the aquifer should be included.	The hydrogeological studies have been conducted and the details are given in Chapter-3.	Section-3.2 Page-C3-2
26	Source of surface/ground water level, site (GPS), cation, anion (Ion Chromatograph), metal trace element (as above) chemical analysis for water to be used. If surface water is used from river, rainfall, discharge rate, quantity, drainage and distance from project site should also be included.	Ground water is proposed to be utilized for the plant and the analysis has been given in Chapter-3	Section-3.7 Page-C3-50

Sr. No	Comments	Report Reference	
		Chapter	Section & Page
27	Ground water analysis with bore well data, litho-logs, drawdown and recovery tests to quantify the area and volume of aquifer and its management.	The hydrological and hydrogeological studies have been conducted in core zone (plant area) and buffer zone (10 km radius) and the details are given in Chapter-3	Section-3.2 Page-C3-2
28	Permission for the drawl of water should be obtained. Water balance data must be provided.	The Central Ground Water Authority has allocated 325 m3/day for the silver refinery plant and the letter is given as **Annexure-IV** and the application for additional water has been submitted on 25th November 2010	-
29	Action plan for rainwater harvesting measures.	The rainwater harvesting studies have been conducted for core zone (plant area) and buffer zone (10 km radius) and the details are given in **Chapter-4**.	Section-4.8.3 Page-C4-34
30	Surface water quality of nearby River (60 m upstream and downstream) and other surface drains at eight locations must be ascertained.	Ground water is proposed to be utilized for the plant and the surface water quality has been given in Chapter-3	Section-3.2 Page-C3-2
31	If the site is within 10 km radius of any major river, Flood Hazard Zonation Mapping is required at 1:5000 to 1;10,000 scale indicating the peak and lean river discharge as well as flood occurrence frequency.	Review of thematic layer of drainage of buffer zone shows that there is no major river flowing in 10 km radius. The plant area is not likely to be affected by any floods. SIDCUL also reported that this area does not fall within flood prone area	-
32	Pretreatment of raw water, treatment plant for waste water should be described in detail. Design specifications may be included.	The details of treatment are given in **Chapter-4**	Section-4.8.1 Page-C4-27
33	Ground water monitoring minimum at 8 locations and near solid waste dump zone, Geological features and Geo-hydrological status of the study area are essential as also. Ecological status (Terrestrial and Aquatic) is vital.	Ground water is proposed to be utilized for the plant and the water quality has been given in Chapter-3	Section-3.2 Page-C3-2
34	Action plan for solid/hazardous waste generation, storage, utilization and disposal particularly slag from all the sources should also be included.	The details of impact of solid waste are given in **Chapter-4**	Section-4.9 Page-C4-39
35	Identification and details of land to be used for all type of slag disposal in the secured land fill as per CPCB guidelines should be included.	There will be no onsite disposal of waste. ETP cake generated shall be disposed off in nearby TSDF. Used oil and waste shall be sold to registered recyclers. The oxidation slag generated from the silver plant is a by-product which shall be fed as raw material in the existing HZL smelters for metal recovery.	Section-4.9 Page-C4-38

Sr. No	Comments	Report Reference	
		Chapter	Section & Page
36	End use of solid waste and its composition should be covered. Toxic metal content in the waste material and its composition should also be incorporated particularly of slag.	The details of impact of solid waste are given in **Chapter-4** Oxidation slag is a by-product will be produced from silver plant which is under implementation. Oxidation slag shall be fed as raw material in the existing HZL smelters for metal recovery.	Section-4.9 Page-C4-38
37	Provision of Toxic Chemical Leachability Potential (TCLP) test for the slag and its end use should be included.	Oxidation slag is a by-product will be produced from silver plant which is under implementation. Oxidation slag shall be fed as raw material in the existing HZL smelters for metal recovery.	-
38	Acton plan for the green belt development plan in 33 % area should be included.	A green belt area of 3.5 ha has been marked for in the plant. The details of greenbelt development are given in **Chapter-4**	Section-4.13 Page-C4-47
39	Detailed description of the flora and fauna (terrestrial and aquatic) should be given with special reference to rare, endemic and endangered species.	The details of flora and fauna are given in **Chapter-3**	Section-3.9 Page-C3-65
40	Disaster Management Plan including risk assessment and damage control needs to be addressed and included.	The risk assessment and Disaster Management Plan are included in **Chapter-7**	Section-7.2 Page-C7-2
41	Occupational health: d) Details of existing Occupational & Safety Hazards. What are the exposure levels of above mentioned hazards and whether they are within Permissible Exposure level (PEL). If these are not within PEL, what measures the company has adopted to keep them within PEL so that health of the workers can be preserved, e) Details of exposure specific health status evaluation of worker. If the workers? health is being evaluated by pre designed format, chest x rays, Audiometry, Spirometry, Vision testing (Far & Near vision, colour vision and any other ocular defect) ECG, during pre placement and periodical examinations give the details of the same. Details regarding last month analyzed data of abovementioned parameters as per age, sex, duration of exposure and department wise. f) Annual report of heath status of workers with special reference to Occupational Health and Safety.	The silver plant is under construction and will be commissioned by March 2011 hence the occupational health study is yet to be conducted. The occupational health measures proposed are given in Chapter-4	Section-4.16 Page-C4-54
42	At least 5 % of the total cost of the project should be earmarked towards the corporate social responsibility and item-wise details alongwith time bound action	5 % of the total cost of the project shall be earmarked towards the corporate social responsibility activities.	Section-8.2.6 Page-C8-2

Sr. No	Comments	Report Reference	
		Chapter	Section & Page
	plan should be included. Socio-economic development activities need to be elaborated upon.	Detailed phase-wise time bound action plan is given in Chapter-8.	
43	Total capital cost and recurring cost/annum for environmental pollution control measures should also be included.	The details of cost provision for Environmental Measures are included in **Chapter-6**	Section-6.3, Page-C6-3
44	Public hearing issues raised and commitments made by the project proponent on the same should be included separately in EIA/EMP Report in the form of tabular chart with financial budget for complying with the commitments made.	The public hearing has been exempted as the unit is located in the Notified Industrial Area.	-
45	Any litigation pending against the project and / or any direction / order passed by any Court of Law against the project, if so, details thereof.	There are no litigations pending against the project and / or any direction / order passed by any Court of Law against the project	-

2.0 PROJECT DESCRIPTION

This chapter deals with the technical details of the silver plant (under implementation), proposed zinc and lead melting and casting plant, process and technology description and details of infrastructure.

2.1 Type of Project

The proposed project is located at Plot No-2, Sector-14, Integrated Industrial Estate (IIE) SIDCUL, Pantnagar, Uttarakhand where silver plant of 500 TPA capacity is under advanced stage of implementation. The proposed project is a secondary metallurgical processing industry coming under Schedule 3 (a) category of EIA notification 2006 and the amendments thereof.

2.2 Need for the Project

The project is proposed to reach the nearby market. Also the zinc and the lead requirement is growing year by year and the project is proposed to meet the requirement of customers and satisfy the growing demand of the zinc and lead in the country. Domestic demand for zinc & lead grew by 25% & 4% respectively in 2009-10 vis-à-vis 2008-09 and further growing in 2010-11 wrt 2009-10.

2.3 Location of the Project

The proposed project will be located within the premises of existing silver plant at State Industrial Development Corporation Limited (SIDCUL), Pantnagar village, Kichha tehsil, Udham Singh Nagar district, Uttarakhand. Techno-economic considerations taking into account factors like land availability, basic infrastructure cost, availability of utilities like water, power, the capital, operating and final cost have been evaluated and found qualified to set up the zinc and lead melting and casting plant at Pantnagar, Uttarakhand. The details of environmental setting are given in **Table-2.1**.

TABLE-2.1
ENVIRONMENTAL SETTING OF THE SITE

Sr. No.	Particulars	Details
1	Plant Location	State Industrial Development Corporation Limited (SIDCUL), Pantnagar village, Kichha tehsil, Udham Singh Nagar district, Uttarakhand state
2	Coordinates	Latitude : 29^0 02' 07'' N Longitude : 79^0 24' 01'' E
3	Plant site elevation above MSL	220 m above MSL
4	Geographical location in toposheet	53 O/8
5	Nearest representative IMD station	Bareilly (75 km)
6	Site Specific Meteorological Data	**Premonsoon Season (2009)** Predominant Wind Direction-East South East Predominant Wind Speed-1 to 5 kmph Maximum temperature-41.2°C Minimum Temperature-19.2°C Relative Humidity-35% to 61% **Postmonsoon & part of winter Season (2010)** Predominant Wind Direction-West

Sr. No.	Particulars	Details
		Predominant Wind Speed-1 to 5 kmph Maximum temperature-31.6°C Minimum Temperature-7.1°C Relative Humidity-25% to 87%
7	India Meteorological Deptt (IMD), Bareilly Meteorological Data	**IMD- Bareilly Data (Annual)** Predominant Wind Direction-West Predominant Wind Speed-1 to 11 kmph Maximum temperature-40.7°C Minimum Temperature-9.9°C Maximum Relative Humidity-86% Minimum Relative Humidity-22% Rainfall-1058 mm **IMD- Bareilly Data (Premonsoon Season)** Predominant Wind Direction-East, West Predominant Wind Speed-1 to 11 kmph Maximum temperature-40.7°C Minimum Temperature-18.3°C Maximum Relative Humidity-66% Minimum Relative Humidity-37% Rainfall-51.2 mm **IMD- Bareilly Data (Monsoon Season)** Predominant Wind Direction-East, West Predominant Wind Speed-1 to 11 kmph Maximum temperature-37.4°C Minimum Temperature-23.6°C Maximum Relative Humidity-81% Minimum Relative Humidity-54% Rainfall-866.8 mm **IMD- Bareilly Data (Postmonsoon Season)** Predominant Wind Direction-West Predominant Wind Speed-1 to 11 kmph Maximum temperature-32.4°C Minimum Temperature-16.5°C Maximum Relative Humidity-72% Minimum Relative Humidity-38% Rainfall-83.1 mm **IMD- Bareilly Data (Winter Season)** Predominant Wind Direction-West Predominant Wind Speed-1 to 11 kmph Maximum temperature-28.7°C Minimum Temperature-9.9°C Maximum Relative Humidity-86% Minimum Relative Humidity-22% Rainfall-57 mm
8	Plant site topography	Plain with gradual slopes
9	Present land use at the site	Industrial
10	Nearest highway	NH-87 (0.8 km, S)
11	Nearest railway line	Adjacent to plant (0.1 km, S)
12	Nearest railway station	Rudrapur City (8 km, S)
13	Nearest airport	Pantnagar airport (6.1 km, E); not operational
14	Nearest rivers	Dhimri Nadi (2 km, W) Baigul Nadi (2 km, E)
15	Nearest lake/ponds	None in 15 km radius
16	Nearest port	None in 15 km radius
17	Nearest town	Rudrapur City (8 km, S)
18	Nearest city	Rudrapur City (8 km, S)
19	Nearest major city with 2,00,000	Moradabad (70.0 km, W)

Sr. No.	Particulars	Details
	population	
20	Nearest village	Pattharchatta (0.8 km, SE)
21	Villages within 1 km radius	Pattharchatta (0.8 km, SE)
22	Distance from the sea coast	Approx 1100 km
23	Hills/valleys	None in 15 km radius
24	Nearest tourist place	Nainital (60 km, N)
25	Archaeologically important places	None in 15 km radius
26	Protected areas as per Wildlife Protection Act,1972 (Tiger reserve, Elephant reserve, Biospheres, National parks, Wildlife sanctuaries, community reserves and conservation reserves)	None in 15 km radius
27	Reserved / Protected Forests	Dhimri P.F. (2.2 km, NNE) Gangapur Patiya P.F. (2.7 km, NE) Tanda P.F. (9.8 km, NE)
28	Seismicity	Seismic Zone-IV as per IS 1893 (Part I): 2002
29	Defence Installations	None in 15 km radius area
30	List of Industries	SIDCUL industrial area
31	Soil type	Sandy clay
32	Depth of water table	3.5 – 6 m
33	Major crops	Paddy, wheat and sugar cane
34	Socio-economic factors	Project is located in notified industrial area of SIDCUL, Uttarakhand hence no Rehabilitation & Resettlement is involved

- ***List of Industries in the 10 km Study Area***

The list of the industries in the 10 km radius around the project site are as given in **Table-2.2**.

TABLE-2.2
LIST OF INDUSTRIES IN 10 KM RADIUS

Sr. No.	Particulars	Details
1	Dabur India Limited	Health Care, Personal care, Ayurvedic Cosmetics & Intermediate
2	Ashok Leyland Limited	Commercial Vehicle
3	Bhaskar Energy Pvt. Ltd.	Generating Sets, Metal Forming Structures and Acessories in Electricals/sheet Metals
4	Parle Biscuits Pvt. Ltd.	Biscuits and Confectionary
5	Britannia Industries Ltd.	Biscuits and Other Food Products
6	Interarch Building Products (P) Ltd.	Pre Engineered Industrial & Commercial Building
7	Ganesh Polytex Ltd.	Polyster Stapee Fibre
8	Pearl Polymers Ltd.	Pet & PP Bottles, Jars & Containers
9	G. S. Pharmbutor Pvt. Ltd.	Mfg and Trading of all types of Pharmaceuticals. Chemical Prep. & Ancillary products
10	Henkel cac ltd	Talcum powder (face powder)
11	Savira industries	General Engineering Products
12	Pioneer polyleathers Pvt. Ltd.	Coated/laminated fabric with plastic, impregneted or non impregneted non wooven, flexible films/fold of plastic, foot wear and components
13	Pioneer Polyleather Pvt. Ltd.	Footwear & omponents, Coated/laminated fabric
14	TATA motors	Vehicles
15	Huhtamaki PPL	Plastic drums
16	Emami ltd	Hair oils etc,,
17	Bajaj Auto Ltd.	Automobile - 2Wheelers, 3 Wheelers, 4 Wheelers & Parts

Sr. No.	Particulars	Details
		Thereof
18	Delta Power Solutions (India) Pvt. Ltd.	IT, Telecom and Networking Products
19	The Bombay Burmah Trading Corporation Ltd.	Decorative, Industrial& other laminates, Automotive Springs, Dental, opthalmic & orthopedic products, Electronic weighing scales and other electronic components, Textile machineries accessories component and spares
20	VHB Mediscіences Inc.	Formulations of Pharmaceuticals
21	Teracom Private Limited	High voltage power cable
22	HCL Infosystems Limited	Computer & Computer Based Systems
23	Nestle India Ltd.	Culinary Products and processed foods
24	Hewlett-Packard India Sales Pvt. Ltd.	Personal Computers, Laptops & Servers
25	Escorts Limited (Railway Equipment Division)	Non Asbestos composition, Brake Blocks, Shock Absorbers
26	Voltas Limited	Commercial refrigeration, Commercial conditioners & Domestic Airconditioners
27	ASIS	Ply wood
28	Greenply Industries Ltd.	Plywood & Block Board, Particle board, medium density, fibre board
29	Archeed	Ply wood
30	Haldirams	Food products
31	Bal Pharma Limited	Pharmaceuticals Formulations
32	U. S. Foods Pvt. Ltd.	Biscuits, Confectionary items and Laminated Films
33	Rama Ply & Laminates	Plywood, Block Board, Flush Door, Particle Baoard & Furniture
34	Boltmaster India Pvt. Ltd.	Automobile Components, All Type of Fasteners, Fabrication
35	Lancer Food Products	Biscuits Cookies and Confectionary
36	Shanti Coils & Refregeration Equipment Pvt. Ltd.	Plasti Components, Airconditioner, water cooler & Refregeration Parts
37	ACME Tele Power Ltd.,	Green shelters, PCM, AC

2.3.1 Layout of the Proposed Project

The map of SIDCUL, Pantnagar and the general layout plan of the zinc and lead melting and casting plant are shown in **Figure-2.1** & **Figure-2.2**.

- **Site Selection for Proposed Project**

The site selection for proposed expansion project of Zinc and Lead Melting & Casting at existing silver plant of Hindustan Zinc Limited, Pantnagar Uttarakhand involved the following criteria for evaluation:-

- Availability of land within existing plant premises
- Infrastructure available due to notified industrial area
- Water availability; and
- Power availability.

The proposed project site is a part of the State Industrial Development Corporation Uttarakhand Limited (SIDCUL) Pantnagar, Uttarakhand where HZL is setting up a Silver Refinery. Techno-economic considerations taking into account, factors like land availability, basic infrastructure, availability of utilities like water, power, the capital & operating cost have been evaluated and found qualified to set up the Zinc Melting and Casting, Lead Melting and Casting, at Pantnagar, Uttarakhand.

2.4 Magnitude of Operation

The proposed zinc and lead melting and casting plant at Pantnagar will have a capacity of Zinc 465,000 TPA and Lead 150,000 TPA melting and casting. The salient features of the proposed Zinc and Lead Melting and Casting plant are presented in **Table-2.3**. No chemical process is involved, only melting & casting to convert pre-finished Zinc & Lead sheet to finished Zinc & Lead ingot. There will be no process waste generation. Zero discharge will be maintained.

TABLE-2.3
DETAILS OF THE PROPOSED PROJECT

Sr. No.	Parameter	Description
1	Land	Open land available within the silver plant of Hindustan Zinc Limited, Pantnagar Uttarakhand will be utilized. No additional land will be acquired for the purpose.
2	Landuse	Industrial area – SIDCUL Pantnagar, Uttarakhand
3	Water Requirement	Existing- 325 m^3/day Additional- 500 m^3/day Total- 825 m^3/day
4	Source of Water	Ground water will be utilized from within the industry premises. NOC from CGWA will be taken. Application filed vide letter dated 25th November 2010
5	Power Requirement	Present- 2.2 MW Additional- 15 MW Total: 17.2 MW
6	Source of Power	State Grid/ Captive DG Set. Captive DG sets of 17 MW are proposed for the project for emergency.
7	Raw Material	Zinc Cathode: 4,85,000 TPA Lead Cathode: 1,60,000 TPA Aluminium: 160 TPA
8	Source	Smelters of HZL in Rajasthan, Aluminium from market
9	Employment	Silver plant-150 Proposed Melting & Casting Facility-250 employees including contract labour
10	Project Cost	Rs 250 Crore (Rs 150 Crore in Phase-I and Rs 100 Crore in Phase-II)
11	Pollution Control Equipment	Capital cost- Rs 12 Crore Recurring cost- Rs 0.75 Crore/Annum
12	Corporate Social Responsibility	Rs 7.5 Crore in Phase-I and Rs 5 Crore in Phase-II

2.4.1 Utilities

The auxiliary services being set up for silver plant will be utilized for the proposed project with proper augmentation, which are:

- Water receipt treatment and distribution;
- Laboratory;
- Stores;
- LDO, HSD Storage;
- Heavy Fuel Storage; and
- Compressors.

Some other infrastructure will be set up for the proposed project, which include

- Cathode storage yard :- This will be covered shed to avoid any rain water on the sheets.
- Finished Goods Godown:- similar to the cathode storage yard the finished godowns also will be covered shed.
- LPG, LSHS/ HFO and HSD storage

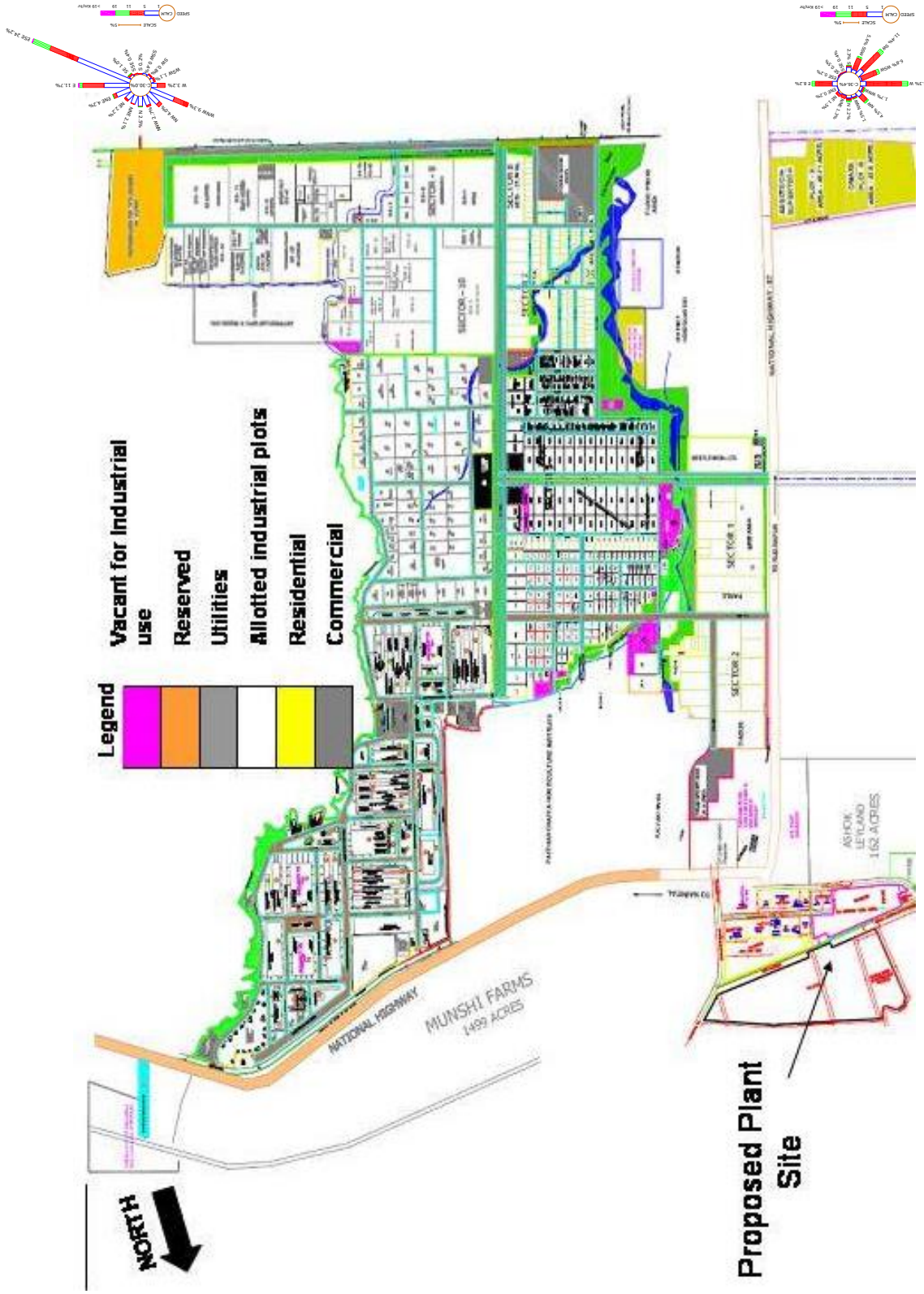


FIGURE-2.1
MAP OF SIDCUL, PANTNAGAR

FIGURE-2.2
LAYOUT PLAN OF THE ZINC AND LEAD MELTING AND CASTING PLANT

2.5 Proposed Schedule and Approval for Implementation

2.5.1 Proposed Schedule for Implementation

The implementation schedule for the proposed project is twelve months from the grant of Consent for Establishment (CFE). This includes 2 months for the preparation of basic / detailed engineering, 9 months construction period and 1 month for commissioning.

2.5.2 Approval for Implementation

The establishment of proposed zinc and lead melting and casting plant activities will be commenced after getting Consent for Establishment (CFE) from Uttarakhand Environment Protection and Pollution Control Board.

2.6 Project Details of Existing Silver Plant (Under Implementation)

2.6.1 Raw Material Requirement

The raw material of silver plant is Anode slime/Dore silver. The total raw material requirement for the silver is 2900 TPA and will be sourced from HZL smelter or bought from the other sources.

The raw material requirement along with product and by product details of silver plant is as given in **Table-2.4**.

TABLE-2.4
RAW MATERIAL AND PRODUCT OF SILVER PLANT

Particulars	Requirement (TPA)
Raw Material	
Anode slime	2900
Products	
Silver	500
By products	
Antimony concentrate	1400
Bismuth concentrate	140
Copper matte	140
Oxidation slag	840

2.6.2 Project Description

The silver refining is carried out in two routes:

1. Pyro-metallurgical refining of anode slime in furnaces; and
2. Hydrometallurgical refining in electrolysis section.

The major design facilities are as given in **Table-2.5**.

TABLE-2.5
MAJOR DESIGN FACILITIES OF THE SILVER PLANT

Sr. No.	Description	Quantity	Capacity (MT/day)
1	Noble Furnace	1	14
2	Cupel Furnace	2	2.5
3	Induction Furnace	3	0.6

The process flow diagram is shown in **Figure-2.3**.

2.6.2.1 Noble Furnace – 1st Stage of Pyro Refining

The steps followed in the Noble Furnace smelting include:

- Charging;
- Melting;
- Oxidizing by air blast and slag formation;
- Precipitation; and
- Tapping and noble lead discharge.

The proportioned charges will be fed in batches of regular interval. The melting stage will last for 12 hours. Compressed air is blown into the molten mass through iron pipes to stir the bath and promote the oxidization and slag formation. At this time the slag is divided into two layers. The upper layer is composed of metal silicates and antimonite which are of high fluidity. The lower layer contains silver with low fluidity and therefore it is called sticky slag.

After the sticky slag is removed, the noble lead is blown with air to volatize the impurities such as copper, bismuth, arsenic and antimony. After this oxidation of impurities and its removal, the noble lead is tapped from the furnace.

Highly fluid lead slag, it shall be returned to the blast furnace and fuming furnace system to recover lead. And since the silver content in sticky slag and oxidizing slag is high, they are recycled in the noble lead furnace. The volatized impurities from the noble furnace contains high antimony, the collected "antimony concentrate" is sold to antimony producers and allied industries.

Light diesel oil is used as the fuel for noble lead furnace to maintain the temperature. The compressed air for smelting is supplied by a high temperature centrifugal fan.

2.6.2.2 *Cupel Furnace*

The noble lead produced from the noble furnace is sent for further treatment to cupel furnace. Two cupel furnaces will be installed to match the production of Noble furnace.

The niter and silver anode slime will be measured and charged into the cupel furnace.

The process in the cupel furnace includes:

- Charging;
- Melting;
- Blowing;
- Oxidizing and slag formation;
- Copper removal; and
- Silver alloy discharge.

Charge fed into the furnace is melted and air is blown through the pipes and the charge is oxidized. During this stage sequentially Lead is oxidized, Antimony concentrate, Bismuth Concentrate is produced. Then the flux material niter is added to generate molecular oxygen, which is used to produce "copper matte" by oxidizing copper. After removal of antimony, bismuth and copper the 97% pure silver alloy is produced.
Primary oxidizing slag which contains lead is recycled in the noble lead furnace to recover lead. The bismuth concentrate, copper matte, antimony concentrate will be sold to allied industries which use these materials.

The silver alloy is cast into silver alloy anode plate in the anode plate casting machine and then sent to the silver electro refining section. The fuel of cupel furnace is Light diesel oil. The compressed air used in the smelting is supplied from the high pressure centrifugal fan.

Direct current is connected to the silver electrolyzing cell. The product is pure silver of 99.95% grade or above. If there is precious metal in the silver alloy, it will concentrate in the silver anode slime.

2.6.3 Silver Electrorefining – Hydrometallurgy Section

The silver refining includes:

- Electrolyte generation
- Silver electro refining
- Treatment of the silver anode slime
- Spent solution treatment
- Melting & casting etc.

The main raw material of silver electro refining is the silver alloy plate from the pyro-metallurgical refining and auxiliary material includes: nitric acid, ethyne, sodium carbonate, niter, sodium borate, charcoal, sodium chloride etc.

In the electro-refining process the anode is the impure silver alloy plate.. The cathode is made of stainless steel plate. The aqueous solution of nitric acid and silver nitrate is used as electrolyte.

Ethyne is used to coat the mould surface and form a layer before the silver casting, which is favorable to the mould release. Charcoal lump, sodium carbonate, niter and borax are also added to purifying the electrolyte. Sodium chloride is used to treat the waste solution of the silver electro refining to recover the silver.

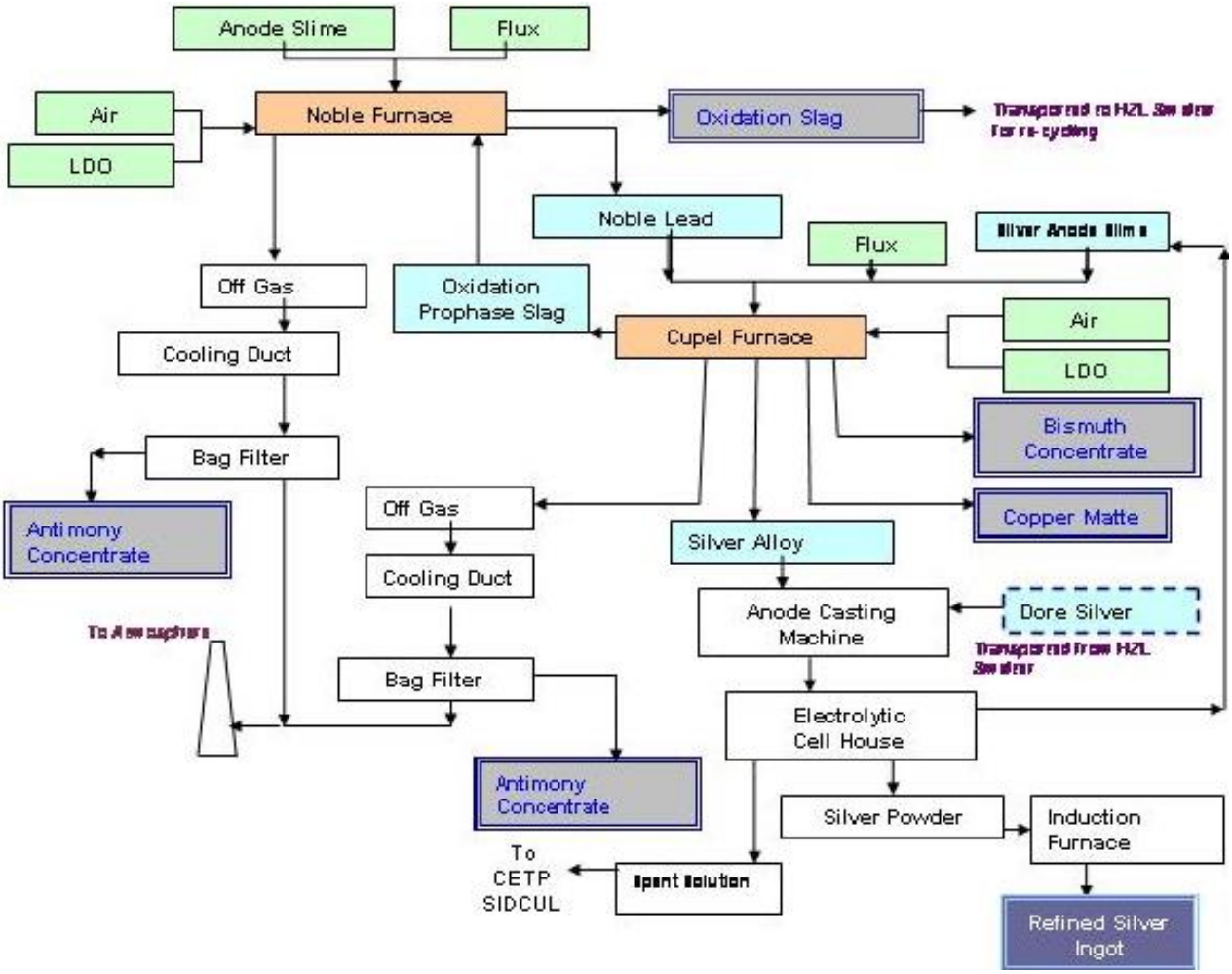


FIGURE-2.3
SILVER-PROCESS FLOW SHEET

During the electrolysis Silver powder is obtained which is washed and dried and further treated in the Medium frequency furnace.

Medium frequency induction furnace is used to melt the silver powder up to 1150 ^{o}C ~1250 ^{o}C and cast into silver ingots of 31 kg each. When casting the silver bullion, proper amount of niter, sodium carbonate ($NaCO_3$), borax and charcoal are added. Finally the ingots will be weighed with electric balance and sent to the safe storage.

2.7 Technology and Process Description-Melting & Casting Facilities

The plant will not have any smelting, processing and refining. Proven and established technologies, induction melting furnaces for zinc and oil fired melting pots for lead shall be used. Efficient ventilation system with bag filters will be utilized to achieve good work zone atmosphere and low stack emissions for particulate matter.

- **Zinc**

Melting of zinc cathodes through state of the art induction furnaces and casting of zinc ingots through an automatic zinc ingot casting machines. Zinc dross (process intermediate) produced in the process will be regularly skimmed out and will be fed as raw material at HZL smelters at other locations.

- **Lead**

Melting lead cathodes in melting pots. Melting pots will be heated by heavy oil burners and lead is melted by indirect heating. The molten metal is then cast into Lead Ingots in casting machines. Lead dross (process intermediate) produced in the process is regularly skimmed out and will be fed as raw material at HZL smelters at other locations.

The major design details of the melting and casting facilities are as given in **Table-2.6**.

TABLE-2.6
MAJOR DESIGN FACILITIES OF THE PROPOSED PROJECT

Sr. No.	Metal	Configuration	Working days	Annual Capacity
	Zinc			
1	Induction Furnaces for cathode melting	2 (Melting) of 30 TPH	360	4,65,000 TPA
2	Induction Furnace for CGG	1 (Alloying) & 1 (Holding) each of 20 TPH	Intermittent	
3	Ingot Casting Plant	2 (slab casting) + 1 (Jumbo casting) each of 30 TPH	360	4,65,000 TPA
	Lead			
4	Melting Pots	5 nos of 180 MT batch capacity each	360	1,50,000 TPA
5	Ingot Casting Machine	2 nos of 13 TPH capacity each	360	1,50,000 TPA

2.8 Project Description-Proposed Zinc & Lead Melting and Casting Plant

2.8.1 Zinc Melting & Casting

The zinc cathodes, received through trucks, will be unloaded at cathode stockyard. From the stockyard, a fork lifter will transfer and place the cathodes on automatic furnace feeding system.
The Automatic Furnace Feeding System receives individual cathode bundles in a horizontal orientation. The bundles are conveyed to the furnace feed chutes, rotated 90° to a vertical orientation and lowered into the melting furnace bath in a gentle and controlled fashion.

The automatic furnace feeding system feeds bundles of cathodes to electric induction melting furnaces. The furnaces will have an average melting rate of 30 tones per hour of zinc cathodes. The melting rate is controlled by the automatic control system to match the rate that molten metal is removed (pumped) from the furnace.

Each furnace is equipped with one or more molten metal pumps. The pump delivers molten zinc to a launder system feeding the casting machines.

In addition to cathode bundles, the furnace chutes are designed to receive metallic zinc "skims" from the casting machines. This material is fed to a chute (normally one dedicated chute) from forklift transported to hoppers that have been raised to the charging floor. The required amount of NH_4Cl to enhance the melting of this material is manually added to each hopper prior to dumping in the charge chute.

The ventilation system is especially designed to maintain the hygienic environment in the work zone. The hoods will be located on the drossing doors of furnace, cathode charging and dross cooling areas. The hoods located near the furnace and dross cooling area will always be under suction to maintain the hygienic environment.

When cathode zinc is melted, a layer of dross comprised mainly of zinc oxide entrained molten zinc droplets is produced. This dross must be removed from the furnace once or twice per shift by manually skimming the dross from the surface of the bath in a process called drossing. This process consists of opening one of the doors on the side of the furnace, manually spreading a few kg of NH_4Cl onto the dross layer, manually agitating the dross layer with steel "rake" and finally using the "rake" to drag the dross through the open door of the furnace into a bin. During the drossing process, the furnace is operated under conditions of increased ventilation to contain the fumes and dust that are generated by the agitation and dross removal processes. The furnace dross is transported by fork lift to the dross cooling area which shall have ventilation hood, from where it will be securely packed & transported. There will also be a provision to treat dross in dross treatment plant, where the fines and metallics will be separated, which will be recharged back in furnace or sent to HZL smelters at other locations for zinc metal recovery by ensuring secure packing and transportation.

Melting furnaces will feed molten zinc to automatic slab casting system. The casting system utilizes the latest technology to automatically pour molten zinc into moulds, solidify the molten zinc, remove the ingots from the moulds, stack the ingots into 1000 kg bundles, strap the bundles, then weigh and mark each bundle and report the product data to the customer's PLC. The system produces "ready for shipment" bundles of ingots.

Bundles are removed from the slab casting system accumulation conveyor by the lift truck and placed in the product storage/shipping area.

- **Continuous Galvanizing Grade (CGG) Zinc**

Production of CGG alloy is designed to produce continuous Ingots by simultaneous working of two furnaces: One batch type Coreless Furnace for making alloy and One continuous type sandwich Channel type Induction Furnace for holding and continuous casting of molten alloy metal.

The system is designed to produce 20 TPH Alloy Ingots containing aluminium 0.5% and Zinc 99.5%. There is a flexibility provided to adjust the Aluminium composition incase if we desire to produce any range between 0.2 – 4.5% aluminium. In order to make homogeneous alloy mixture the coreless furnace with higher frequency in current is opted which can provide better mixing of zinc and aluminium and the alloy formation.

Molten Zinc @ 490 - 520ºC from already existing melting furnace will be pumped to the coreless furnace through a metal launder. The coreless furnace is a tilting type water cooled inductor furnace with a load cell provided to it. Hence the quantity of molten zinc present in the furnace can be known and the required amount of aluminium can be added to maintain the composition. A charging system with weighing facility is provided to add known amounts of Aluminium Pellets or Ingots into the Furnace. The temperature is maintained up to 660ºC to have better melting and mixing of Aluminium with Zinc. The alloying and composition correction takes approximately 0.75 Hours. Once the molten alloy is ready, it will be transferred by the lip pour hydraulic tilting system to the Holding Furnace. The water cooling system for the coreless furnace will be installed.

The Holding furnace consists of two chambers, i.e metal receiving chamber and holding chamber/ pump well. The inductor is placed (Sandwiched) in between both the chambers. The furnace is operated continuously by means of feeding molten metal in receiving chamber at a rate equal to casting rate or pumping rate of metal drawn for casting/pump well chamber. A minimum temperature of 550ºC is maintained for 0.5% Aluminium Grade. The furnace has to be kept on holding power at minimum metal level unlike in the Coreless Furnace. Hence, it needs emergency DG Power in case of power failure. A molten metal pump will be provided at the discharge end of the Holding Furnace to feed to the casting system for production of ingots. The process flow diagrams of the proposed plant is shown in **Figure-2.4**.

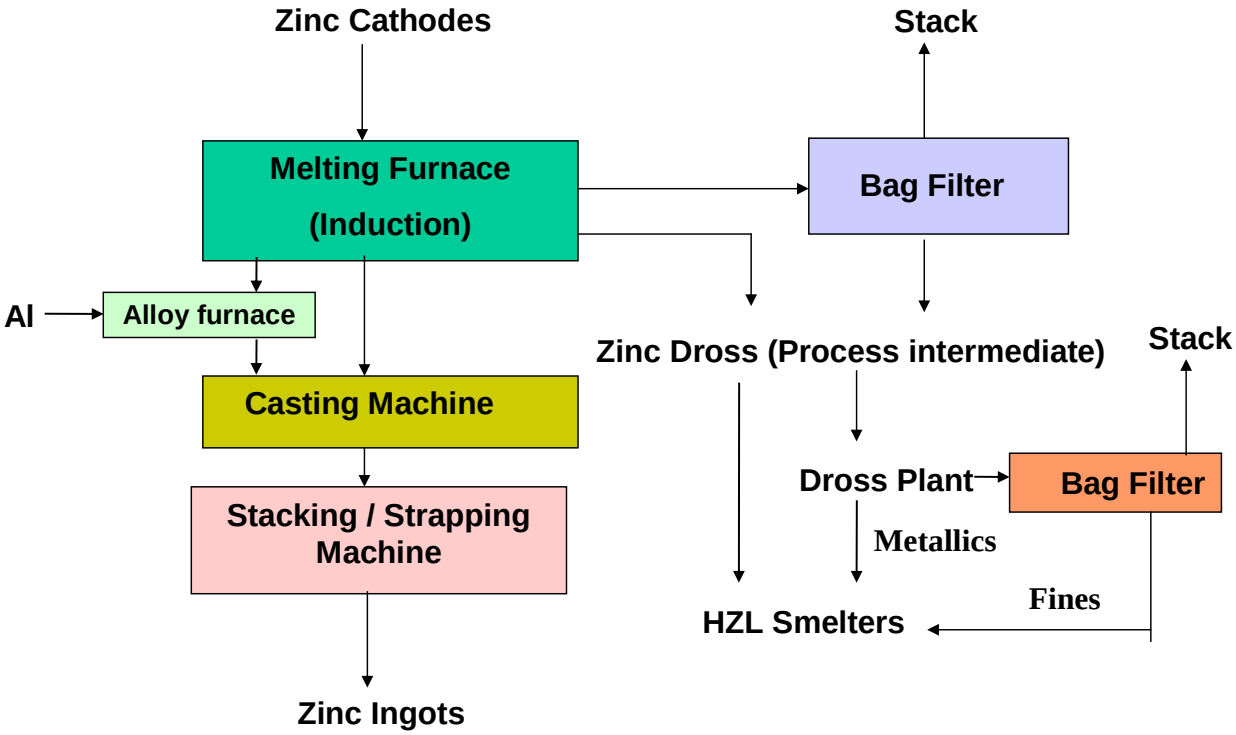


FIGURE-2.4
PROCESS FLOW SHEET OF ZINC MELTING AND CASTING

- **Cooling Water System**

The casting plant requires absorbing the heat energy from the ingots as they solidify and cool. This cooling water is supplied to the equipment at 32°C and exits at 40°C. The cooling water discharge from equipments is collected in a sump and returned by pump to the cooling system. Two pumps of suitable capacity, one operating and one standby, will be installed to handle the volume of cooling water required while the casting machines are operated. The water requirement is only for make up loss for the cooling water system. Apart from this, cooling water is also required for indirect cooling of DM water (Close) circuit used for furnace inductor cooling.

The cooling water circuit would also be so well designed as to operate at optimum cycles of concentration, with minimum blow down and minimum fresh water make up. Necessary chemical dosing systems with anti-scalant / dispersant / corrosion inhibitor chemicals to prevent scale formation / fouling / corrosion, acid dosing system shall also be provided as a part of Cooling Water (CW) treatment system.

2.8.2 Lead Melting and Casting

Raw material for the Lead Melting and Casting is Lead Cathodes which will be sourced mainly from the smelters of HZL in Rajasthan. Cathodes are handled by EOT crane in the plant.

Cathodes are melted in three 180 MT capacity melting pots and treated by adding sodium nitrate and caustic soda. The molten bath is agitated to form dross. After de-drossing metal is pumped to casting pot and casted into ingots for sale.

The cathode lead from the electro refining section of lead electro refinery still contains micro-scale impurities so it needs further treatment. The cathode lead will be treated in 180 MT lead pot by use of EOT cranes. The temperature of molten lead will be raised to 500 ºC - 520 ºC by using heavy oil burners. Fuel requirement for each melting pot is 150 kg per hour. A high pressure centrifugal fan is used to blow air into the burner for combustion of fuel. Each melting pot is equipped with an agitator and lead pump. The agitator is used to agitate the molten lead.

Caustic soda 0.25 kg per ton of cathode lead and sodium nitrate 0.1 kg per ton of cathode lead are added to the molten bath before agitation. After one to two hours, metal impurities and a small quantity of lead will be oxidized by atmospheric oxygen during agitation. The dross thus formed floats on the molten lead, forming lead oxidation slag. The dross is then removed by dragging machine. This dross is process intermediate, which will be used as feed as raw material to HZL smelters at other locations for metal recovery.

After de-drossing the pure molten lead will be pumped to the casting pot from where the pure molten lead is casted into ingots by lead casting machine. A thin layer of lead oxide forms on the surface of the molten metal which is removed manually. For effective ingot solidification the casting machine is water cooled and water circulation rate is 50 m^3/hr. Hot water from the ingot casting machine

is sent to cooling tower and circulated back. Ingots are spray cooled. The ingots are packed by ingot packing machine. Packed lot is lifted from the casting machine platform by EOT crane and transferred to store yard.

Heavy oil is used for combustion to raise the temperature of the melting pots. The off gases from the combustion chamber are emitted to the atmosphere through a stack height of 40 m. The off- gases from the furnaces are passed through the bag filter before emitting to atmosphere through the same stack of 40 m height. Particulate matter emissions from the stack will be less than 50 mg/NM^3. Lead particulate matter emissions from the stack will be less than 10 mg/NM^3. Process flow sheet of lead melting and casting is given in **Figure-2.5**.

2.9 Raw Material Requirement

The raw material requirement for zinc and lead melting and casting plant is as given in **Table-2.7**.

2.9.1 Source

Zinc and Lead cathode will be sourced from HZL smelters via trucks/containers, and aluminum from market. Possibility of the transportation of raw material via rail from the premises of existing smelters to nearest railway station shall also be explored. In this case, the raw material shall be transported from Pantnagar railway station to site by trucks. Zinc balance for the proposed zinc plant is given in **Table-2.8**. Lead balance for the proposed lead plant is given in **Table-2.9**. The characteristics of the dross, the intermediate, are given in **Table-2.10**.

TABLE-2.7
RAW MATERIAL REQUIREMENT FOR ZINC AND LEAD MELTING AND CASTING PLANT

Particulars	Requirement (TPA)
Zinc cathode	485,000
Lead cathode	160,000
Aluminum Metal (Optional)	160

TABLE-2.8
ZINC BALANCE

Material	Percentage	TPA	Remarks
Input			
Cathode	100	485000	From HZL smelters
Output			
Ingot	95.88	465,000	Saleable ingots
Dross	4.12	20,000	HZL smelters

TABLE-2.9
LEAD BALANCE

Material	Percentage	TPA	Remarks
Input			
Cathode	100	160,000	From HZL smelters
Output			
Ingot	93.75	150,000	Saleable ingots
Dross	6.25	10,000	HZL smelters

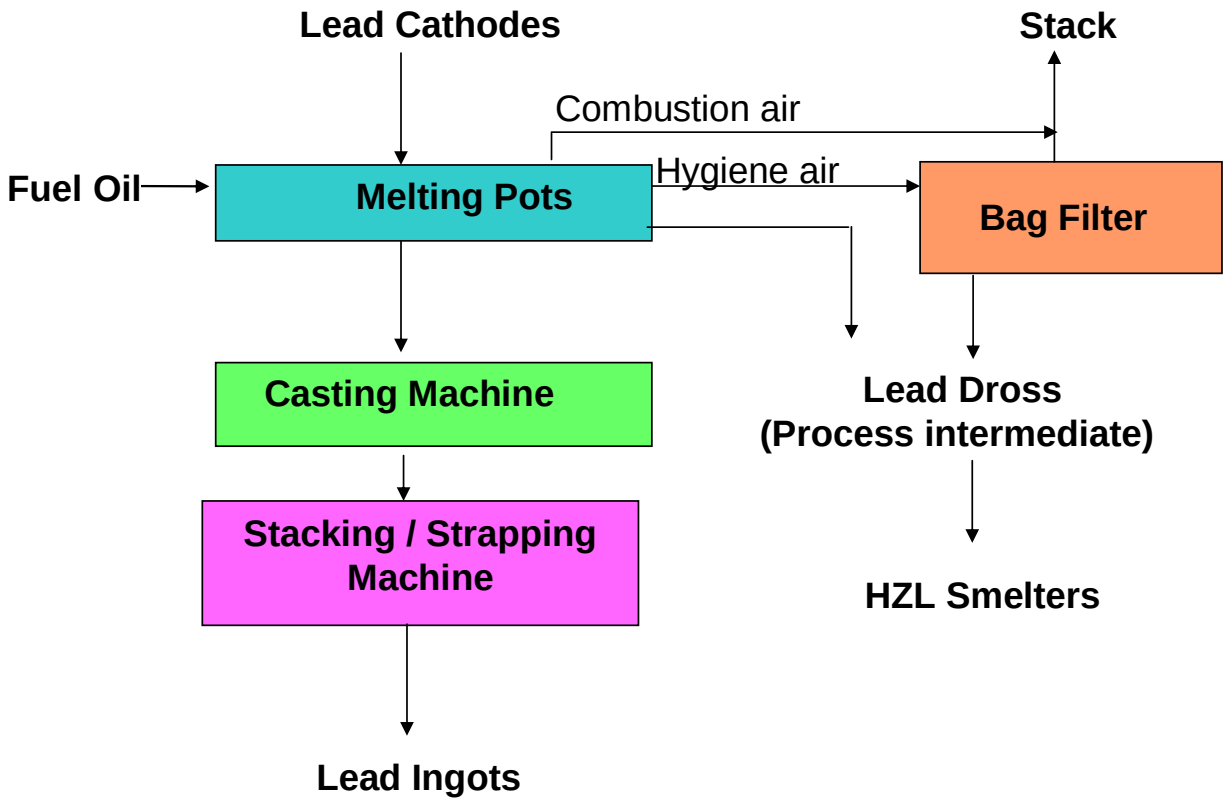


FIGURE-2.5
PROCESS FLOW SHEET OF LEAD MELTING AND CASTING

TABLE-2.10
CHARACTERISTICS OF THE DROSS

Sr. No.	Particulars	Details		
		Zn (%)	Pb (%)	Sb (%)
1	Zinc dross	80-85	0.1-0.2	-
2	Lead dross	-	60-65%	18

2.9.2 Consumables

The requirement of other consumables (fuels & process chemicals) required in the plant has been estimated and furnished in **Table-2.11.**

TABLE- 2.11
CONSUMABLES PER ANNUM

Particulars	Requirement
Zinc melting and casting	
Ammonium Chloride	465 (Tons)
LPG/ Propane	500 (KL)
Lead melting and casting	
Heavy Fuel/LSHS	10000 (KL)
Caustic Soda	60 (Tons)
Sodium Nitrate	15 (Tons)

2.10 Infrastructure

2.10.1 Land Requirement

The total land requirement for both the phases of the zinc and lead melting and casting plant will be 3.5 ha. The landuse of zinc and lead melting and casting plant is broadly classified as given in **Table-2.12**. The proposed project is planned within the premises of existing silver refinery plant site at SIDCUL, Pantnagar in an industrial plot owned by HZL admeasuring 10 ha and the land allotment letter is enclosed as **Annexure-III**. There will be no additional land acquisition.

TABLE-2.12
LANDUSE PROPOSED FOR THE PLANT

Sr. No.	Facilities	Present (under implementation) (ha)	Proposed (ha)	Area (ha)
1	Silver refinery section	1.5	-	1.5
2	Zinc Melting & Casting section	-	2.0	2.0
3	Lead Melting & Casting section	-	1.0	1.0
4	Utilities	0.5	0.5	1.0
5	Administration Block	0.3	-	0.3
6	Roads and Drains	0.2	0.3	0.5
7	Greenbelt	0.75	2.75	3.5
8	Open space	6.75	-	0.2
	TOTAL	**10.0**	**-**	**10.0**

2.10.2 Water Requirement

The fresh water requirement for total capacity of zinc and lead melting and casting plant is 500 m^3/day. The source of water is ground water. The Central Ground Water Authority has allocated 325 m^3/day for the silver refinery plant and the letter is enclosed as **Annexure-IV** and the application for additional water has been applied to CGWA vide letter dated 25th November 2010. Recently, Central Ground Water Authority has issued guidelines for evaluation of proposals for ground water abstraction for industrial purposes which states that "Industries located in Safe category areas, are required to obtain NOC from CGWA if ground water abstraction by the industry exceeds 1000 m^3/day for hard rock areas and 2000 m^3/day for alluvial areas". As our proposed project is located in safe category areas and total water requirement is 825 m^3/ day, hence NOC is not required from CGWA for abstracting water from groundwater. However, we have applied for CGWA approval.

2.10.3 Power Requirement

The power requirement for proposed project is 15 MW. This power will be sourced from Uttarakhand State Power Corporation Limited (UPCL)/captive DG sets.

- Diesel Generator Sets

It is proposed to install DG Sets of 17 MW capacities. The emergency DG sets is designed for utilizing LSHS/ HFO / HSD as the fuel. Hindustan Zinc Limited (HZL) proposes to install four number of DG sets (one – 500 KVA for silver plant and three 5.5 MW for the zinc and lead melting and casting plant) of total capacity 17 MW to cater to the needs of shortage of power during initial period and will be used as standby/backup power during the uninterrupted supply from the state grid. In the DG sets HSD will be used as startup fuel and LSHS/ HFO/HSD for running. In case of unavailability of LSHS, Heavy duty Furnace oil shall be used. In case of HFO, Fuel Gas Desulphurisation (FGD) system shall be used to reduce sulphur dioxide emissions from exit gases. The efficiency of reduction in FGD's considered as 75%.

2.10.4 Fuel Requirement

The fuel requirement for the proposed plant is given in **Table-2.13.** The fuel will be sourced from nearby depots. In case of unavailability of LSHS, Heavy duty Furnace oil shall be used. In case of HFO, Fuel Gas Desulphurisation (FGD) system shall be used to reduce sulphur dioxide emissions from exit gases. The efficiency of reduction in FGD's considered as 75%.

TABLE-2.13
FUEL REQUIREMENT

Sr. No.	Unit	Fuel Used	Quantity/year (worst case requirement)
1	LPG	Used in burners (for melting and casting plant)	500 KL
2	LSHS/ HFO	Used in burners (for Lead melting and casting plant)	10000 KL

Sr. No.	Unit	Fuel Used	Quantity/year (worst case requirement)
3	LSHS/ HFO/ HSD*	DG set (for melting and casting plant)	14000 KL
4	LDO/ HFO/ HSD	Silver plant furnace	4333 KL
5	LDO/ HFO/ HSD	DG set (silver plant)	440 KL

* Assuming DG set will be run for 10 hours per day throughout the year

2.10.5 Manpower

The proposed zinc and lead melting and casting plant will require skilled and semi-skilled personal during construction and operational phase. Many of the people from neighbouring villages may, if found suitable will get the opportunity for employment during construction and operational phase. The total manpower requirement during operation phase will be around 250 nos.

2.10.6 Project Cost

Total cost of the proposed project is estimated to be Rs. 250 Crores and the details are given in **Table-2.14.**

TABLE-2.14
DETAILS OF PLANT INVESTMENT

Sr. No.	Particulars	Phase-1	Phase-2	Total
1	Zinc melting & casting stream	35	-	35
2	Zinc melting & casting stream-2	35	-	35
3	CGG and Jumbo Casting	-	10	10
4	Lead melting & casting stream	-	40	40
5	Utilities (Water, Air, Power transmission, DG Set etc.)	40	25	65
6	Infrastructures	25	15	40
7	Environment protection measures	8	4	12
8	Miscellaneous	7	6	13
	Total	**150**	**100**	**250**

2.10.7 Energy requirement

The energy balance for the plant is shown in **Figure-2.6**, **Figure-2.7**, **Figure-2.8**, **Figure-2.9**, and **Figure-2.10**.

Energy balance – Electrical

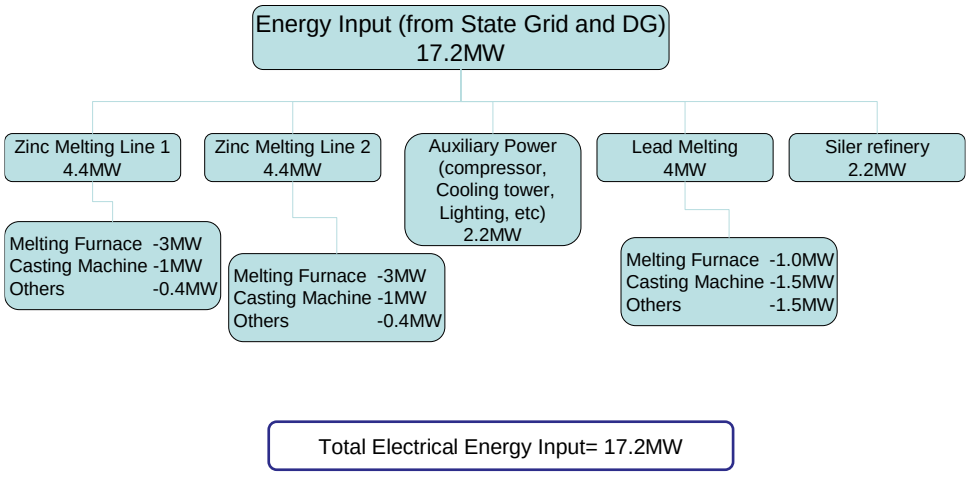


FIGURE-2.6
ENERGY BALANCE - ELECTRICAL

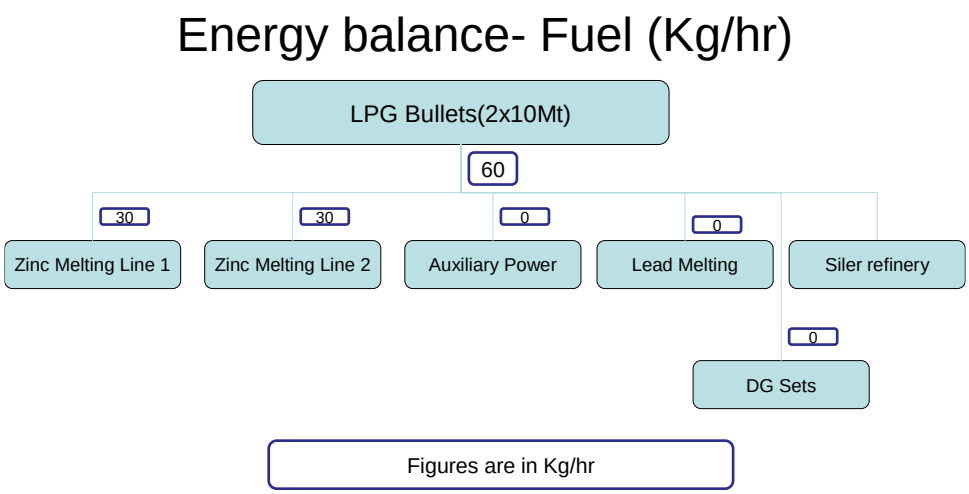


FIGURE-2.7 (A)
ENERGY BALANCE - FUEL ENERGY - LPG

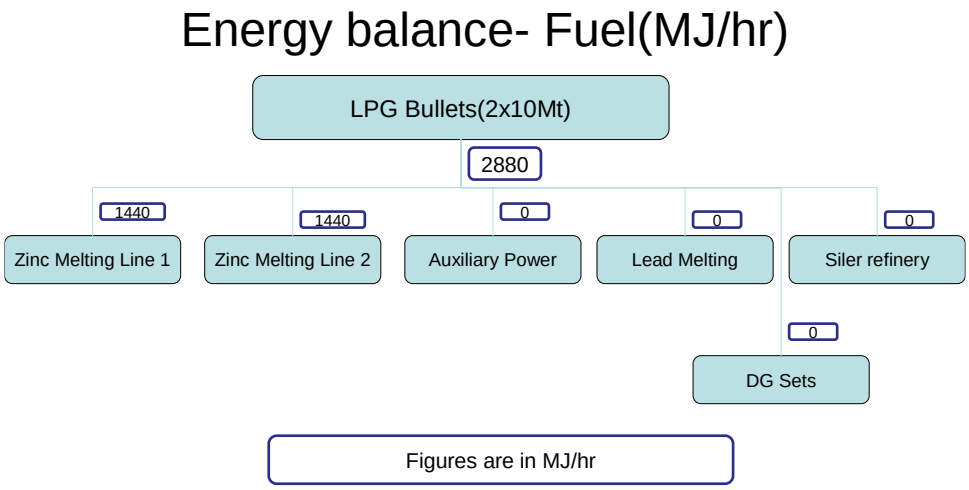


FIGURE-2.7 (B)
ENERGY BALANCE - FUEL ENERGY - LPG

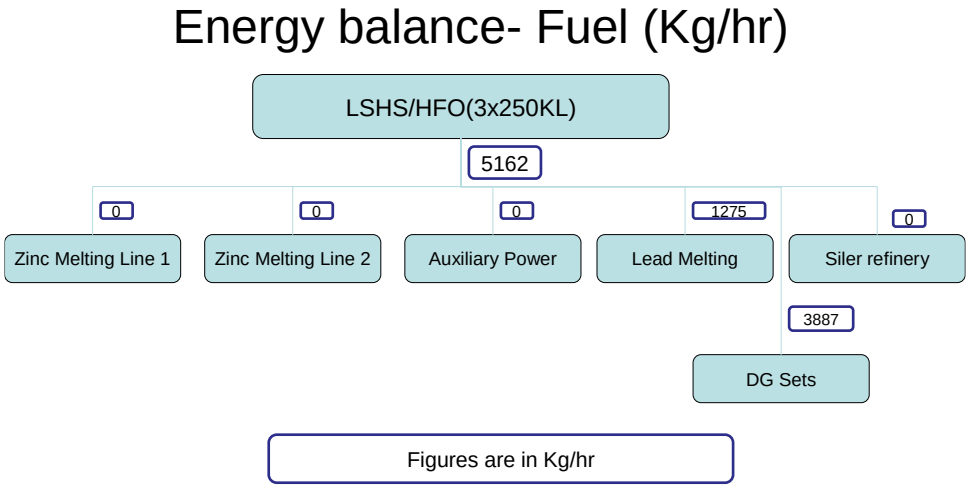


FIGURE-2.8 (A)
ENERGY BALANCE - FUEL ENERGY - LSHS

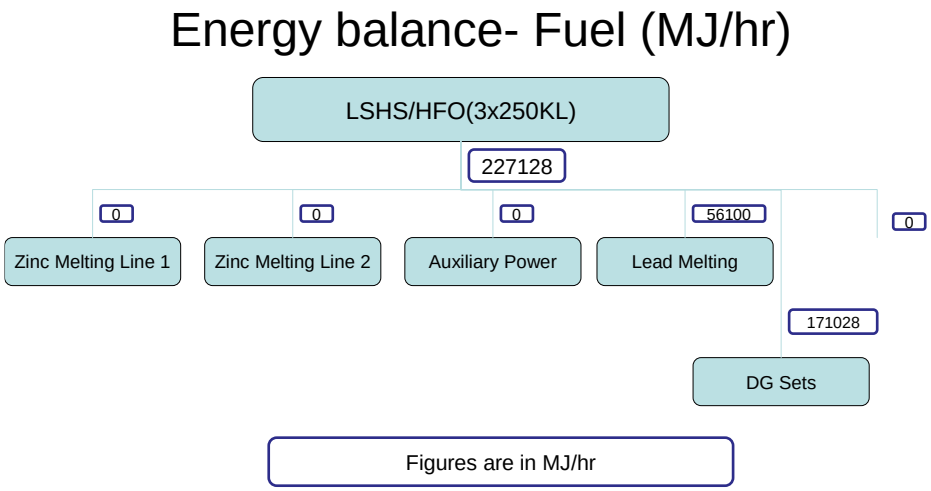


FIGURE-2.8 (B)
ENERGY BALANCE - FUEL ENERGY - LSHS

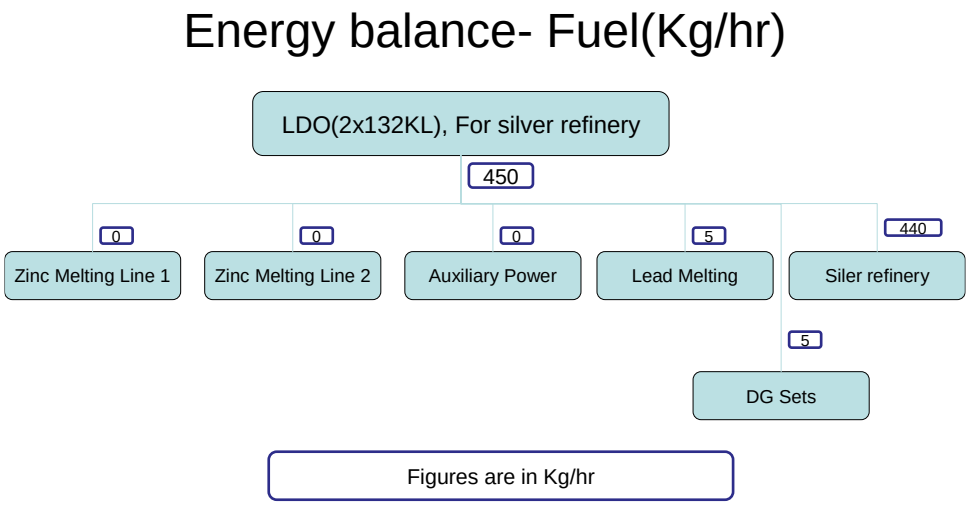


FIGURE-2.9 (A)
ENERGY BALANCE - FUEL ENERGY - LDO

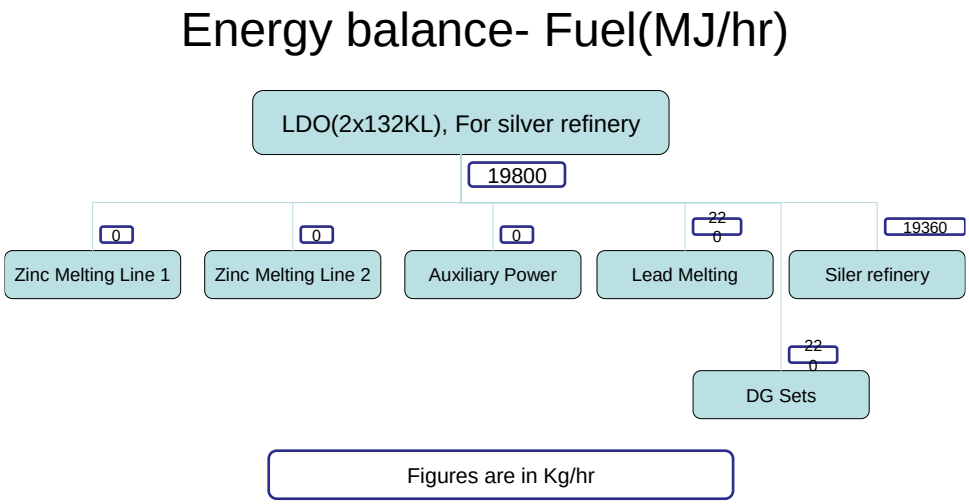


FIGURE-2.9 (B)
ENERGY BALANCE - FUEL ENERGY - LDO

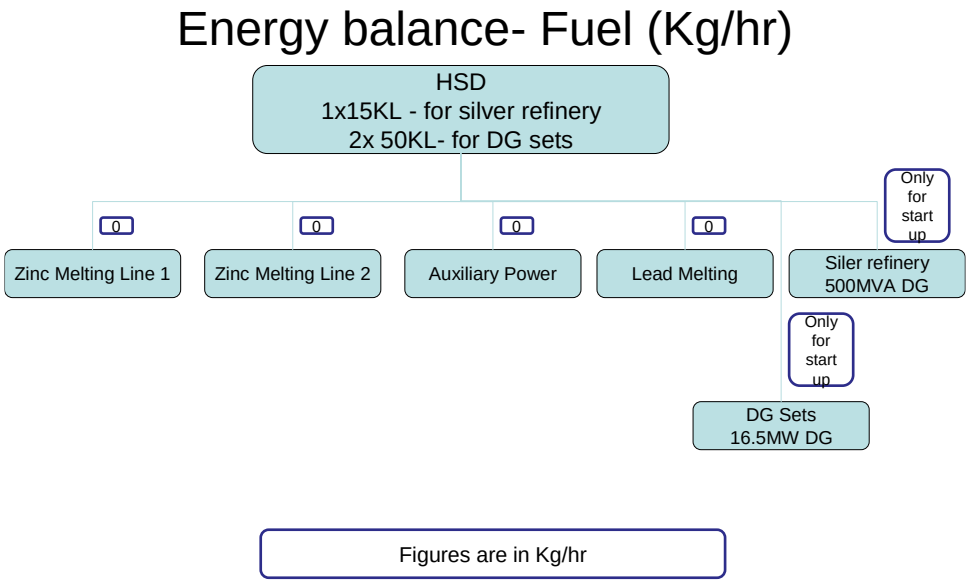


FIGURE-2.10
ENERGY BALANCE - FUEL ENERGY - HSD

3.0 BASELINE ENVIRONMENTAL STATUS

3.1 Introduction

A regional background to the baseline data is being presented at the very outset, which will help in better appreciation of micro-level field data, generated on several environmental and ecological attributes of the study area. The base line status of the project environs is described section wise for better understanding of the broad-spectrum conditions. Field monitoring studies to evaluate the base line status of the project site were carried out during the period of 1st March 2009 to 31st May 2009, representing pre-monsoon season and during 1st October 2010 to 31st December 2010, representing post monsoon and part of winter season. The methodology for sample collection and preservation techniques followed are given in **Annexure-V**. The baseline values are compared with the applicable standards as given in **Annexure-VI** (Ambient air quality as per National Ambient Air Quality Emission Standards issued by the Ministry vide G.S.R. No. 826(E) dated 16th November, 2009).

- ***Profile of Pantnagar***

Udham Singh Nagar was a portion of district Nainital before the Tarai belt was separated to form the present Udham Singh Nagar on 30/09/1995. In the past this land which is full of forest land was neglected till 1948 due to difficult climate. marshy lands, extreme heat, rains which lasted months, a place full of wild animals, diseases and no means of transportation prevented the human race to form a colony here. The history of development started with 1948, when the problem of partition brought refugee problem with it.

Pantnagar is a town in Udham Singh Nagar district, Uttarakhand. Nainital, Rudrapur and Kiccha, Haldwani are the major cities surrounding Pantnagar. Rudrapur is the district headquarters. The district is located in the Terai region, and is part of Kumaon Division. It is bounded on the north by Nainital district, on the northeast by Champawat district, on the east by Nepal, and on the south and west by Uttar Pradesh state.

This area was actually a dense forest near Himalayan foothills and the government was using this area to rehabilitate Hindu/ Sikh migrants from West Pakistan, in the aftermath of the partition.

Pantnagar town is famous for having the first agricultural university of India which was established on 17th November, 1960. Previously, the university was called the Uttar Pradesh Agricultural University, or Pantnagar University. It is now known as the Govind Ballabh Pant University of Agriculture & Technology.

- ***Integrated Industrial Estate, Pantnagar***

Before 2002, the G.B. Pant University owned 16,000 acre (65 km^2), out of which 3,339 acre (13.51 km^2) was transferred to State Infrastructure and Industrial Development Corporation of Uttaranchal (SIDCUL) for developing an Integrated Industrial estate.

Integrated Industrial Estate is located near National Highway no. NH-87 at 235 km from National Capital Delhi and 300 km from State Capital Dehradun in an area of 3339 acres. The main industries located in the industrial estate are Cosmetics, Allied Plastic, Allied Apparel, Allied Agro Food, Allied Pharma Products, Electrical, Electronic, Allied Furniture Hub, Institutional, Commercial & Allied.

3.2 Hydrology & Hydrogeology

3.2.1 Physiography of Ganga River Basin

The study area falls in Ganga river basin. Ganga basin is a part of the composite Ganga-Brahmaputra-Meghna basin. The basin lies in China, Nepal, India and Bangladesh and drains an area of 10,86,000 km^2. It is bounded on the north by the Himalayas, on the west by the Aravallis as well as the ridge separating it from Indus basin, on the south by the Vindhyas and Chhotanagpur plateau and on the east by the Brahmaputra ridge. Its catchment lies in the states of Uttar Pradesh & Uttrankhand (294,364 km^2), Madhya Pradesh (198,962 km^2), Bihar (143,961 km^2), Rajasthan (112,490 km^2), West Bengal (71,485 km^2), Haryana (34,341 km^2), Himachal Pradesh (4,317 km^2) and Delhi (1,484 km^2) in India.

The Ganga originates as Bhagirathi from the Gangotri glaciers in the Himalayas at an elevation of about 7010 m above mean sea level, in the Uttarkashi district of Uttrakhand.

3.2.2 Physiography of the Study Area

The buffer zone forms the northen part of the district Udham Singh Nagar and lies in Gola river basin. Gola is a tributary of Ganga river. The study area drains towards south west. The principal streams of the buffer zone are Bhakra, Kagarrsen and Dhimri in north west; and Pathatchhata, Haldi and Chakpheri in north east. A number of seasonal streams originate from the buffer zone and merge with larger streams and rivers which are tributaries of river Ganga. These tributaries dissect the buffer zone and finally deposit their load in to river Ganga.

Major area of buffer zone forms a flat alluvial plain with minor undulations and has 3 to 5 m/km slope towards south west. The elevation within the buffer area varies from 300 m above msl in north east to 200 m above msl in the south-western part of the buffer zone.

3.2.3 Geology of the Area

The study area, as per the stratigraphy is composed of the Quaternary Period, i.e. loose sand, kankar, gravel and pebbles with little silty and sandy clays and in general are referred as unconsolidated alluvium deposits.

The Siwalik range is followed by the Bhabar zone along foothills, which is fringed further down by the Tarai zone.

- ***Bhabhar Zone***

The Bhabar zone is a narrow zone which extends in northwest-southeast

direction, having very steeply sloping topography with a southward gradient of about 10 m/km and a width of 18 to 24 km. Geomorphologically, this zone is formed by the alluvial fan deposits comprising talus sedimentary material viz. boulders, cobbles, unconsolidated sands and gravels with occasional clay admixtures. The Bhabar belt is the main recharge zone for Tarai sub-region. The phreatic water table is generally deep and varies from 15 to 30 m b.g.l. This is due to high permeability of the deposits and absence or rarity of confining clay layers at shallow depths. The ground water occurs in confined condition at the deeper depth ranging from 40 to 125 m b.g.l.

- ***Tarai Zone***

The Tarai zone forms an elongated belt fringing the Bhabar zone on its south and separated from it by a spring line running in northwest-southeast direction. It has a gentle southward gradient of 2.34 and 3.18 m/km in Ramnagar-Kashipur and Haldwani-Kichha section, respectively. The maximum width of Tarai zone is about 26 km. The Tarai formations comprise of well defined intercalated stratum of clay, sandy clay and sand with occasional gravel deposit in stratified formations over the bed rock continuity of Siwaliks. The shallow aquifers at a depth of 10-15 m are interconnected and recharge by percolation as well as infiltration from irrigated fields. The deeper, coarse textured stratum consisting of sands with pebbles and gravel encountered at a depth of 60 to 80 m is the potential confined aquifer, receiving recharge from Siwalik runoff and infiltration in Bhabar zone. The piezometric head of this aquifer, ranges up to 9 m and supports a number of artesian wells.

The hydrogeological map of core and buffer zones of the plant is given in **Figure-3.2.1**. The contour map of core and buffer zone of the plant is given in **Figure-3.2.2**.

3.2.4 Nature of Occurrence of Ground Water

Ground water occurs in the Pliestocene to Recent formations, under water table conditions. Of all the formations, only alluvium of Gangetic plain, Tarai and Bhabhar zones form the principal aquifers in the area. In alluvium, the ground water is transmitted through the voids and interstitial openings. The alluvium is unconsolidated and pervious in nature and has primary porosity.

The water bearing formations in the core (plant area) and buffer zone (10 km radius area) is mostly composed of silt, clay, silty sand and sand with gravel belonging to Tarai and Bhabar formations. The depth to water table in the plant area ranges from 3.50 to 4.50 m below land surface during post monsoon period and 5.00 to 6.00 m during pre-monsoon period. The depth to water in buffer zone ranges from 1.00 to 3.00 b.g.l. during post-monsoon period while it is deeper ranging from 3.00 to 6.00 m b.g.l during pre-monsoon. The fluctuation of water table in alluvium is moderate and ranges from 1 to 2 m from pre to post monsoon periods. However, the water levels are shallow near streams, ponds and low lying areas in buffer zone where it ranges from 0.2 to 0.50 m.

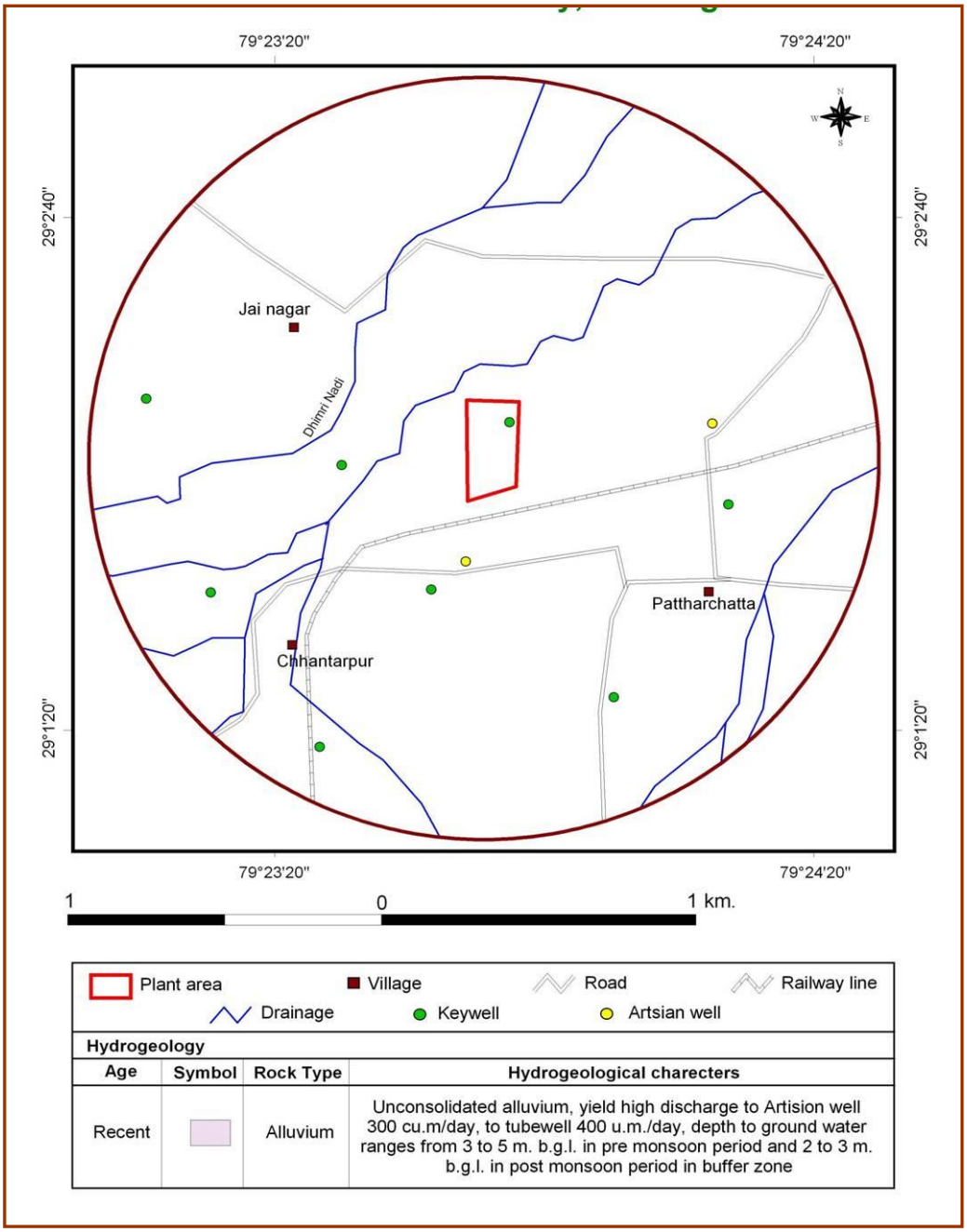


FIGURE-3.2.1
HYDROGEOLOGICAL MAP OF CORE AND BUFFER ZONE

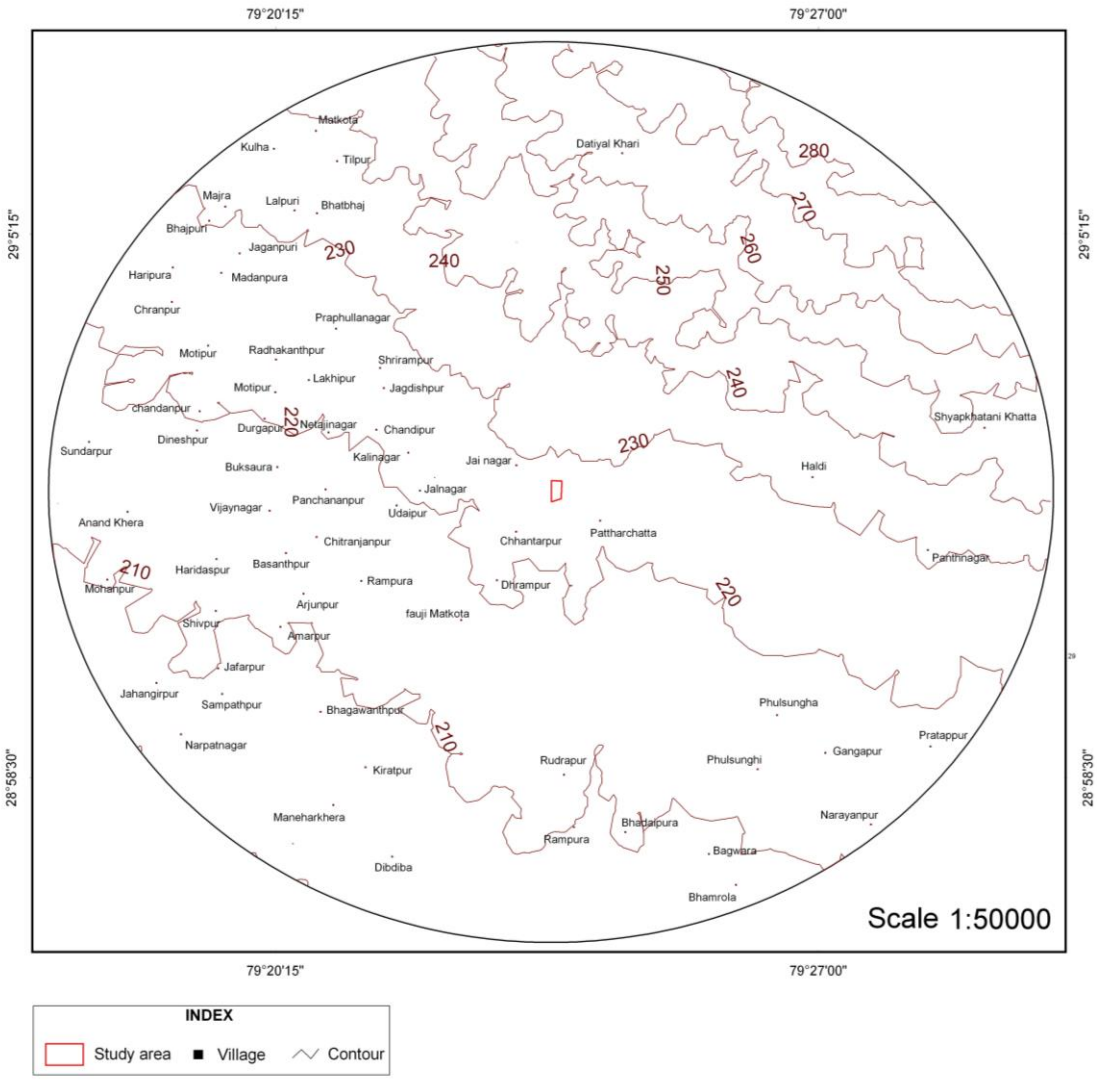


FIGURE-3.2.2
CONTOUR MAP OF CORE AND BUFFER ZONE

3.2.5 Movement of Ground Water

As indicated, ground water movement is controlled mainly by the hydraulic conductivity of aquifer. A review of the topography and drainage pattern reveals that the general slope of the area is towards south west and ranges from 3 m/km to about 5 m/km. The ground water also follows the topography and surface water flow direction and moves in south west direction. However, the hydraulic gradient is not so high and has been observed as hardly 3.0 m/km to 4 m/km as calculated from the monitoring of wells of the area.

3.2.6 Nature of Hydraulic Conductivity

The principal aquifer of the area is mainly alluvium have high hydraulic conductivity which is mainly developed due to interstitial openings of granular material.

The hydraulic conductivity of granular horizons, mostly sand, with boulder and gravel is high. There are large number of irrigation wells mostly tubewells driven by centrifugal pumps. Pump tests carried out in nearby areas on a tubewell tapping alluvium has indicated hydraulic conductivity (K) of 11.7 m/day which can be classified as high.

3.2.7 Aquifer Test and Hydraulic Characteristics

3.2.7.1 Theory

The basic aim of pump-test analysis is to establish the fundamental aquifer properties like hydraulic conductivity (K), transmissivity (T) and storage coefficient (S). Various methods for determining K, T and S were developed long back for equilibrium and non-equilibrium conditions in confined and unconfined aquifers.

During an aquifer test, the hydraulic head in the aquifer declines as the time of pumping increases. Analysis of hydraulic head decline, or drawdown, allows for the estimation of aquifer hydraulic properties.

Generally, the type of aquifers with special conditions are :

- Confined;
- Leaky or Recharge Boundary; and
- Unconfined.

3.2.7.2 Pumping and Recuperation Data

The details of the pump test conducted on the tubewell (N 29º 02' 09.9'' E 79º 23' 45.1'') available in the plant premises is given in **Table-3.2.1** The lithological log of the tubewell is shown in **Figure-3.2.3**. 90 m in depth and a pump of 25 H.P has been lowered up to depth of 36.58 m. The free flow of tubewell has been measured as 10.80 m^3/hour. The pumping test reports of tubewell are given in **Table-3.2.2**

TABLE-3.2.1
LITHOLOGICAL LOG OF THE TUBEWELL

Depth (m)	Formation
0.00-7.62	Soil
7.62-12.19	Sand mixed with gravel
12.19-31.39	Clay
31.39-35.97	Sand mixed with gravel
35.97-68.58	Clay
68.58-89.92	Sand mixed with gravel
89.92-106.68	Clay

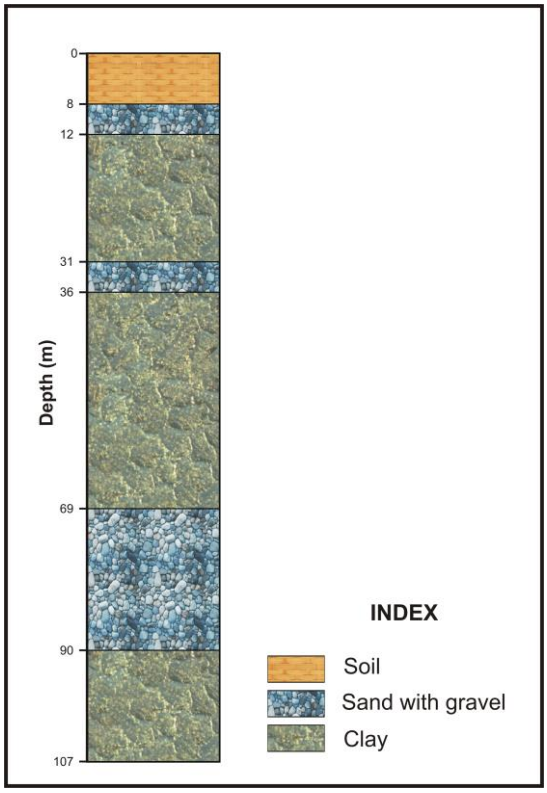


FIGURE-3.2.3
LITHOLOGICAL LOG OF THE TUBEWELL

TABLE-3.2.2
PUMPING TEST REPORT OF PLANT AREA, PANTNAGAR

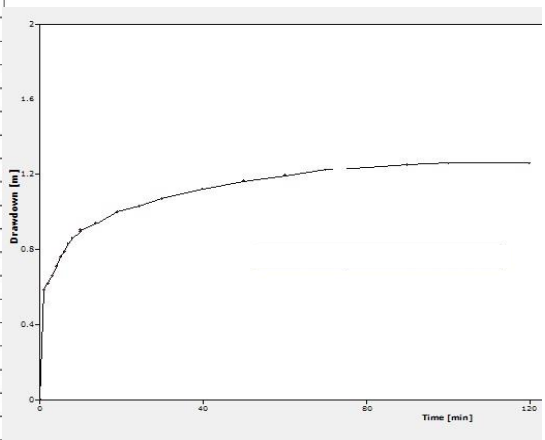
HYDRO-GEOSURVEY CONSULTANTS (P) LTD.
C-103, SHATRINAGAR
JODHPUR - 342003
RAJASTHAN, INDIA

Pumping Test - Water Level Data Page 1 of 1

Project: Pantnagar
Number: Silver Refinery
Client: Hindustan Zinc Limited

Location: Pantnagar	Pumping Test: Pumping Test 1	Pumping Well: WATER SUPPLY WELL
Test Conducted by: Dr Satinder Singh	Test Date: 11/22/2010	Discharge Rate: 25 [m³/h]
Observation Well: WATER SUPPLY WELL	Static Water Level [m]: 0.00	Radial Distance to PW [m]: -

	Time [min]	Water Level [m]	Drawdown [m]
1	0	0.00	0.00
2	1	0.58	0.58
3	2	0.62	0.62
4	3	0.663	0.663
5	4	0.71	0.71
6	5	0.76	0.76
7	6	0.79	0.79
8	7	0.83	0.83
9	8	0.86	0.86
10	9.9	0.89	0.89
11	10	0.90	0.90
12	13.8	0.94	0.94
13	19	1.00	1.00
14	24.4	1.03	1.03
15	30	1.07	1.07
16	40	1.12	1.12
17	50	1.16	1.16
18	60	1.19	1.19
19	70	1.22	1.22
20	90	1.25	1.25



HYDRO-GEOSURVEY CONSULTANTS (P) LTD.
C-103, SHATRINAGAR
JODHPUR - 342003
RAJASTHAN, INDIA

Pumping Test Analysis Report

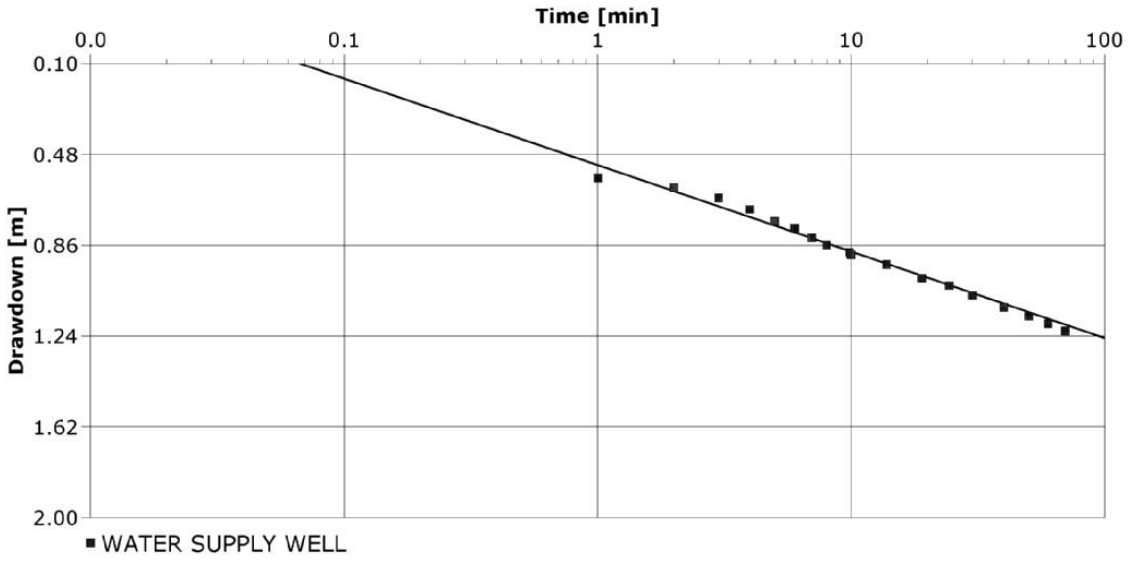
Project: Pantnagar
Number: Silver Refinery
Client: Hindustan Zinc Limited

Location: Pantnagar	Pumping Test: Pumping Test 1	Pumping Well: WATER SUPPLY WELL
Test Conducted by: Dr Satinder Singh		Test Date: 11/22/2010
Aquifer Thickness: 25.90 m	Discharge Rate: 25 [m³/h]	

	Analysis Name	Analysis Performed by	Analysis Date	Method name	Well	T [m²/d]	K [m/d]	S
1	Cooper & Jacob	R V Khilani	11/23/2010	Cooper & Jacob I	WATER SUPPLY WELL	3.04×10^{2}	1.17×10^{1}	4.20×10^{-1}

HYDRO-GEOSURVEY CONSULTANTS (P) LTD. C-103, SHASTRINAGAR JODHPUR - 342003 RAJASTHAN, INDIA	**Pumping Test Analysis Report** 1 Project: Pantnagar Number: Silver Refinery Client: Hindustan Zinc Limited

Location: Pantnagar	Pumping Test: Pumping Test 1	Pumping Well: WATER SUPPLY WELL
Test Conducted by: Dr Satinder Singh		Test Date: 11/11/2010
Analysis Performed by: R V Khilani	Cooper & Jacob	Analysis Date: 11/23/2010
Aquifer Thickness: 25.90 m	Discharge Rate: 25 [m³/h]	



Calculation after Cooper & Jacob

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Storage coefficient	Radial Distance to PW [m]	
WATER SUPPLY WELL	3.04×10^{2}	1.17×10^{1}	4.20×10^{-1}		

The pump test has indicated the transmissivity value of 304 m^2/day and its hydraulic conductivity value of 11.7 m/day for sand mixed with little gravel. The storativity value of 4.20 x 10^{-1} was found indicating it to be confined aquifer.

3.2.8 Yield of Wells

There are number of bore wells. Generally, cultivators construct bore wells of 200 mm dia up to average depth of 10-15 m by boring till granular horizon is encountered. A centrifugal pump is installed in the borewell with a suction pipe of 7 to 8 m in length in the bore. Each such borewell yields about 30 to 50 m^3/hour. The pumps are operated by electric motors of 7.5 to 10 H.P. There are large number of hand pumps mostly used for drinking purpose in villages. The yield of such hand pumps is not much and is just sufficient to meet the drinking water requirement. The yield of such hand pumps range from 500-1,000 litres per hour of potable quality of water.

In the northern part of the buffer zone, many cultivators utilize artesian wells (average depth of bore is about 100 m). Each such artesian well yield is about 25

to 40 m^3/hour without installing the pump.

3.2.9 Comprehensive Hydrogeological Assessment of Core & Buffer Zones

3.2.9.1 Ground Water Recharge

The main source of ground water recharge is by the rainfall by direct percolation to the zone of saturation. As already indicated, there is well developed drainage in the area due to moderate rainfall and loamy soils. A significant part of the rainfall is lost as runoff from the area while a limited percentage of rainfall therefore reaches zone of saturation and becomes the part of ground water storage after meeting the evaporation and evapotranspiration losses. There is also ground water recharge from the return flow of irrigation water pumped from tubewells and artesian well operated by the cultivators. The ground water recharge from return flow of irrigation is normally taken as 20% of the total water applied for irrigation this percentage has been suggested by the Ground Water Estimation Committee for ground water assessment for this part of the state.

3.2.9.2 Ground Water Recharge of Core Zone (Plant Area)

The core zone covers 10 ha area of plant, mainly composed of alluvium. There are no tubewells or open dug wells in the plant area. The recharge from rainfall infiltration as per the guidelines of the Ground Water Estimation Committee, Govt. of India (1997) has also been calculated just for counter check.

- ***Increment in Ground Water Storage***

The ground water recharge can be computed by multiplying the increment in ground water storage by measuring the water level fluctuation during pre and post monsoon periods with area of assessment and specific yield.

Increment in the ground water storage in the core zone was determined by recording the water levels in the wells close to the plant area during pre and post-monsoon periods of 2010. Average rise of water level in the alluvium due to rainfall was found as 2.40 m.

The ground water recharge of 0.036 mcm has taken place due to rainfall of 2049 mm for the year 2010 but when normalized to average annual rainfall of 1095 mm, it amounts to 0.019 mcm.

- ***Rainfall Infiltration***

The Ground Water Resource Estimate Committee (1997), formed by Govt. of India has proposed rainfall infiltration factor to be used for estimation of ground water recharge for the areas where monitoring of wells can not be done or has not been done.

The committee has suggested 15-25% as the rainfall infiltration factor for unconsolidated alluvium. The upper limit can be taken for the areas having favourable hydrogeological conditions of ground water recharge as for this area, where rainfall is moderate and area is well drained. Taking the value of infiltration

as 20%, the ground water recharge from rainfall for core zone has been estimated as 0.022 mcm.

This value of ground water recharge calculated from rainfall infiltration matches very well with the value calculated on the basis of actual increment in ground water storage by rainfall.

3.2.9.3 Ground Water Recharge of Buffer Zone (10 km Radius Area)

Buffer zone has mainly alluvium as water bearing formation. The total area of the buffer zone is 10.15 km^2 (10.25 – 0.10 km^2 of the rerfinery area) in the district of Udham Singh Nagar. Major part of the cultivable area is dependent on tube / borewells and artesian wells.

The ground water fluctuation of water table during pre and post-monsoon periods were recorded for the year 2010 from the 10 key wells (**Table-3.2.3)** as per the guidelines of the Ministry of Environment & Forests and taking specific yield values of 15% for alluvium, the ground water recharge by rain fall has been calculated as under.

- ***Increment in Ground Water Storage***

The total ground water recharge of the buffer zone has been calculated as 4.03 mcm against the rainfall of 204.9 mm recorded during the year 2010 which when normalized for average rainfall of 1095 mm amounts to 2.15 mcm.

TABLE-3.2.3
HYDROLOGICAL DATA OF KEY WELLS OF CORE AND BUFFER ZONE- 2010

Sr. No.	Village	Latitude	Longitude	Depth of well (m)	Post monsoon water level (m)	Pre monsoon water level (m)	Aquifer	Yield m^3/day	Pump capacity (hp)	Purpose
1	Plant	29°02'08.5''	79°23'46.8''	10.50	1.50	4.45	Alluvium	300.00	25HP/EM	Industrial purpose
2	Jainagar	29°02'01.5''	79°23'21.8''	10.60	1.74	3.94	Alluvium	200.00	7.5HP/EM	Irrigation
3	Jainagar	29°02'12.1''	79°22'52.3''	9.15	2.16	3.10	Alluvium	240.00	7.5HP/EM	Irrigation
4	Chhatarpur	29°01'46.5''	79°23'40.4''	9.25	2.22	3.50	Alluvium	240.00	10HP/EM	Irrigation
5	Chhatarpur	29°01'41.9''	79°23'02.2''	116.00	Artisian Well		Alluvium	240.00	Natural	Irrigation
6	Chhatarpur	29°01'42.3''	79°23'35.2''	90.24	2.60	4.37	Alluvium	240.00	10HP/EM	Irrigation
7	Chhatarpur	29°01'17.6''	79°23'18.5''	11.80	2.75	4.10	Alluvium	230.00	10HP/EM	Irrigation
8	Pattarchatta	29°02'07.7''	79°24'17.6''	112.00	Artisian Well		Alluvium	250.00	Natural	Irrigation
9	Pattarchatta	29°01'55.4''	79°24'19.9''	8.10	2.17	3.26	Alluvium	230.00	7.5HP/EM	Irrigation
10	Pattarchatta	29°01'25.4''	79°23'18.5''	9.94	2.44	3.65	Alluvium	230.00	10HP/EM	Irrigation

(Source: Hydrogeosurvey Consultants, Jodhpur)

- ***Rainfall Infiltration***

Taking the value of infiltration as 20%, the ground water recharge from rainfall for buffer zone has been estimated as 2.22 mcm.

This value of ground water recharge calculated from rainfall infiltration matches with the value calculated on the basis of actual increment in ground water storage by rainfall.

- ***Return Flow of Irrigation***

The norms prescribed by the Estimate Committee for return seepage from the irrigation fields for loamy soils has been suggested as 20% of the total water applied for the irrigation. There are a number of artesian well and tubewells in the buffer zone being operated for irrigation tapping alluvium. Taking 20% as return flow to saturation zone, ground water recharge by seepage amounts to 0.31 mcm.

The total ground water recharge therefore amounts to 2.46 mcm after including recharge from return flow of irrigation water.

3.2.10 Ground Water Discharge

3.2.10.1 Ground Water Discharge in Core Zone (Plant Area)

At present, there is one tubewell in the plant area being operated for the Silvery refinery providing 325 m^3/day. This tubewell is tapping confined aquifer. For melting and casting unit, there will be additional water requirement of 500 m^3/day which will be obtained by constructing another tubewell tapping confined aquifer. So the total ground water withdrawal from the plant area from confined aquifer is estimated 0.30 mcm

3.2.10.2 Ground Water Discharge in Buffer Zone (10 km Radius Area)

The ground water discharge takes place mainly by evapo-transpiration and by withdrawal from tube/ bore wells and artesian wells for irrigation.

There are 19 shallow borewells tapping the phreatic aquifer in operation for irrigation along with 3 deep artesian wells tapping the confined Bhabar aquifer (zone).

In addition, the drinking and livestock water requirement of around 4 villages having a local population of about 13,720 is met by tubewells, and hand pumps and is around 0.38 mcm considering 75/litre/capita/day consumption of the local population. The total ground water discharge (except withdrawal from artesian wells) therefore amounts to 1.91 mcm.

3.2.11 Present Status of Ground Water Development

The present study reveals that against the total ground water recharge of 2.46 mcm, including recharge from return flow of irrigation water of buffer zone, the

ground water discharge is 1.91 mcm indicating the status of ground water development of buffer zone as 77.64%. The buffer zone therefore appears to be safe as no long term depletion of water table has been observed. Similarly, against the ground water recharge of shallow aquifer of 0.019 mcm of the plant area, there is no ground water abstraction from shallow unconfined aquifer of plant area. The total ground water abstraction of 0.30 mcm for the plant will be from the confined aquifer for which recharge values are not known.

The Central Ground Water Board in association with state ground water organization carry out estimation of dynamic ground water reserves of every taluka/mandal of the state by monitoring the water levels in key wells during pre and post monsoon periods every year along with estimation of ground water draft. The report is published once in two years and last report has been released in August, 2005 for the dynamic ground water reserves as on 1.4.2004. This report places all the talukas/ mandals in different categories like safe, semi-critical, critical and over-exploited depending on the status of ground water development and long term water level trend. This report has indicated the status of ground water development of Udham Singh Nagar district as 79% without any long term declining trend of water levels either in pre or post monsoon period thereby placing it under safe category.

The present study has also indicated the buffer zone in safe category because the buffer zone covers a limited area of Udham Singh Nagar and has less number of bore wells/tubewells for irrigation.

3.3 Land Use Studies

Studies on land use aspects of eco-system play important roles for identifying sensitive issues, if any, and taking appropriate actions for maintaining the ecological balance in the development of the region.

3.3.1 Objectives

The objectives of land use studies are:

- To determine the present land use pattern;
- To analyze the impacts on land use due to plant activities in the study area; and
- To give recommendations for optimizing the future land use pattern vis-a-vis growth of plant activities in the study area and its associated impacts.

3.3.2 Land Use in Study Area Based on Satellite Data

The satellite IRS – P6, data LISS 4 MX of 16th November 09 was procured from National Remote Sensing Centre, Hyderabad to prepare the land use map of the plant site by identifying the different land use units and the area of each land use unit of the total area. The satellite image of the study area is given in **Figure-3.3.1**.

The base map information has been taken from Survey of India toposheet No. 53 O/8 on 1:50,000.

➢ Villages, Industrial Estate and Transport Network

The buffer zone is more or less flat land with slight undulations. The area is otherwise rich in agriculture and has potential for industrial development. With SIDCUL industrial estate, the buffer zone has well developed urban and rural base. The base map indicating town, villages, major roads and industrial area has been prepared and shown as **Figure-3.3.2**. There are very few villages in this area. There is a small aerodrome at Pantnagar. All the towns, villages, main roads, industrial area etc as seen in toposheet 53 O/8 were mapped on base map and were then updated using satellite data.

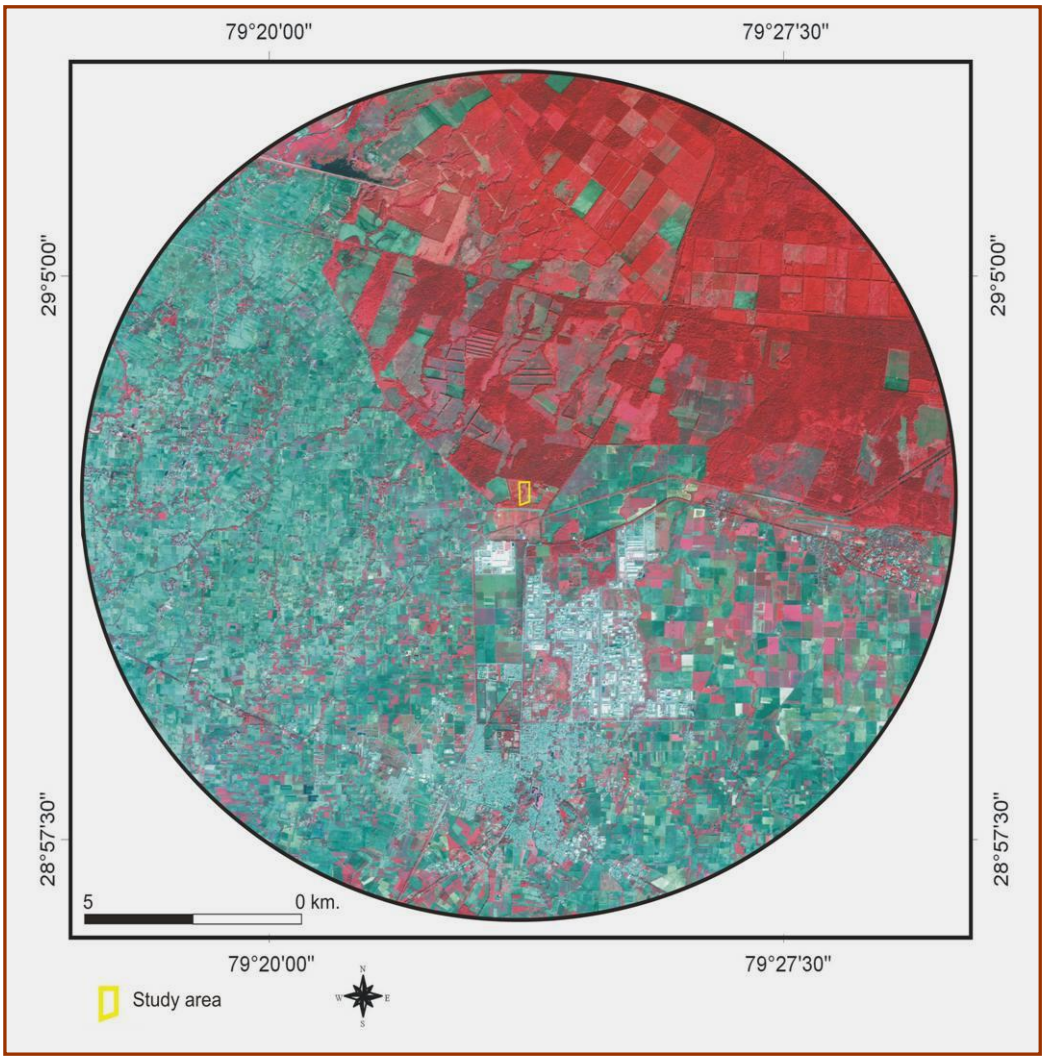


FIGURE-3.3.1
SATELLITE IMAGE OF BUFFER ZONE

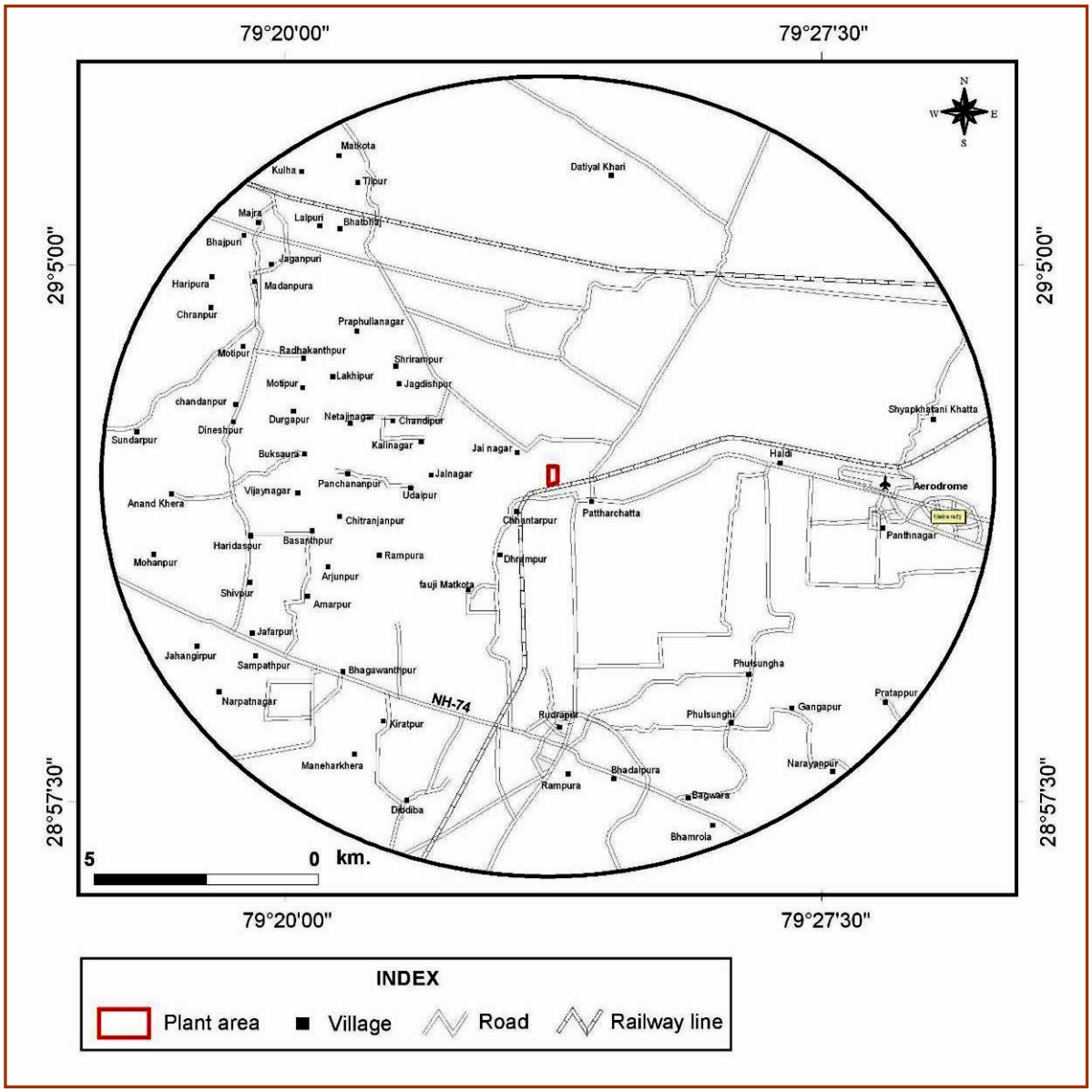


FIGURE-3.3.2
BASE MAP OF BUFFER ZONE

- **Drainage & Water Bodies**

The drainage net work, as seen by rivers, streams, water bodies etc in the toposheet was updated by with the satellite data (**Figure-3.3.3**). The two ponds in the northern region and the canal are the other important water bodies of the buffer zone. The rivers present in the area are Dhimri Nadi (2 km, W), and Baigul Nadi (2 km, E). The Haldi nala and Pattarchhata nala are close to core zone. Further, there are no nallahs passing through the plant site.

- **Geomorphology**

The thematic layer showing the geomorphology of the buffer zone was prepared using geological map of Geological Survey of India (**Figure-3.3.4**). This layer is based on lean season data of winter crop season. The area under different geomorpholigical units in the study area is given in **Table-3.3.1**.

TABLE–3.3.1
AREA UNDER DIFFERENT GEOMORPHOLOGICAL UNITS IN THE STUDY AREA

Sr. No.	Geomorphological Units	Area in km^2	% of the Total Area
1	Plant area	0.10	0.03
2	Flood plain	41.52	11.02
3	Alluvial plain	335.27	88.95
		376.90 km^2	**100 %**

- **Slope (Digital Elevation Model) Map**

Satellite data was used to prepare a digital elevation map at the interval of 10 m (**Figure-3.3.5**). This map clearly shows the slope pattern. The general slope is from North east to South west.

The highest elevation (300 m) of buffer zone is in the Northwest corner. Then it drops to the range of 270 to 250 m followed by 230 and 210 m. Thus, there is hardly a drop of 5 m in per one km representing a plain topography.

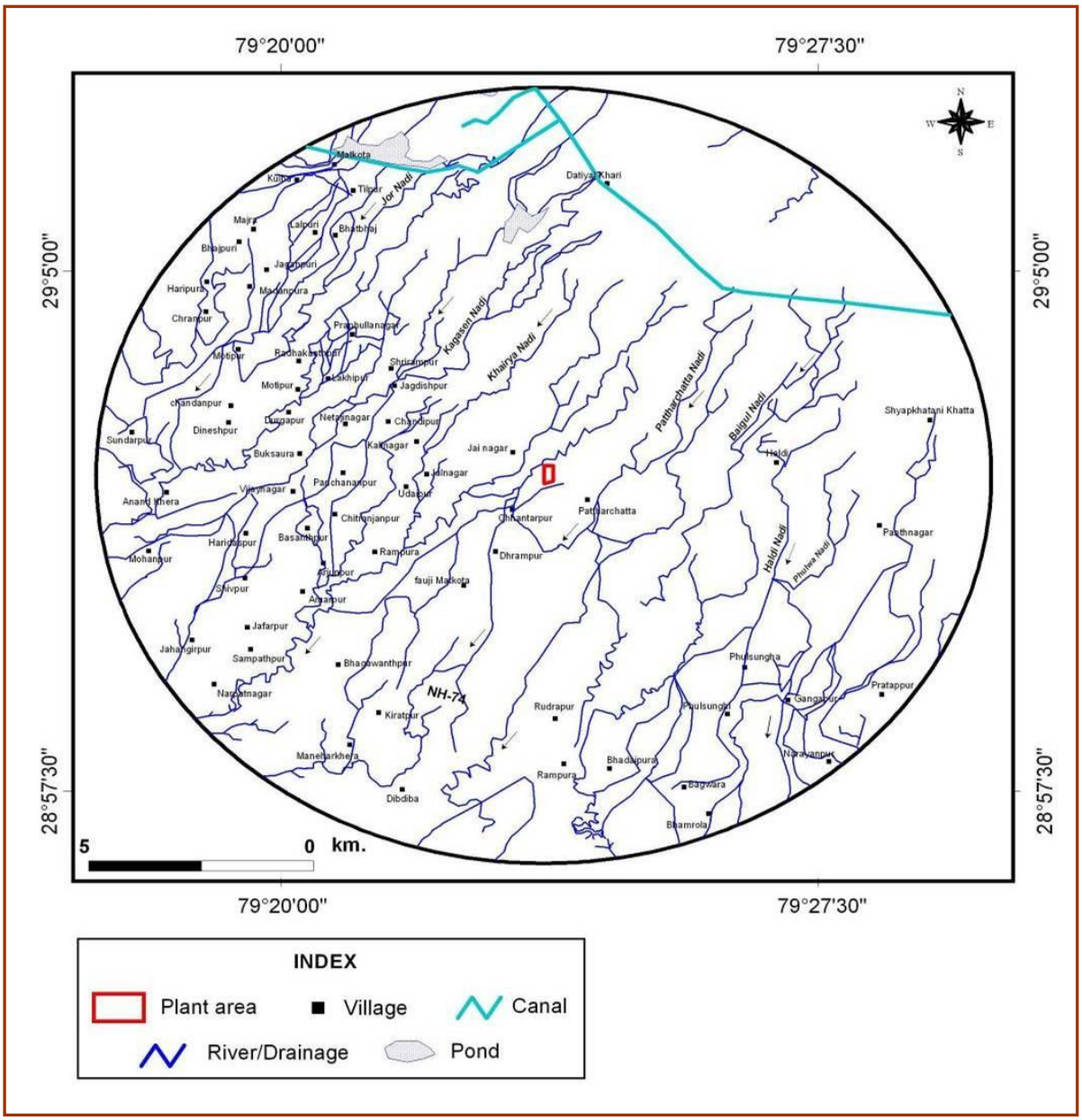


FIGURE-3.3.3
DRAINAGE MAP OF BUFFER ZONE

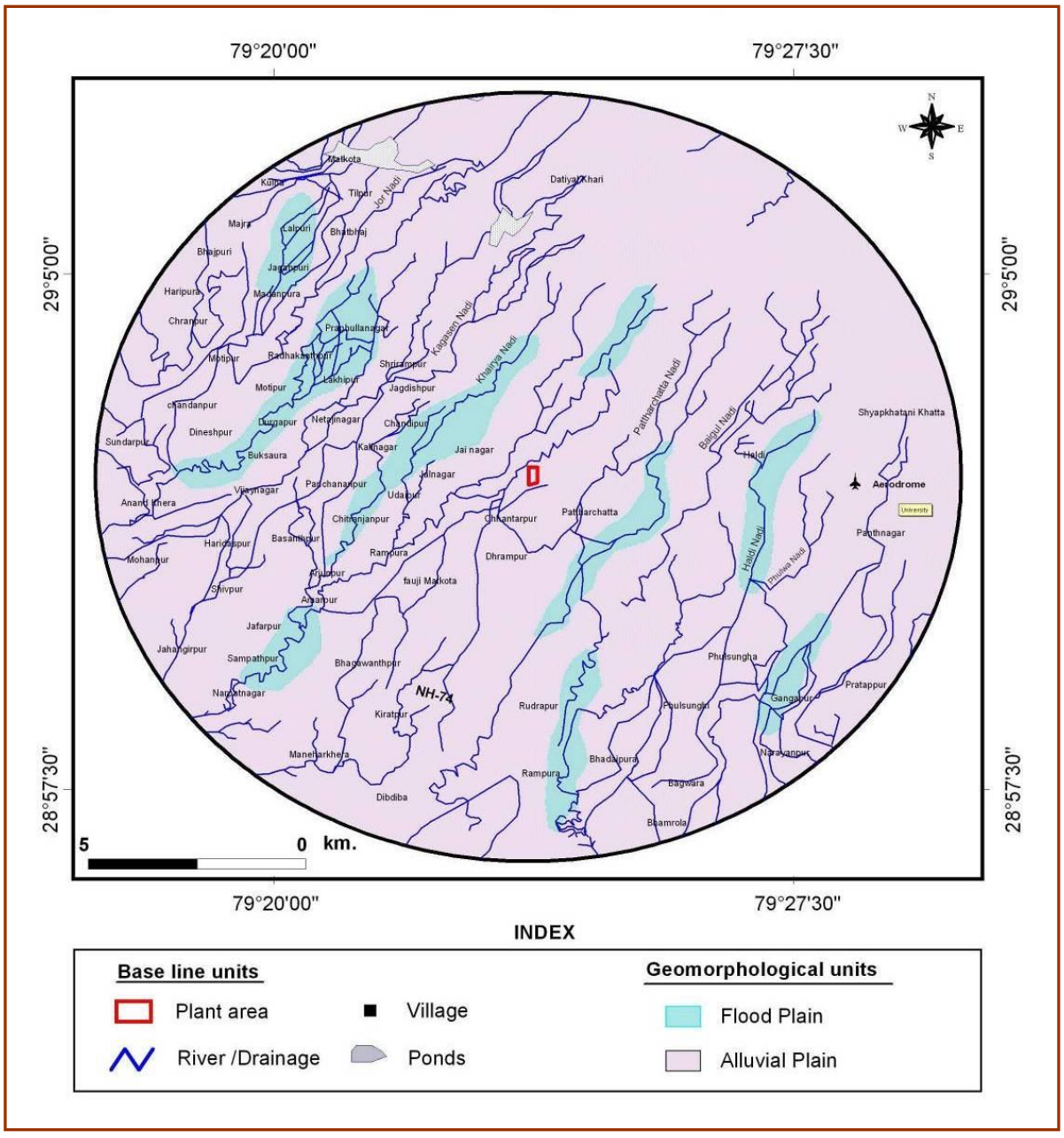


FIGURE-3.3.4
GEOMORPHOLOGICAL MAP OF BUFFER ZONE

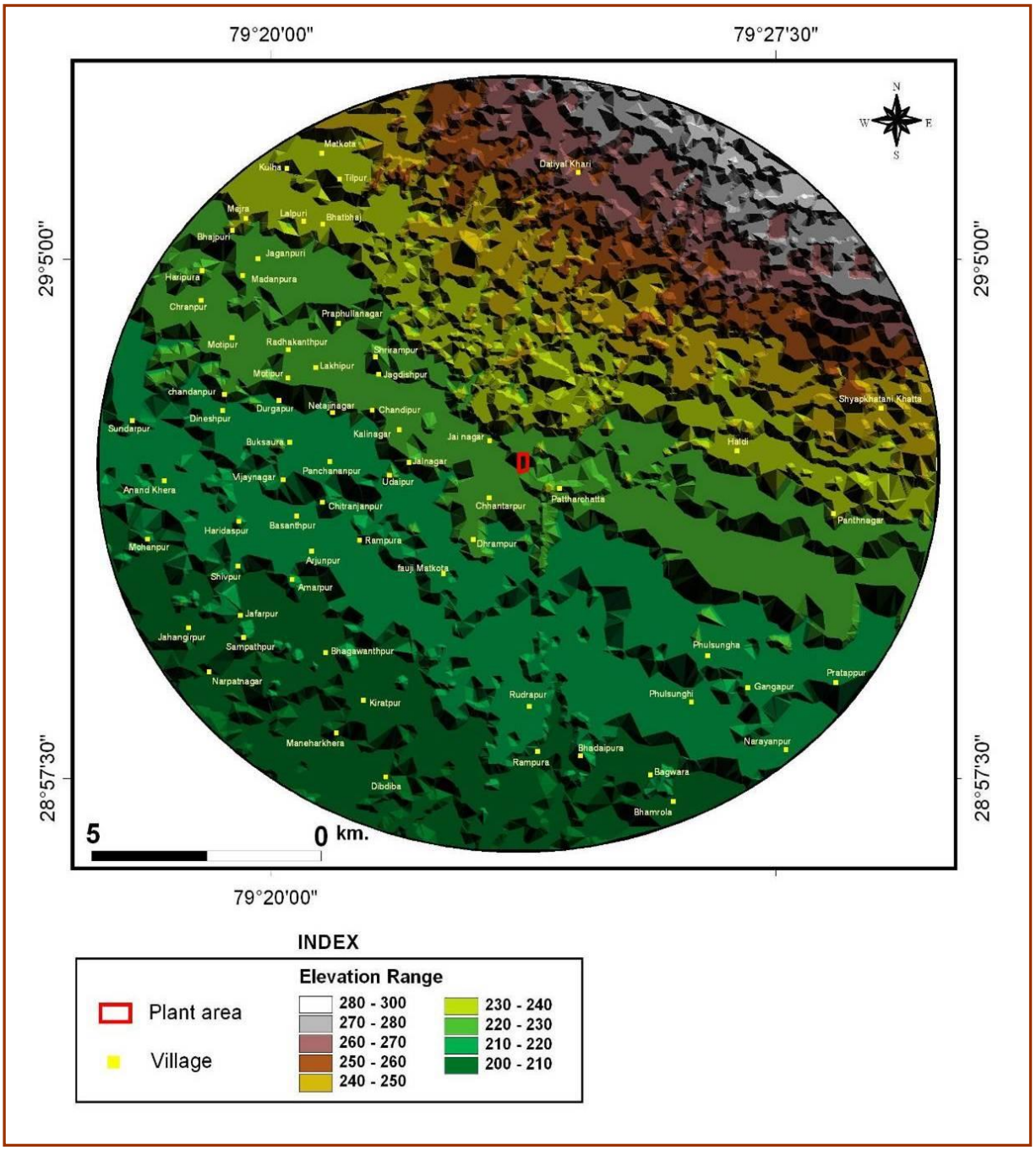


FIGURE-3.3.5
DIGITAL ELEVATION MODEL (DEM) OF THE AREA

➢ Integrated Land use of the Area

Based on the different themes prepared using satellite data, toposheet and field check, an integrated land use theme is prepared. The **Figure-3.3.6** shows the integrated land use map of the area. The percentage of land occupied by each unit is given in **Table-3.3.2**. The integrated map shows that the buffer zone is almost a plain to moderately undulating land having some higher elevation in the northeast portion. The 0.03% of the land is the plant area. Most of the buffer zone is agricultural land. A large portion of buffer zone in northwest and south west is under forest marked as Tanda, Gangapurpatia and Dhimri protected forest, but its major portion has been leased out for cultivation. The farmers take three crops in a year. In the month of August they sow rice, Urad and sugarcane, and in November they cultivate wheat and peas. After the winter crop again in March they cultivate rice, sugarcane and corn. Besides this the vegetables are grown through out the year as per the season. The buffer zone has many orchids of Guava and Mango. The area other than cultivation is marked by shrubs. There is no agriculture, plantation, drainage, forest in the plant area (core zone). The railway track passes near the southern end of core zone. There are small shrubs in the core zone.

The irrigation in the buffer zone is mainly by bore wells, tubewells and canal. The area is highly fertile and has surplus groundwater, the water is existing in artisian conditions. Thus, the agricultural land covers 58.16% of the lease area. The built up land in the buffer zone is clustered around Pantnagar, Rudrapur, Rampura and Bhadarpura near NH – 74 thereby occupying 18.2% of the buffer zone. Dense jungle is yet another category occupying 9.39% of the buffer zone. These are the parts of the protected forests which are not leased out for agriculture. The water bodies comprising of rivers, ponds and canal occupy 14.22 % of the buffer zone. Thus buffer zone is a highly fertile agricultural land, having very good groundwater prospects.

TABLE–3.3.2
AREA UNDER DIFFERENT LAND USE CLASSES IN THE STUDY AREA

Sr. No.	Category Level I	Level II	Level III	Area in km^2	% of the Total Area
1	Lease area			0.10	0.03
2	Built up land	Villages (Rural), Railway line and Road		68.60	18.20
3	Agriculture	Crop land	Rabi/Kharif	219.19	58.16
4	Forest land	Dense forest		35.40	9.39
5	Water bodies	Rivers, Ponds and Canal		53.60	14.22
				376.90 km^2	**100 %**

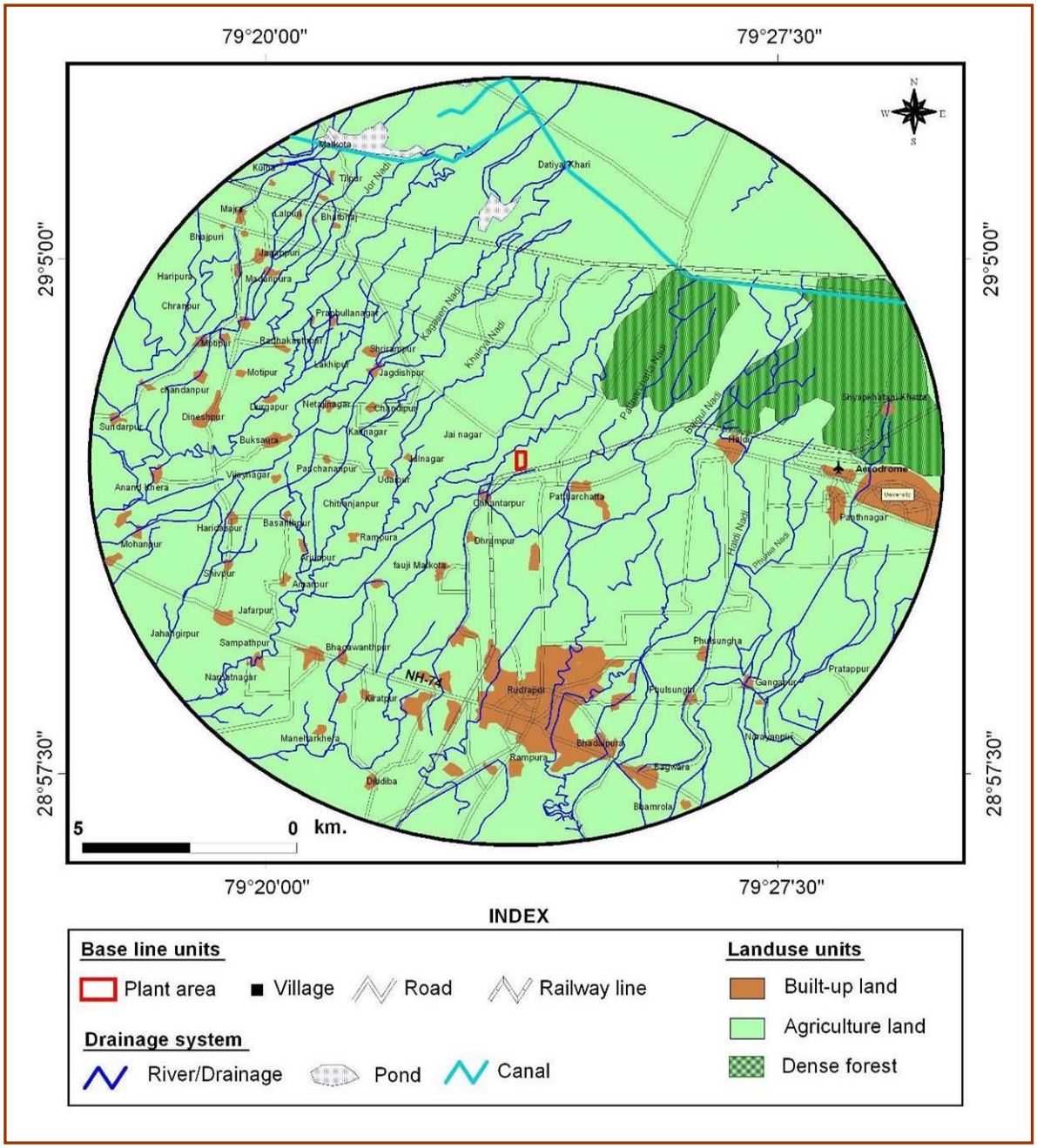


FIGURE-3.3.6
INTEGRATED LANDUSE MAP OF BUFFER ZONE

3.3.3 Land use Based on Secondary Data

For the study of land use, literature review of various secondary sources such as district census handbooks, regional maps regarding topography, zoning settlement, industry, forest etc., were taken. The data was collected from various sources like district census handbook, revenue records, state and central government offices and Survey of India (SOI) topo sheets and also through primary field surveys.

Based on the census report, 10 km radial distance around the plant site has been considered in the study. These areas were studied in detail to get the idea of land use pattern in the study area. The land use pattern of the study area is given in **Table-3.3.3** and presented in detail in **Annexure-VII.**

TABLE-3.3.3
LAND USE PATTERN IN THE STUDY AREA (Ha)

Sr. No	Particulars of Landuse	0-3 km	3-7 km	7-10 km	0-10 km	Percentage
1	Forest Land	96.00	14.00	111.00	221.00	1.08
2	Land under Cultivation					
	a) Irrigation Land	3088.01	4308.50	7934.48	15330.99	75.18
	b) Un Irrigated Land	0.22	58.00	432.60	490.82	2.41
3	Cultivable Waste Land	67.00	189.00	216.00	472.00	2.31
4	Area not Available for Cultivation	412.00	2147.44	1317.44	3876.88	19.01
	Total Area	3663.23	6716.94	10011.51	20391.68*	100

Source: District Primary Census Hand Books-2001
**An area of 11008.32-Ha is not covered in the Census records*

- ***Forest***

The revenue forestland under the study area consists of 221 ha (1.08 %) of the total geographic area.

- ***Land under Cultivation***

Altogether 15821.81 ha (cultivable land (irrigated and un-irrigated)) was observed in the study area. The irrigated land admeasures to about 15330.99 ha in the study area which works out to be 75.18% of total study area. The un-irrigated land admeasures about 490.82 ha and works out to about 2.41% of the total study area.

- ***Cultivable Waste***

This land includes that land, which was cultivated sometime back and left vacant during the past 5 years in succession. Such lands may either be fallows or covered with shrubs, which are not put to any use. Lands under thatching grass, bamboo bushes, other grooves useful for fuel etc., and all grazing lands and village common lands are also included in this category. The study area comprises of about 472 ha (2.31%) cultivable wastelands.

- ***Land not available for Cultivation***

All the lands not included in the above categories of land uses are considered in the category of land not available for cultivation. This category of land use mainly consists of the hilly and barren lands, human settlements, roads, water-bodies, etc. About 3876.88 ha area working out to about 19.01% of the total study area falls in this category.

3.4 Soil Characteristics

It is essential to determine the potential of soil in the area and identify the current impacts of urbanization and industrialization on soil quality and also predict impacts, which may arise due to the project operations. Accordingly, a study of assessment of the baseline soil quality has been carried out.

3.4.1 Data Generation

For studying soil profile of the region, sampling locations were selected to assess the existing soil conditions in and around the project area representing various land use conditions. The physical, chemical and heavy metal concentrations were determined. The samples were collected by ramming a core-cutter into the soil up to a depth of 90 cm.

The sampling locations have been identified with the following objectives:

- To determine the baseline soil characteristics of the study area;
- To determine the impact of industrialization on soil characteristics; and
- To determine the impact on soils more importantly from agricultural productivity point of view.

Eight locations within 10 km radius of the project boundary were selected for soil sampling. At each location, soil samples were collected from three different depths viz. 30 cm, 60 cm and 90 cm below the surface and are homogenized. This is in line with IS: 2720 and Methods of Soil Analysis, Part-1, 2nd edition, 1986 of (American Society for Agronomy and Soil Science Society of America). The homogenized samples were analyzed for physical and chemical characteristics. The soil samples were collected during pre-monsoon season 2009 and post monsoon and part of winter season 2010. The samples have been analyzed as per the established scientific methods for physico-chemical parameters. The heavy metals have been analyzed by using Atomic Absorption Spectrophotometer (AAS) and Inductive Coupled Plasma (ICP).

The methodology adopted for each parameter is described in **Table-3.4.1**.

TABLE-3.4.1
ANALYTICAL TECHNIQUES FOR SOIL ANALYSIS

Parameter	Method (ASTM Number)
Grain size distribution	Sieve analysis (D 422 – 63)
Textural classification	Chart developed by Public Roads Administration
Bulk density	Sand replacement, core cutter
Sodium absorption ratio	Flame colorimetric (D 1428-82)
pH	pH meter (D 1293-84)
Electrical conductivity	Conductivity meter (D 1125-82)

Parameter	Method (ASTM Number)
Nitrogen	Kjeldahl distillation (D 3590-84)
Phosphorus	Molybdenum blue, colorimetric (D 515-82)
Potassium	Flame photometric (D 1428-82)
Copper	AAS (D 1688-84)
Iron	AAS (D 1068-84)
Zinc	AAS (D 1691-84)
Boron	Surcumin, colorimetric (D 3082-79)
Chlorides	Argentometric (D 512-81 Rev 85)

The details of the sampling locations are given in **Table-3.4.2** and are shown in **Figure-3.4.1**. The results of the analysis are presented in **Table-3.4.3** and are compared with standard soil classification given in **Table-3.4.4**.

TABLE-3.4.2
DETAILS OF SOIL SAMPLING LOCATIONS

Code No	Location	Distance w.r.t Project Site (km)	Direction w.r.t Project Site	Environmental setting
S1	Plant site	-	-	Industrial land
S2	Tanda village	4.9	NNE	Agricultural land
S3	Haldi village	4.7	E	Agricultural land
S4	Pratappur village	9.2	SE	Agricultural land
S5	Rudrapur village	6.4	S	Barren land
S6	Matkota farm	2.2	S	Agricultural land
S7	Chhantapur village	1.2	SW	Agricultural land
S8	Dineshpur village	7.6	W	Agricultural land

Source: Vimta Labs Limited

3.4.2 Baseline Soil Status

➢ **Pre-Monsoon Season-2009**

- It has been observed that the pH of the soil in the study area ranged from 6.8 to 7.5. The maximum pH value of 7.5 was observed at S7 & S4, and where as the minimum value of 6.8 was observed at S8;

- The electrical conductivity was observed to be in the range of 150 µS/cm to 259 µS/cm, with the maximum observed at S6 and the minimum observed at S8;

- The nitrogen values range between 62.1-170.2 mg/. The nitrogen content in the study area falls in less to better category;

- The phosphorus values range between 76.9 to 102.8 mg/kg, indicating that the phosphorus content in the study area falls in sufficient to more than sufficient;

- The potassium values range between 86.2–110.1 mg/kg. The potassium content in the study area falls in very less category; and

- The chlorides were found to be in the range of 39.6-88.2 mg/kg of soil.

➢ **Post monsoon and part of winter Season-2010**

- It has been observed that the pH of the soil in the study area ranged from 7.9 to 8.3. The minimum value of 7.9 was observed at S1 & S3 and where as the maximum pH value of 8.3 was observed at S6 & S7;
- The electrical conductivity was observed to be in the range of 124 µS/cm to 217 µS/cm, with the minimum observed at S4 and maximum observed at S7;
- The nitrogen values range between 215-390 mg/kg.;
- The phosphorus values range between 70.2 to 124.5 mg/kg;
- The potassium values range between 161.1–283 mg/kg.; and
- The chlorides were found to be in the range of 106-248 mg/kg of soil.

Essential elements which determine the fertility of the soil:

- pH: The soil is slightly alkaline to moderately alkaline in nature;
- Nitrogen: The nitrogen content in the study area falls in better to sufficient category;
- Phosphorus: The phosphorus content in the study area falls in sufficient to more than sufficient; and
- Potassium: The potassium content in the study area falls in less to average category.

It has been observed that the texture of soil is mostly sandy clay in the study area. The common color of the soil ranged from light brown to black. The soil from the study area indicate that medium fertility due to their NPK content.

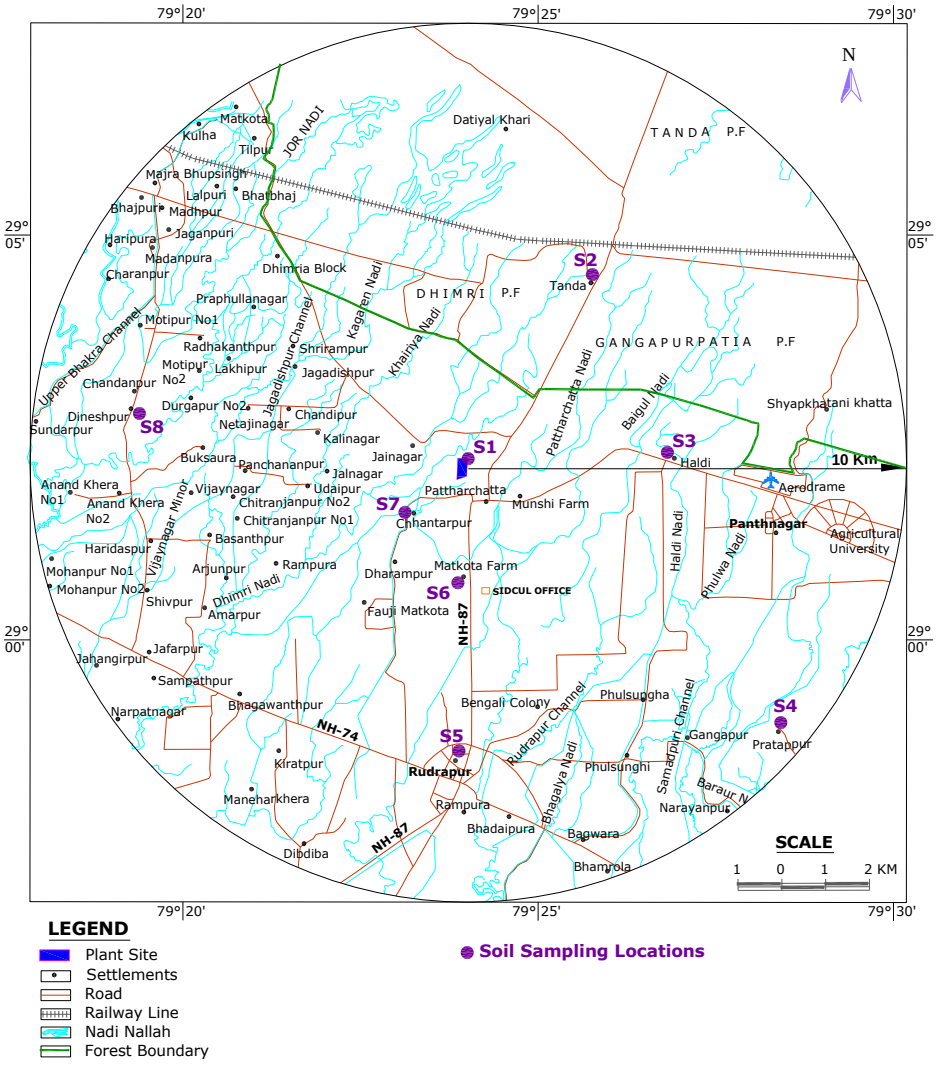


FIGURE-3.4.1
SOIL SAMPLING LOCATIONS

TABLE-3.4.3 (A)
SOIL ANALYSIS RESULTS-PRE-MONSOON SEASON-2009

Sr. No.	Parameter	UOM	S1	S2	S3	S4	S5	S6	S7	S8
1	Texture	--	Clay	Sandy clay	Clay	Clay	Clay	Clay	Clay	Sandy clay
2	Sand	%	30	15	23	16	28	15	20	35
3	Clay	%	60	67	61	72	57	65	61	54
4	Silt	%	10	18	16	12	15	20	19	11
5	Bulk Density	g/cc	1.0	1.1	1.3	1.2	1.2	1.2	1.1	0.09
6	pH(1:5 aq. extract)	--	7.1	7.1	7.3	7.5	7.2	7.3	7.5	6.8
7	Conductivity (1:5 aq.extract)	µS/cm	208	159	178	166	238	259	190	150
8	Water soluble Chlorides as Cl	mg/kg	88.2	64.9	78.6	69.5	45.8	80.0	70.6	39.6
9	Water soluble sulphates as SO4	mg/kg	34.5	22.6	38.9	60.6	38.9	50.6	52.1	98.9
10	Exchangeable Calcium as Ca	mg/kg	5940.2	4680	5329.6	654	7100.0	6595.0	4895.1	5602.1
11	Exchangeable Magnesium as Mg	mg/kg	88.9	83.5	86.2	98.2	89.0	96.5	92.5	102.6
12	Available Sodium as Na	mg/kg	52.9	66.3	78.4	84.3	68.2	54.6	49.8	64.9
13	Available Potassium as K	kg/kg	86.2	103.7	110.0	90.2	98.3	95.6	105.4	110.1
14	Available Nitrogen as N	kg/ha	170.2	88.9	92.3	98.3	68.3	62.1	132.6	130.8
15	Available Phosphorus as P	kg/ha	79.2	80.2	76.9	98.0	102.8	90.5	82.9	84.6
16	Organic Carbon	%	0.05	0.07	0.07	0.05	0.05	0.04	0.05	0.06
17	Organic Matter	%	0.09	0.12	0.13	0.09	0.08	0.07	0.08	0.10
18	Sodium Absorption Ration	--	0.08	0.08	0.12	0.13	0.08	0.13	0.09	0.07
19	Aluminium as Al	%	1.58	1.59	1.53	1.69	1.07	1.34	1.09	1.62
20	Iron as Fe	%	0.98	0.86	0.90	0.98	0.92	1.09	1.00	1.05
21	Magnesium as Mn	mg/kg	140.2	130.2	142.6	160.9	139.8	150.2	138.6	160.9
22	Boron as B	mg/kg	25.6	23.6	24.0	26.0	20.6	21.8	22.6	32.9
23	Zinc as Zn	mg/kg	188.9	82.5	79.8	82.6	102.0	98.9	82.5	78.0

Source: Vimta Labs Ltd

TABLE-3.4.3 (B)
SOIL ANALYSIS RESULTS-2010

Sr. No.	Parameter	UOM	S1	S2	S3	S4	S5	S6	S7	S8
1	pH(1:5 aq. extract)	--	7.9	8.3	8.3	8.2	8.2	7.9	7.9	8.1
2	Conductivity (1:5 aq.extract)	µS/cm	161	197	217	173	175	124	176	177
3	Texture	--	Sandy clay	Sandy clay	Sandy clay	Sandy clay	Sandy loam	Sandy clay	Sandy loam	Sandy loam
4	Sand	%	45	48	46	50	52	54	52	51
5	Silt	%	20	16	22	15	16	10	10	15
6	Clay	%	35	36	32	35	32	36	38	34
7	Bulk Density	g/cc	1.1	1.2	1.4	1.1	1.3	1.1	1.2	1.4
8	Exchangeable Calcium as Ca	mg/kg	563	716	1314	799	839	959	760	757
9	Exchangeable Magnesium as Mg	mg/kg	68	629	48	73	122	24	121	24
10	Available Sodium as Na	mg/kg	140.7	149.2	229	146	194.3	206	160.0	149.4
11	Available Potassium as K	kg/kg	207.9	234.1	283.0	208.6	161.1	211.2	232.5	265.9
12	Available Phosphorus as P	kg/ha	73.4	80.0	124.5	74.0	86.3	70.2	88.3	90.3
13	Available Nitrogen as N	kg/ha	274.5	341	390	307	215	298	354	371
14	Organic Matter	%	2.58	2.94	2.9	2.9	1.7	2.8	3.04	2.7
15	Organic Carbon	%	1.2	1.7	1.67	1.67	1.0	1.62	1.76	1.3
16	Water soluble Chlorides as Cl	mg/kg	106.2	176	248	142	177	106	177	142
17	Water soluble sulphates as SO4	mg/kg	126.2	40	210.5	138	104	151	160	156
18	Sodium Absorption Ration	--	0.69	0.52	0.76	0.6	0.74	0.80	0.64	0.65
19	Aluminium as Al	%	0.68	0.8	0.6	1.0	1.2	0.82	0.42	0.89
20	Iron as Fe	%	1.1	0.72	0.93	0.6	1.4	1.0	0.64	0.8
21	Manganese as Mn	mg/kg	188	60.6	122	110.8	241	98.6	66.8	160
22	Boron as B	mg/kg	11	13.6	12.2	17.8	18.9	14.6	12.6	10.2
23	Zinc as Zn	mg/kg	20.4	30.8	28.4	26.2	72.6	26.8	28.6	18.9
24	Lead	mg/kg	0.03	0.08	0.05	0.02	0.06	0.18	0.05	0.08
25	Nickel	mg/kg	1.0	10.6	8.5	6.2	13.0	9.8	6.2	0.8

Source: Vimta Labs Ltd

TABLE-3.4.4
STANDARD SOIL CLASSIFICATION

Sr. No.	Soil Test	Classification
1	pH	<4.5 Extremely acidic 4.51- 5.00 Very strongly acidic 5.51-6.0 moderately acidic 6.01-6.50 slightly acidic 6.51-7.30 Neutral 7.31-7.80 slightly alkaline 7.81-8.50 moderately alkaline 8.51-9.0 strongly alkaline 9.01 very strongly alkaline
2	Salinity Electrical Conductivity (ppm) (1ppm = 640 µmho/cm)	Upto 1.00 Average 1.01-2.00 harmful to germination 2.01-3.00 harmful to crops
3	Organic Carbon (%)	Upto 0.2: very less 0.21-0.4: less 0.41-0.5 medium, 0.51-0.8: on an average sufficient 0.81-1.00: sufficient >1.0 more than sufficient
4	Nitrogen (kg/ha)	Upto 50 very less 51-100 less 101-150 good 151-300 Better >300 sufficient
5	Phosphorus (kg/ha)	Upto 15 very less 16-30 less 31-50 medium, 51-65 on an average sufficient 66-80 sufficient >80 more than sufficient
6	Potassium (kg/ha)	0 -120 very less 120-180 less 181-240 medium 241-300 average 301-360 better >360 more than sufficient

Source: Hand Book of Agriculture, ICAR (Indian Council for Agricultural Research), New Delhi

3.5 Meteorology

The meteorological data recorded during the study period is very useful for proper interpretation of the baseline information regarding project area and surrounding area for air quality dispersion. Historical data on meteorological parameters will also play an important role in identifying the general meteorological regime of the region.

The year may broadly be divided into four seasons:

- Winter season : December to February
- Pre-Monsoon season : March to May
- Monsoon season : June to September
- Post-Monsoon season : October to November

On-site monitoring was undertaken for various meteorological variables in order to generate the site-specific data. Data was collected at site every half an hour continuously during 1st March 2009 to 31st May 2009, pre-monsoon season and 1st October 2010 to 31st December 2010 representing post monsoon and part of winter season. The generated data is then compared with the meteorological data generated by nearest representative India Meteorological Department (IMD) station located at Bareilly located at a distance of approximately 75 km.

3.5.1 Methodology

The meteorological parameters were recorded on half hourly basis during the study period and include parameters like wind speed, wind direction (from 0 to 360 degrees), temperature, relative humidity, atmospheric pressure, rainfall and cloud cover. The maximum, minimum and average values for all the parameters except wind speed and direction are presented in **Table-3.5.1**.

TABLE-3.5.1 (A)
SUMMARY OF METEOROLOGICAL DATA GENERATED AT SITE PRE-MONSOON SEASON-2009

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	Cloud Cover (Oktas)		Atmospheric Pressure (mb)	
	Max	Min	Max	Min		Max	Min	0830	1730
March 2009	34.3	19.2	61	35	6.2	4/8	3/2	1012.3	994.6
April 2009	38.6	21.9	49	45	2.2	3/8	0/8	1003.4	982.8
May 2009	41.2	25.1	52	51	Nil	2/8	0/8	998.6	975.5
Range	**19.2-41.2**		**35-61**		**8.4 (total)**			**975.5-1012.3**	

TABLE-3.5.1 (B)
SUMMARY OF METEOROLOGICAL DATA GENERATED
AT POST MONSOON AND PART OF WINTER SEASON SITE-2010

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	Cloud Cover (Oktas)		Atmospheric Pressure (mb)	
	Max	Min	Max	Min		Max	Min	0830	1730
October 2010	31.6	21.2	70	49	42.3	4/8	2/8	1004.2	985.0
November 2010	29.5	16.8	73	35	5.6	6/8	0/8	1011.6	995.0
December 2010	7.1	22.6	25	87	3.1	1/8	2/8	1016.3	998.0
Range	**7.1-31.6**		**25-87**		**51.0**			**985-1016.3**	

- **Wind Speed/ Wind Directions**

The site specific wind rose for the study period representing premonsoon season 2009 and post monsoon and part of winter season 2010 is shown in **Figure-3.5.1** and the data is presented in **Table-3.5.2**.

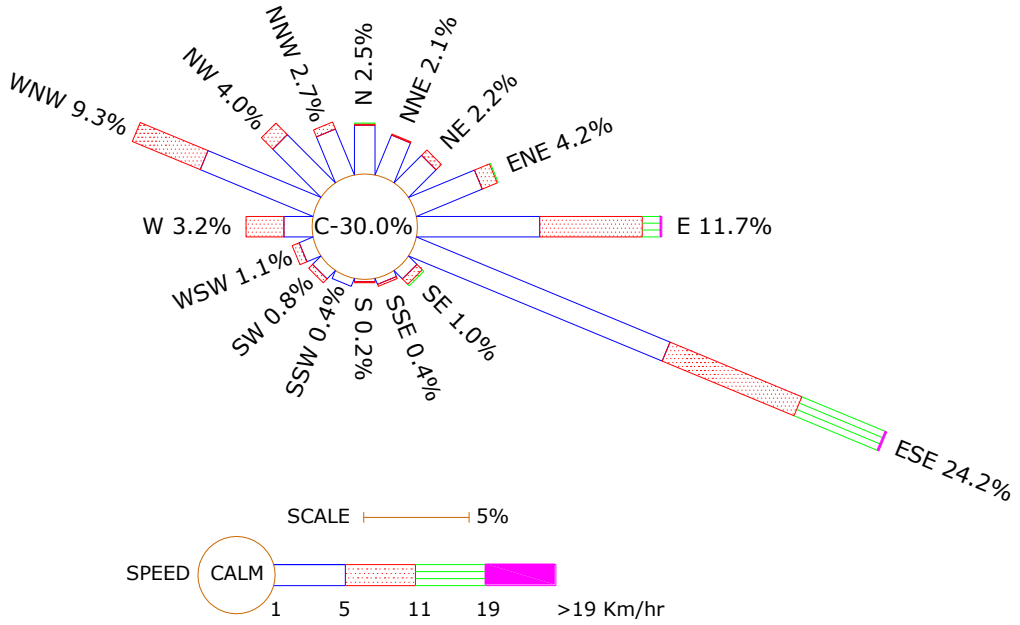

WNW 9.3%
NW 4.0%
NNW 2.7%
N 2.5%
NNE 2.1%
NE 2.2%
ENE 4.2%
W 3.2%
C-30.0%
E 11.7%
WSW 1.1%
SW 0.8%
SSW 0.4%
S 0.2%
SSE 0.4%
SE 1.0%
ESE 24.2%
SCALE
5%
SPEED
CALM
1
5
11
19
>19 Km/hr

FIGURE-3.5.1 (A)

SITE SPECIFIC WIND ROSE (PRE-MONSOON SEASON)-2009

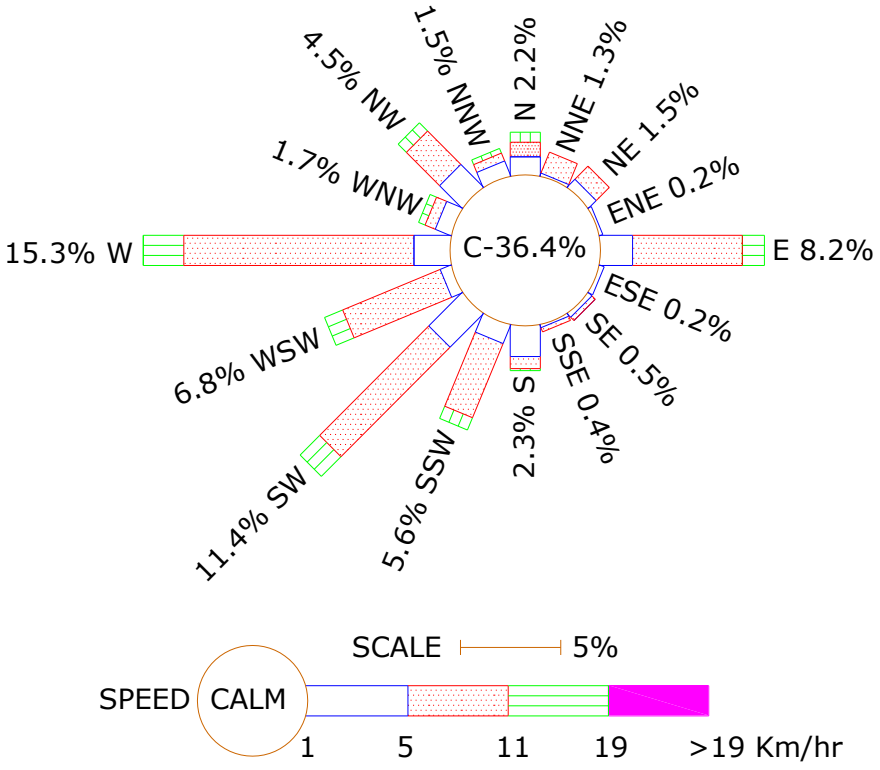


FIGURE-3.5.1 (B)
SITE SPECIFIC WIND ROSE (POST MONSOON AND PART OF WINTER SEASON) 2010

TABLE-3.5.2 (A)
SUMMARY OF WIND PATTERN AT THE STUDY AREA
PRE-MONSOON SEASON-2009

Parameters	Pre-Monsoon Season
First Predominant Wind Direction	ESE (24.2%)
Second Predominant Wind Direction	E (11.7 %)
Predominant Wind Speeds (kmph)	1.0 To 5.0 5.0 to 11.0
Calm conditions (%)	30.0 %

Note: Figures in parenthesis indicates percentage of time wind blows

TABLE-3.5.2 (B)
SUMMARY OF WIND PATTERN AT THE STUDY AREA
(P0ST-MONSOON SEASON) 2010

Parameters	Post monsoon and part of winter Season 2010
First Predominant Wind Direction	W (15.3 %)
Second Predominant Wind Direction	SW (11.4 %)
Predominant Wind Speeds (kmph)	1.0 To 5.0 5.0 to 11.0
Calm conditions (%)	36.4 %

Note: Figures in parenthesis indicates percentage of time wind blows

- **Pre-Monsoon Season-2009**

Predominant winds were observed from ESE direction for 24.2% of the total time. In the E direction winds were observed for 11.7% of the total time. Whereas for WNW direction the winds were observed for 9.3% of the total time. In other directions, the percentages frequencies were observed from N (2.5%), NE (2.2%), NNE (2.1%), ENE (4.2%), SE (1.0%), SSE (0.4%), S (0.2%), SSW (0.4%), SW (0.8%), WSW (1.1%), W (3.2%), NW (4.0%), and NNW (2.7%). The calm conditions prevailed for 30.0% of time.

- **Post monsoon and part of winter Season 2010**

Predominant winds were observed from west direction for 15.3 % of the total time. In the Southwest direction winds were observed for 11.4 % of the total time. Whereas for WSW direction the winds were observed for 6.8% of the total time. In other directions, the percentages frequencies were observed from N (2.2%), NNE (1.3%), NE (1.5%), ENE (0.2%), E (8.2%), ESE (0.2%), SE (0.5%), SSE (0.4%), S (2.3%), SSW (5.6%), WNW (1.7%), NW (4.5%) and NNW (1.5%). The calm conditions prevailed for 36.4 % of time.

3.5.2 Secondary Data Collected from IMD-Bareilly

Secondary data from IMD-Bareilly has been collected for atmospheric pressure, temperature, relative humidity, rainfall, wind speed and direction and is presented in **Table-3.5.3** & **Table-3.5.4**. The data at IMD is usually measured twice a day viz., at 0830 and 1730 hr. The meteorological data (except the wind roses which are for the years 1990-2000) presented are average of IMD, Bareilly station data for the period ranging from 1951-1980.

Generally, light to moderate winds prevail throughout the year. Winds were light and moderate particularly during the morning hours. While during the afternoon hours the winds were stronger. The seasonal and annual wind roses of IMD, Bareilly are shown in **Figure-3.5.2 (A), Figure-3.5.2 (B), & Figure-3.5.2 (C)** respectively.

TABLE-3.5.3
CLIMATOLOGICAL DATA GENERATED AT IMD BAREILLY

Month	Atmospheric Pressure (mb)		Temperature (^{0}C)		Relative Humidity (%)		Rainfall (mm)
	0830	1730	Max	Min	0830	1730	Monthly Total
January	1017.1	996.5	21.4	9.9	86	22	34.8
February	1014.5	994.3	28.7	13.8	76	30	20.1
March	1010.8	990.9	33.7	18.3	66	37	12.7
April	1005.2	986.1	39.5	23.5	42	50	10.6
May	1001.8	982.8	40.7	26.4	53	54	27.9
June	998.1	979.3	37.4	26.1	62	58	133.1
July	998.3	979.1	33.2	24.9	81	56	292.4
August	998.9	979.9	32.1	24.4	76	58	281.8
September	1004.4	985.2	32.4	23.6	80	54	159.5
October	1005.4	986.0	32.4	20.9	69	47	74.0
November	1013.8	993.9	29.6	16.5	72	38	9.1
December	1017.6	997.2	26.5	12.4	86	24	2.1
							Total-1058.1

TABLE-3.5.4
SUMMARY OF WIND PATTERN-IMD BAREILLY

Season	First Predominant Winds		Second Predominant Winds		Calm Condition		Predominant Wind Speed (kmph)
	0830	1730	0830	1730	0830	1730	
Pre-Monsoon	W (29.0%)	W (45.6%)	E (14.2%)	NW (15.3%)	34.7%	20.3%	1 to 5 5 to 11
Monsoon	E (29.3%)	W (19.8%)	W (12.8%)	E (17.9%)	36.5%	39.5%	1 to 5 5 to 11
Post Monsoon	W (14.0%)	W (12.0%)	E (7.5%)	E (4.0%)	70.0%	78.5%	1 to 5 5 to 11
Winter	W (26.4%)	W (31.3%)	NW (8.0%)	E (5.8%)	54.3%	53.3%	1 to 5 5 to 11
Annual	W (20.6%)	W (27.2%)	E (14.0%)	E (8.5%)	48.9%	47.9%	1 to 5 5 to 11

Note: Figures in parenthesis indicates % of time wind blows

3.5.3 Comparison of Primary and Secondary Data

The India Meteorological Department (IMD) records the meteorological data twice a day viz. 0830 hr and 1730 hr while the site specific data has been recorded continuously at half hourly intervals. On comparison of site specific data generated for study period vis-à-vis the IMD data, slight variations were observed. The following observations are brought out:

➢ **Post monsoon and part of winter Season 2010**

- The temperature recorded onsite when compared vis-à-vis the IMD data, slight variations were found. The minimum and maximum temperatures recorded at site during study period were 7.1°C and 31.6°C whereas the maximum and minimum temperature recorded at IMD, Bareilly for the same period are 16.5 °C and 32.4°C respectively during the same period;

- The relative humidity was observed to range between 25% to 87% during the study period whereas according to IMD, Bareilly data the relative humidity was observed to range between 38% to 72%.The variation could be because of the fact that RH values considered for the site are actual values recorded continuously; while the IMD, Bareilly data represents data collected only twice a day.

- The predominant wind directions from post monsoon wind rose of IMD Bareilly was observed in West direction with secondary predominant wind direction as East. The first and second predominant wind directions observed during the post monsoon and part of winter season 2010 (during study period) were West (15.3%) and Southwest (11.4%) with prevailing calm conditions 36.4%.

- The data generated at continuous monitoring station at project site when compared with the data recorded at IMD, it can be observed that the data generated at the site is broadly compatible with regional meteorology, except minor variations as described above. However the data cannot be compared on one to one basis as the stations (IMD and Site) are 75 km away and there is site elevation difference of 50 m between the two sites. Moreover, the site topography is a hilly area when compared to the IMD station which is plain.

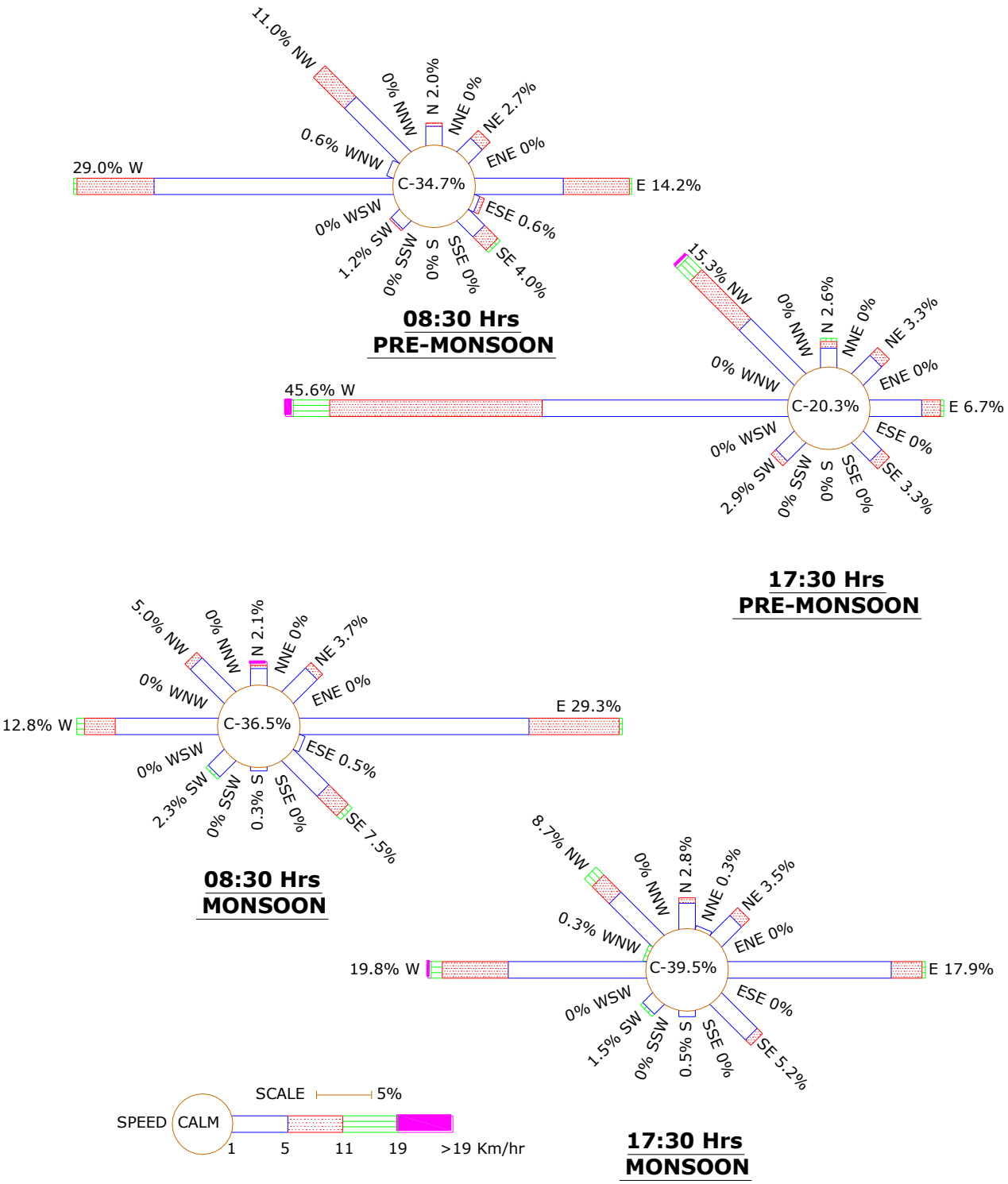
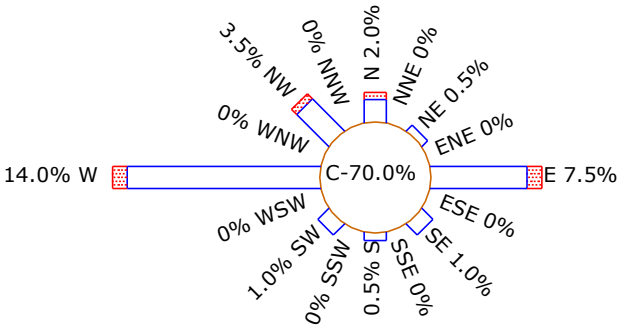
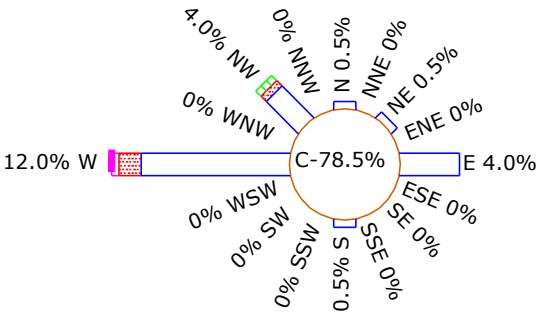


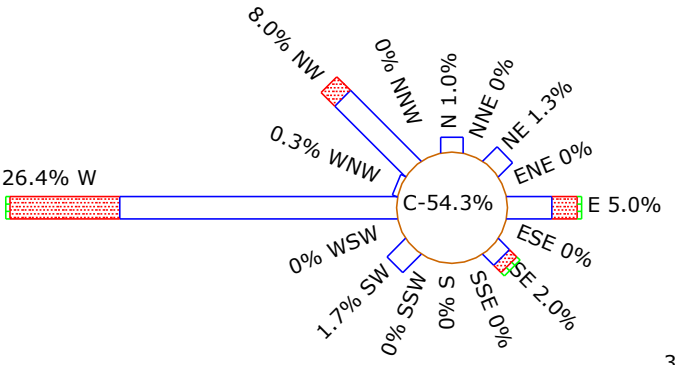
FIGURE-3.5.2(A)
WIND ROSE-PRE-MONSOON & MONSOON (IMD- BAREILLY)



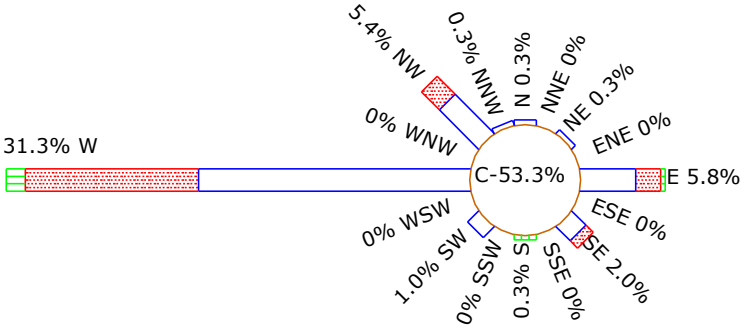
08:30 Hrs
POST- MONSOON



17:30 Hrs
POST- MONSOON



08:30 Hrs
WINTER



17:30 Hrs
WINTER

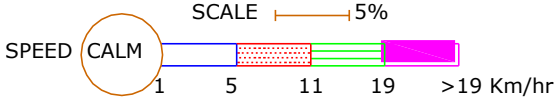
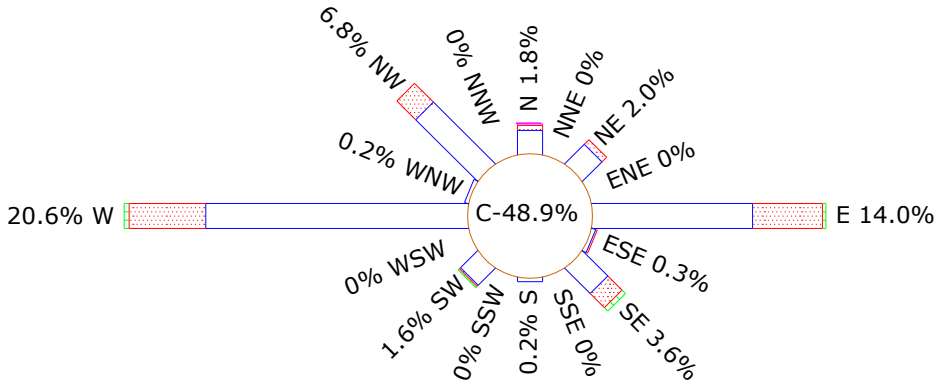
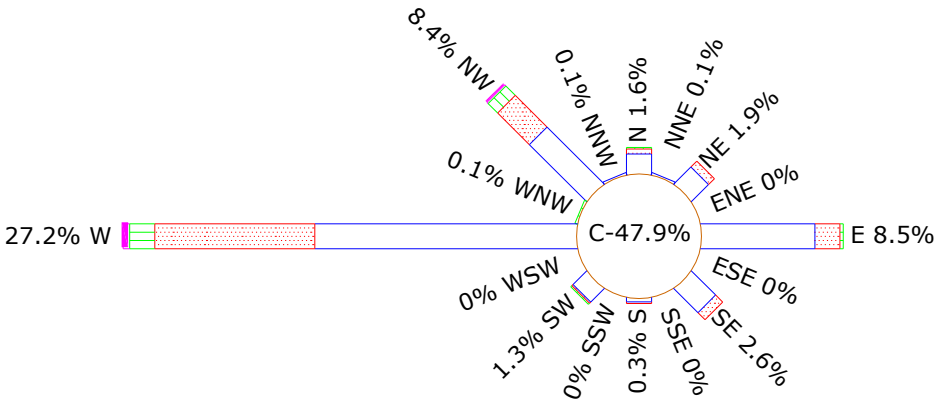


FIGURE-3.5.2(B)
WIND ROSE-POST MONSOON & WINTER (IMD- BAREILLY)



08:30 Hrs
ANNUAL



17:30 Hrs
ANNUAL

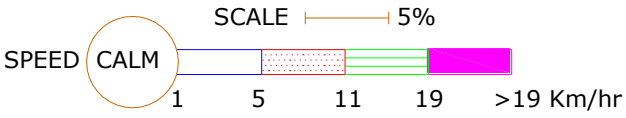


FIGURE-3.5.2(C)
WIND ROSE-ANNUAL (IMD- BAREILLY)

3.6 Ambient Air Quality

The prime objective of the baseline air monitoring was 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 silver refinery and melting and casting opeerations.

The ambient air quality was monitored at nine locations in and around the project site. The results of ambient air quality are presented in **Annexure-VIII.**

3.6.1 Methodology adopted for Air Quality Survey

- ***Selection of Sampling Locations***

The baseline status of the air quality in the study area has been assessed through a scientifically designed ambient air quality monitoring network. The design of monitoring network in the air quality surveillance program has been based on the following considerations:

- Meteorological conditions on synoptic scale;
- The methodology for conducting the baseline environmental survey and selection of sampling locations considered the guidelines given in the EIA manual 2006 of the MoEF;
- Topography of the study area;
- Representatives of regional background air quality for obtaining baseline status; and
- Representatives of likely impact areas.

Ambient Air Quality Monitoring (AAQM) stations were set up at nine locations with due consideration to the above mentioned points. **Table-3.6.1** gives the details of environmental setting around each monitoring station and their distances with reference to the proposed project. The AAQM locations are shown in **Figure–3.6.1.**

TABLE-3.6.1
DETAILS OF AMBIENT AIR QUALITY MONITORING LOCATIONS
PRE-MONSOON SEASON-2009

Location Code	Location	Distance (km)	Direction	Environmental Setting	Name of the House owner (Instrument installed)
AAQ1	Plant site	--	--	Industrial	-
AAQ2	Jainagar village*	1.1	WNW	Residential	Mr. Gopal
AAQ3	Jalnagar village	3.0	W	Residential	Mr. Krishna
AAQ4	Chhantarpur village	1.6	SW	Residential	Mr. T.V. Arora
AAQ5	Rudrapur village	6.5	S	Commercial	Mr. Rahul Singh
AAQ6	Munshi Farm	1.1	ESE	Residential	Mr. Amar Singh
AAQ7	Haldi village	4.7	E	Residential	Mr. Ajay Singh
AAQ8	Tanda village	5.1	NNE	Residential	Mr. Kapil
AAQ9	Agricultural University*	8.3	ESE	Sensitive	-
AAQ9A	Chitranjanpur village**	5.1	WSW	Residential zone	Mr. Bankim Sarkar
AAQ9B	Pratappur village**	9.2	SE	Residential zone	Mr. Pramod Kumar

* Not monitored during post monsoon season
** Monitored during post monsoon season only

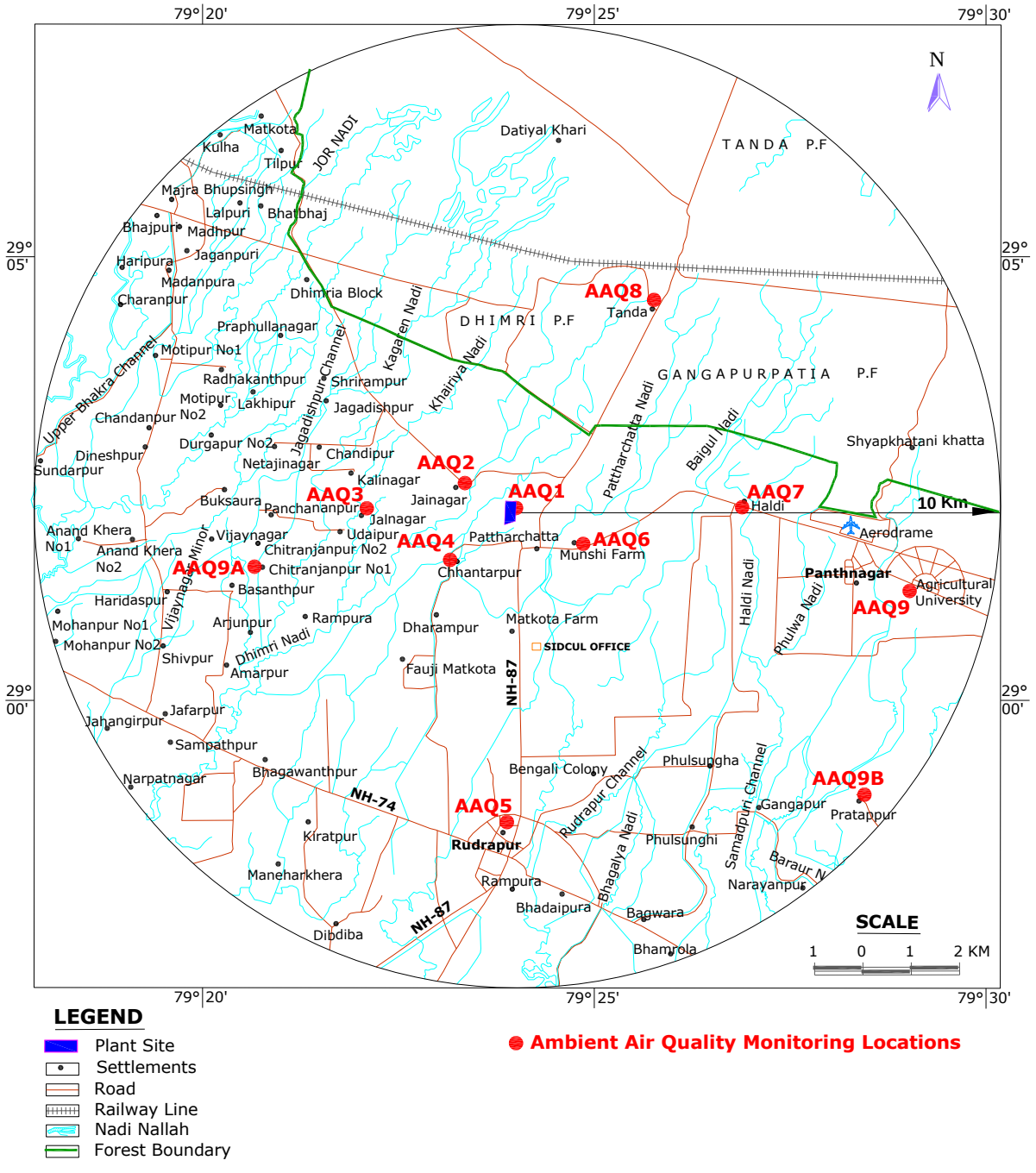


FIGURE-3.6.1
AMBIENT AIR QUALITY SAMPLING LOCATIONS

3.6.2 Frequency and Parameters for Sampling

Ambient air quality monitoring has been carried out with a frequency of two days per week at nine locations during study period. The ambient air quality parameters along with their frequency of sampling are given in **Table-3.6.2**.

TABLE-3.6.2
MONITORED PARAMETERS AND FREQUENCY OF SAMPLING

Parameters	Sampling Frequency
$PM_{2.5}$	24 hourly sample twice a week for one season
PM_{10}	24 hourly sample twice a week for one season
Sulphur dioxide (SO_2)	24 hourly samples twice a week for one season
Oxides of Nitrogen (NO_X)	24 hourly samples twice a week for one season
Carbon monoxide (CO)	Three 8 hourly samples in a day; twice a week for one season
Heavy metals	24 hourly samples twice a week for one season
Polyaromatic Hydrocarbons (PAH)	24 hourly samples twice a week for one season

The sampling duration for $PM_{2.5}$, PM_{10}, Heavy Metals, SO_2 and NOx is twenty four hourly continuous samples per day and CO is sampled for 8 hours continuously thrice a day. This is to allow a comparison with the present revised standards mentioned in the latest Gazette notification of the Central Pollution Control Board (CPCB) (November 16, 2009).

Dustfall was measured using dustfall jars. The dustfall jar was installed at nine AAQ locations for one month during AAQ monitoring. The jar was filled with 2.5 litre of water. The water in the jar was mixed with copper sulphate solution (0.02 N solution) to prevent any growth of algae. A funnel was attached to the top of the jar on which dust falls and slides into the jar. The water level in the jar is constantly maintained in such way that the 2.5-liter of water is retained. After one month the water was analyzed for total un-dissolved matter, ash, total dissolved matter and total solids to arrive at dust fall concentration. Dustfall in 1 m^2 area was calculated by using following formula:

$$Factor = \frac{127.3 \times 10^4}{d^2}$$

where d = top diameter of funnel in meter.

The factor is multiplied to the mg of dust collected to get the dust deposition in $mg/m^2/day$.

3.6.3 Instruments used for Sampling

Respirable dust samplers (RDS) have been used for monitoring of Particulate Matter ($PM_{2.5}$ & PM_{10}) and gaseous pollutants like SO_2, NOx and CO. Solvent extraction of the respirable dust samples followed by HPLC/Gas Chromatography techniques have been used for the estimation of benzene soluble Poly Aromatic Hydrocarbons (PAH).

3.6.4 Sampling and Analytical Techniques

$PM_{2.5}$ and PM_{10} have been estimated by gravimetric method. Modified West and Gaeke method (IS-5182 Part-II, 1969) has been adopted for estimation of SO_2. Jacobs-Hochheiser method (IS-5182 Part-IV, 1975) has been adopted for the estimation of NOx. The techniques used for ambient air quality monitoring and its minimum detectable levels are given in **Table-3.6.3**.

TABLE-3.6.3
TECHNIQUES USED FOR AMBIENT AIR QUALITY MONITORING

Sr. No.	Parameter	Technique	Technical Protocol	Minimum Detectable Limit ($\mu g/m^3$)
1	Particulate Matter ($PM_{2.5}$)	Respirable Dust Sampler (Gravimetric method)	IS-5182 (Part-IV)	1.0
2	Particulate Matter (PM_{10})	Respirable Dust Sampler (Gravimetric method)	IS-5182 (Part-IV)	1.0
3	Heavy metals	Respirable Dust Sampler (Spectroscopic method)	IS-5182 (Part-IV)	0.01
4	Polyaromatic Hydrocarbons	Respirable Dust Sampler (Gas chromatography)	IS-5182 (Part-IV)	0.1 (ng/m^3)
5	Sulphur Dioxide	Improved West and Gaeke	IS-5182 (Part-II)	4.0
6	Nitrogen Oxide	Modified Jacob & Hochheiser	IS-5182 (Part-VI)	4.0
7	Carbon monoxide	FID technique (Gas chromatography)	IS-5182(Part-X)	12.5

Source: Vimta Labs Limited and Bureau of Indian standards

3.6.5 Presentation of Results

Various statistical parameters like 98th percentile, average, maximum and minimum values have been computed from the observed raw data for all the AAQ monitoring stations.

The summary of these results for all the locations is presented in **Table-3.6.4.** These are compared with the National Ambient Air Quality Emission Standards issued by the Ministry vide G.S.R. No. 826(E) dated 16th November, 2009.

TABLE- 3.6.4 (A)
SUMMARY OF AMBIENT AIR QUALITY RESULTS- PRE-MONSOON SEASON-2009

Location	TSPM (µg/m³)				RPM (µg/m³)				SO_2 (µg/m³)				NO_X (µg/m³)				CO (µg/m³)			
	Max	Min	Avg	98%	Max	Min	Avg	98%	Max	Min	Avg	98%	Max	Min	Avg	98%	Max	Min	Avg	98%
Plant site (AAQ1)	93.6	65.8	81.8	92.5	27.2	16.8	21.7	26.4	7.8	5.2	6.6	7.8	8.7	6.1	7.6	8.7	232	154	204	231
Jainagar (AAQ2)	108.7	75.1	95.0	108.3	28.8	19.5	23.1	28.1	8.5	6.1	7.2	8.5	9.2	6.6	7.7	9.1	263	176	225	262
Jalnagar (AAQ3)	110.5	75.2	94.8	109.5	29.8	19.4	24.5	29.0	9.1	6.4	7.9	9.0	9.8	7.3	8.9	9.8	278	184	223	258
Chhantarpur (AAQ4)	103.3	71.2	90.5	102.4	26.5	19.2	23.7	26.5	8.3	6.5	7.4	8.3	9.3	6.5	7.8	9.2	267	175	222	263
Rudrapur (AAQ5)	121.2	78.6	102.1	120.5	34.7	21.6	27.4	33.7	9.4	6.2	7.7	9.3	9.9	6.3	8.2	9.8	311	210	259	300
Munshi farm (AAQ6)	100.4	68.2	84.9	98.8	25.5	18.1	22.1	25.4	8.2	5.8	7.3	8.2	8.9	6.2	7.9	8.8	245	165	199	232
Haldi (AAQ7)	112.3	72.1	97.0	111.6	31.8	20.3	26.2	30.7	8.4	6.3	7.4	8.4	9.8	7.2	8.5	9.8	298	179	256	294
Tanda (AAQ8)	114.5	79.7	98.9	114.2	29.6	18.2	25.4	29.6	8.7	5.9	7.3	8.6	9.6	6.9	8.4	9.6	266	177	229	265
Agricultural university	102.8	73.9	90.2	102.3	26.4	18.7	22.8	26.4	8.4	6.5	7.4	8.4	9.4	6.9	8.2	9.4	228	157	198	227
Range	**65.8-121.2**				**16.8-34.7**				**5.2-9.4**				**6.1-9.9**				**154-311**			

TABLE- 3.6.4 (B)
SUMMARY OF AMBIENT AIR QUALITY RESULTS- POST MONSOON AND PART OF WINTER SEASON-2010

Station Code	Location	$PM_{2.5}$ (µg/m³)				PM_{10} (µg/m³)				SO_2 (µg/m³)				NO_X (µg/m³)				CO (µg/m³)			
		Max	Min	Avg	98%	Max	Min	Avg	98%	Max	Min	Avg	98%	Max	Min	Avg	98%	Max	Min	Avg	98%
AAQ1	Plant site	6.8	5.4	6.1	5.9	25.6	18.5	22.8	22.0	8.9	6.8	7.9	7.7	9.1	7.1	8.2	8.0	369	171	257	247
AAQ3	Jalnagar village	7.2	4.7	6.2	6.0	28.6	21.4	25.3	24.8	7.9	6.1	7.0	6.9	8.8	6.8	7.7	7.5	385	275	317	311
AAQ4	Chantrapur village	8.3	5.3	6.9	6.5	30.2	22.6	26.7	26.0	8.9	6.9	8.1	7.9	9.9	7.3	8.5	8.3	362	245	303	294
AAQ5	Rudrapur village	10.8	6.3	7.9	7.6	45.3	30.1	37.4	35.7	12.4	9.6	11.2	11.0	13.8	10.2	11.9	11.7	369	205	276	268
AAQ6	Munshi Farm village	8.7	7.1	7.9	7.6	24.7	19.5	22.2	21.5	9.1	6.6	7.8	7.5	9.9	7.2	8.2	8.0	395	223	285	277
AAQ7	Haldi village	8.3	5.8	6.9	6.7	31.2	21.8	25.7	25.2	8.7	7.3	8.0	7.8	9.5	7.6	8.4	8.2	389	255	302	383
AAQ8	Tanda village	6.7	4.9	5.6	5.5	29.9	18.1	24.7	23.4	8.5	6.3	7.5	7.2	9.3	6.9	8.0	7.7	367	233	284	277
AAQ9A	Chitranjanpur village	6.6	5.2	5.9	5.6	28.4	16.2	21.6	20.5	9.2	6.1	7.2	7.9	9.5	7.2	8.2	7.9	375	225	323	313
AAQ9B	Pratappur village	6.8	5.1	5.9	5.7	31.6	15.7	21.9	21.2	8.6	6.2	7.4	7.2	9.8	6.8	8.3	8.1	371	269	317	310
	Range	**4.7-10.8**				**15.7-45.3**				**6.1-12.4**				**6.8-13.8**				**171-395**			

TABLE-3.6.4 (C)
SUMMARY OF AMBIENT AIR QUALITY RESULTS- POST MONSOON AND PART OF WINTER SEASON-2010

Sr. No.	Location	Lead (µg/m³)		Zinc (µg/m³)		Cadmium (µg/m³)		PAH (ng/m³)	
		Max	Min	Max	Max	Min	Min	Max	Min
AAQ1	Plant site	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
AAQ3	Jalnagar village	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
AAQ4	Chantrapur village	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
AAQ5	Rudrapur village	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
AAQ6	Munshi Farm village	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
AAQ7	Haldi village	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
AAQ8	Tanda village	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
AAQ9A	Chitranjanpur village	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
AAQ9B	Pratappur village	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Range	**<0.1**		**<0.1**		**<0.1**		**<0.1**	

Pollutant	NAAQ/CPCB Standards in Ambient Air (µg/m³), 2009 (24 hours)	
	Industrial, Residential, Rural and other Area	Ecologically Sensitive Area (notified by Central Government)
Sulphur dioxide (SO_2)	80	80
Oxides of Nitrogen (NOx)	80	80
Particulate Matter (Size less than 10µm) or PM_{10} µg/m³	100	100
Particulate Matter (Size less than 10µm) or PM2.5 µg/m³	60	60
Lead (Pb)	1.0	1.0
Carbon monoxide (CO) (8 hours)	2.0 mg/m³	2.0 mg/m³
Benzo(α) Pyrene (BaP)- particulate phase only ng/m³ (Annual)	01 ng/m³	01 ng/m³

TABLE-3.6.4 (D)
SUMMARY OF DUSTFALL CONCENTRATION- PRE-MONSOON SEASON-2009

Sr. No.	Location	Dust fall Concentration (mg/m^2/day)
1	Plant site (AAQ1)	88
2	Jainagar (AAQ2)	125
3	Jalnagar (AAQ3)	114
4	Chhantarpur (AAQ4)	108
5	Rudrapur (AAQ5)	130
6	Munshi farm (AAQ6)	118
7	Haldi (AAQ7)	99
8	Tanda (AAQ8)	95
9	Agricultural university	91
	Range	**88-130**

TABLE-3.6.4 (E)
SUMMARY OF DUSTFALL CONCENTRATION- POST MONSOON AND PART OF WINTER SEASON-2010

Sr. No.	Location	Dust fall Concentration (mg/m^2/day)
1	Plant site	92
3	Jalnagar village	75
4	Chantrapur village	86
5	Rudrapur village	105
6	Munshi Farm	95
7	Haldi village	89
8	Tanda village	81
9A	Pratappur village	94
9B	Chitranjanpur village	84
	Range	**75-105**

The characterization of RSPM is given in **Table-3.6.4 (F)**.

TABLE-3.6.4 (F)
RSPM CHARACTERIZATION- POST MONSOON AND PART OF WINTER SEASON-2010

Sr. No.	Parameter	Composition (%)
1	Silica	0.6
2	Aluminium	1.4
3	Calcium	9.8
4	Sodium	29.6
5	Potassium	11.1
6	Lead	0.2
7	Zinc	4.2
8	Vanadium	0.1
9	Iron	0.3
10	Manganese	0.4
11	Carbon	35.2
12	Sulphur	0.8
13	Nitrogen	0.2
14	Chloride	4.9
15	Phosphorus	1.2

3.6.6 Observations of the Results

The observations based on a perusal of the results (**Table-3.6.4)** are summarized. These are compared with the standards prescribed by MoEF and Central Pollution Control Board (CPCB).

- **Pre-Monsoon Season-2009**

TSPM: A minimum value of 65.8 μg/m^3 was observed at plant site (AAQ1) and maximum value of 121.2 μg/m^3 was observed at Rudrapur (AAQ5). The maximum value at Rudrapur junction was due to NH-87 and NH-74 passing through the village. Observed values are well with in the NAAQ specified standards.

RPM: The minimum value 16.8 μg/m^3 for RPM was observed at plant site (AAQ1) and maximum value of 34.7 μg/m^3 was observed at Rudrapur (AAQ5). The maximum value at Rudrapur junction was due to traffic density of NH-87 and NH-74. Observed values are well with in the NAAQ specified standards.

SO_2: Minimum concentration of SO_2 is observed to be 5.2 μg/m^3 at plant site (AAQ1) and maximum value of 9.4 μg/m^3 was recorded at Rudrapur (AAQ5). Observed values are well with in the NAAQ specified standards.

NO_X: Minimum concentration of NO_x is observed to be 6.1 μg/m^3 at plant site (AAQ1) and maximum value of 9.9 μg/m^3 was observed at Rudrapur (AAQ5). Observed values are well with in the NAAQ specified standards.

CO: The CO concentrations in the region are observed to be well under the limits of 2000 μg/m^3 NAAQ specified by standards.

Dust Fall

The maximum rate of dust fall concentration at the monitored locations was recorded as 130 mg/m^2/day and the minimum was recorded as 88 mg/m^2/day.

- **Post monsoon and part of winter Season-2010**

$PM_{2.5}$: A minimum value of 4.7 μg/m^3 was observed at Jalnagar village (AAQ3) and maximum value of 10.8 μg/m^3 was observed at Rudrapur (AAQ5). The maximum value at Rudrapur junction was due to NH-87 and NH-74. Observed values are well with in the NAAQ specified standards.

PM_{10}: The minimum value 15.7 μg/m^3 for RPM was observed at Pratappur village (AAQ9B) and maximum value of 45.3 μg/m^3 was observed at Rudrapur (AAQ5). The maximum value at Rudrapur junction was due to traffic density of NH-87 and NH-74. Observed values are well with in the NAAQ specified standards.

SO_2: Minimum concentration of SO_2 is observed to be 6.1 μg/m^3 at Chitranjanpur village (AAQ9A) and Jalnagar village (AAQ3) and maximum value of 12.4 μg/m^3 was recorded at Rudrapur (AAQ5). Observed values are well with in the NAAQ specified standards.

NO_X: Minimum concentration of NO_x is observed to be 6.8 μg/m^3 at Jalnagar village (AAQ3) and Pratappur village (AAQ9B) and maximum value of 13.8 μg/m^3 was observed at Rudrapur (AAQ5). Observed values are well with in the NAAQ specified standards.

CO: The CO concentrations in the region are observed to be well under the limits of 2000 μg/m^3 specified standards.

Heavy Metals

Heavy metals measured in ambient air are below detectable limits.

PAH

The suspended particulate matter present in the ambient air was analyzed for the presence of poly-aromatic hydrocarbons (PAH) and were found to be below detectable limits.

Dust Fall

The minimum rate of dust fall concentration at the monitored locations was recorded as 75 mg/m^2/day and the minimum was recorded as 105 mg/m^2/day.

3.7 Water Quality

Selected water quality parameters of ground water and surface water resources within 10 km radius of the study area have been studied for assessing the hydrological environment to evaluate anticipated impact of proposed project. Understanding the water quality is essential in the preparation of Environment Management Plan. It also assists to identify critical issues in a view to suggest appropriate mitigation measures for implementation to curb the deterioration of various hydrological sources in the vicinity of the project site.

The purpose of this study is to:

- Assess the water quality characteristics for critical parameters;
- Evaluate the impacts on agricultural productivity, habitat conditions, recreational resources and aesthetics in the vicinity; and
- Predict the likely impacts on water quality due to the project and related activities.

3.7.1 Methodology

Reconnaissance survey was undertaken and monitoring locations were finalized based on:

- Drainage pattern;
- Location of residential areas representing different activities/likely impact areas; and
- Likely areas, which can represent baseline conditions.

Six surface water samples and four ground water samples (Pre-Monsoon Season-2009) and eight surface water samples and eight ground water samples (Post monsoon and part of winter Season-2010) were examined for physico-chemical, heavy metals and bacteriological parameters in order to assess the effect of industrial and other activities on surface and ground water. The samples were analyzed as per the procedures specified in 'Standard Methods for the Examination of Water and Wastewater' published by American Public Health Association (APHA).

Samples for chemical analysis were collected in polyethylene carboys. Samples collected for metal content were acidified with 1 ml HNO_3. Samples for bacteriological analysis were collected in sterilized glass bottles. Selected physico-chemical and bacteriological parameters have been analyzed for projecting the existing water quality status in the study area. Parameters like Dissolved Oxygen (DO) and pH were analyzed onsite.

3.7.2 Water Sampling Locations

Eight surface water and eight ground water samples were collected as grab samples and were analyzed for various parameters. The analyzed results were compared with the standards for drinking water as per IS: 10500 (the standard prescribes the requirements for the essential and desirable characteristics required to be tested for ascertaining the suitability of water for drinking purpose). The water sampling locations are listed below in **Table-3.7.1** and are shown in **Figure-3.7.1**.

TABLE-3.7.1(A)
DETAILS OF WATER SAMPLING LOCATIONS-PRE-MONSOON SEASON-2009

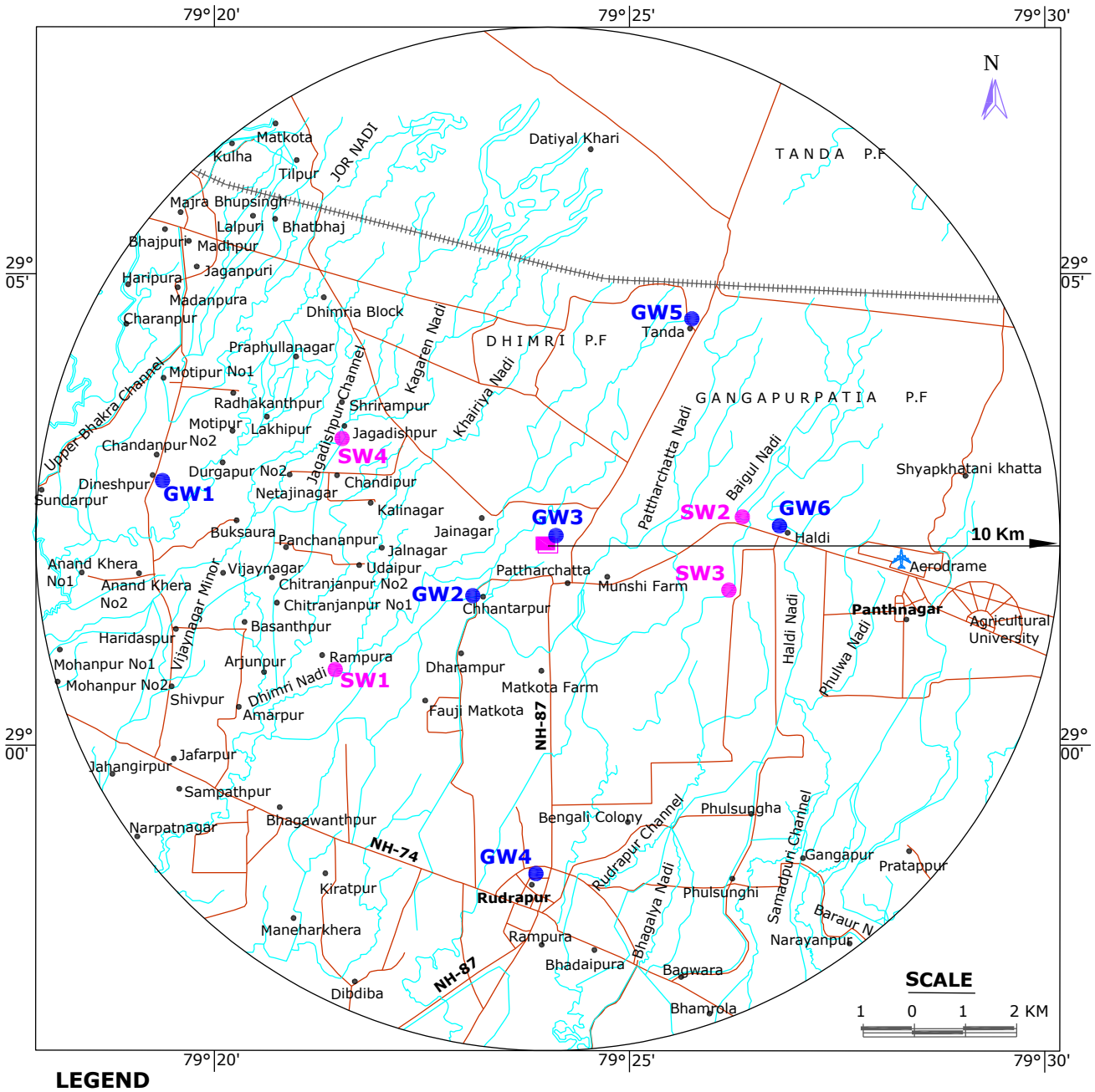
Location Code	Locations	Source	Distance (km)	Direction
Ground Water				
GW1	Dineshpur	Bore well	7.8	WNW
GW2	Chhantarpur	Open well	1.6	SW
GW3	Plant site	Open well	--	-
GW4	Rudrapur	Bore well	6.5	S
GW5	Tanda	Hand pump	5.1	NNE
GW6	Haldi	Open well	4.7	E
Surface Water				
SW1	Dhimri nadi near Rampura village	-	4.7	SW
SW2	Baigul nadi upstream Haldi village	-	3.9	E
SW3	Baigul nadi downstream Munshi farm	-	3.6	ESE
SW4	Jagadishpur channel near Jagadishpur village	-	4.5	NW

TABLE-3.7.1(B)
DETAILS OF WATER SAMPLING LOCATIONS- POST MONSOON AND PART OF WINTER SEASON-2010

Location Code	Locations	Source	Distance (km)	Direction
Ground Water				
GW1	Jainagar village	Handpump	1.1	WNW
GW2	Tanda village	Handpump	4.9	NNE
GW3	Haldi village	Handpump	4.7	E
GW4	Rudrapur village	Handpump	3.4	S
GW5	Pattarchata village (Plant site)	Handpump	2.2	S
GW6	Chantrapur village	Handpump	1.2	SW
GW7	Chitaanjanpur village	Handpump	5.1	WSW
GW8	Dineshpur village	Handpump	7.6	W
Surface Water				
SW1	Patharabhatta nadi	Fresh water	1.4	E
SW2	Baigulladi canal	Fresh water	3.9	E
SW3	Munshi farm (Haldi nadi)	Fresh water	3.7	ESE
SW4	Rudrapur (Bengali colony)	Fresh water	6.0	
SW5	Dhimri nadi near Rampura village	Fresh water	4.4	SW
SW6	Khairiya nadi	Fresh water	3.0	W
SW7	Jagdishpur canal	Fresh water	4.2	NW
SW8	Motipur (Upper Bhakra canal)	Fresh water	7.8	

3.7.3 Presentation of Results

Six surface water samples and four ground water samples (Pre-Monsoon Season-2009) and Eight surface water samples and eight ground water samples (Post monsoon and part of winter Season-2010) have been considered around the project within the periphery of 10 km taking in to account the various uses, these water resources are put to uses like drinking, bathing, washing clothes etc, and hydraulic gradient prevalent in the area. The results of ground water samples are presented in **Table-3.7.2.** The results of surface water samples are presented in **Table-3.7.3**.



LEGEND

- Plant Site
- Settlements
- Road
- Railway Line
- Nadi Nallah

- **Ground Water Sampling Locations**
- **Surface Water Sampling Locations**

FIGURE-3.7.1 (A)

WATER SAMPLING LOCATIONS- PRE-MONSOON SEASON-2009

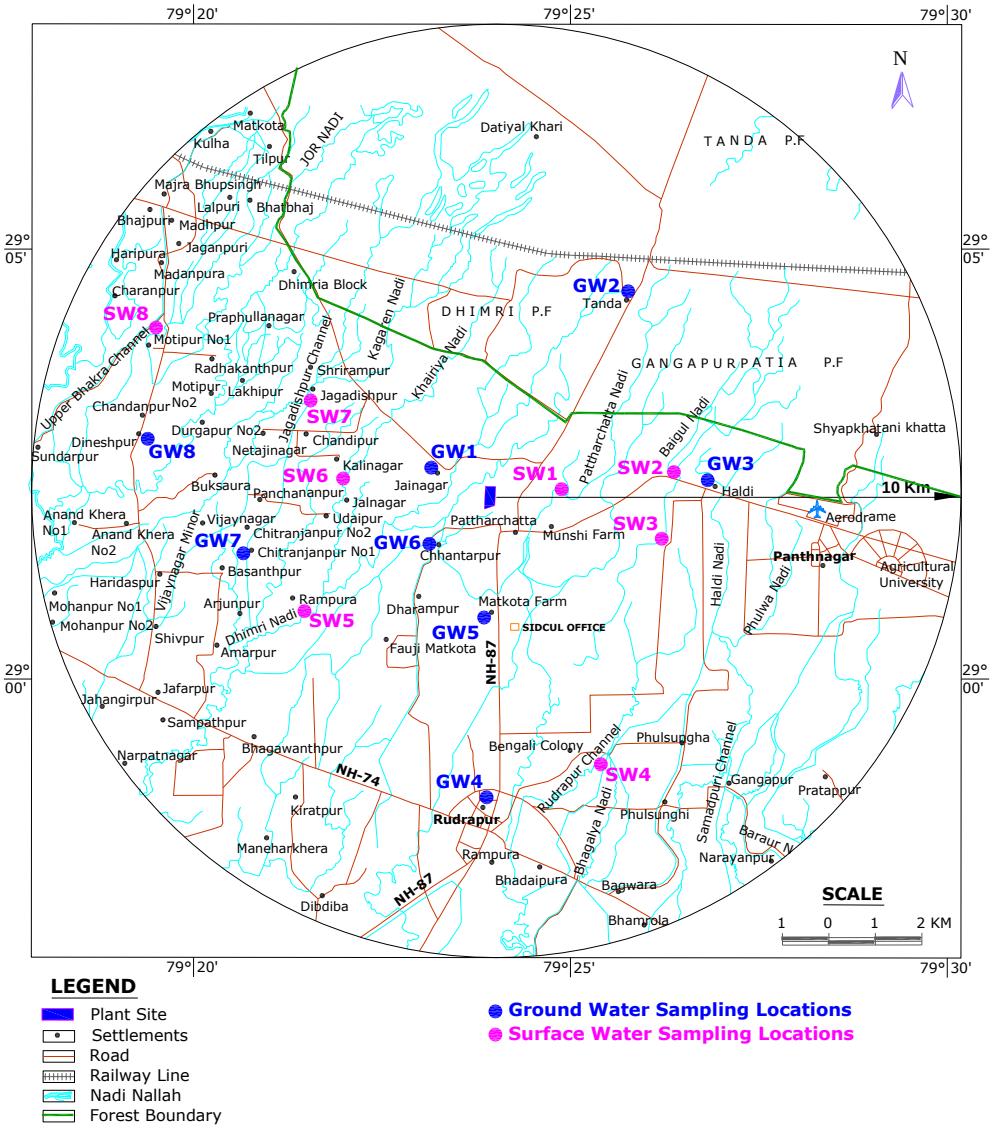


FIGURE-3.7.1 (B)
WATER SAMPLING LOCATIONS- POST MONSOON AND PART OF WINTER SEASON-2010

TABLE-3.7.2(A)
GROUND WATER QUALITY- PRE-MONSOON SEASON-2009

Sr. No	Parameters	Unit	IS:10500 Requirement (Desirable limit)	GW1	GW2	GW3	GW4	GW5	GW6
1	pH	-	6.5-8.5 (NR)	8.3	8.4	8.0	8.4	8.4	8.3
2	Color	Hazen	5 (25)	1	2	2	1	1	2
3	Odour	-	UO	UO	UO	UO	UO	UO	UO
4	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
5	Turbidity	(NTU)	5 (10)	2	2	3	2	2	4
6	Total Hardness	mg/l	300 (600)	204	110	126	146	150	156
9	Conductivity	μδ/cm	$	392	300	422	366	346	393
10	Total Dissolved Solids	mg/l	500 (2000)	210	185	238	205	178	214
13	Chlorides as Cl^-	mg/l	250 (1000)	4.3	5.7	17.0	1.4	5.0	7.1
14	Residual Free Chlorine	mg/l	0.2 Min. (-)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
15	Fluoride as F	mg/l	1.0 (1.5)	0.1	0.1	0.2	0.3	0.2	0.1
16	Calcium as Ca	mg/l	75 (200)	65	42.4	55.2	56	33.6	48
17	Magnesium as Mg	mg/l	30 (100)	3.4	1.0	9.2	1.5	16.0	8.7
18	Sulphates as SO_4^-	mg/l	200 (400)	4.6	8.2	21.5	10.3	7.8	6.6
19	Nitrates as NO_3	mg/l	45 (NR)	5.6	8.6	2.0	2.7	1.5	9.7
22	Phenolics as C_6H_5OH	mg/l	0.001(0.002)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
23	Cyanide as CN	mg/l	0.05 (NR)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
24	Alkalinity as $CaCO_3$	mg/l	200 (600)	186	140	168	168	160	174
25	Boron	mg/l	1 (5)	0.02	0.02	0.02	0.03	0.02	0.03
26	Sodium as Na	mg/l	$	10	20	18.2	16	10	19
27	Potassium as K	mg/l	$	1.2	3.9	4.1	1.4	2	4
28	Iron as Fe	mg/l	0.3 (1.0)	0.02	0.01	0.05	0.02	0.02	0.04
29	Copper as Cu	mg/l	0.05 (1.5)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
30	Manganese as Mn	mg/l	0.1 (0.3)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
31	Aluminum as Al	mg/l	0.03 (0.2)	0.01	0.01	<0.01	<0.01	<0.01	<0.01
32	Chromium as Cr^{+6}	mg/l	0.05 (NR)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
33	Cadmium as Cd	mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
34	Selenum as Se	mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
35	Arsenic as As	mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
36	Lead as Pb	mg/l	0.05 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
37	Zinc as Zn	mg/l	5 (15)	<0.01	<0.01	0.02	0.01	0.04	<0.01
38	Mercury as Hg	mg/l	0.001 (NR)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
39	Anionic Detergents as MBAS	mg/l	0.2 (1.0)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
41	Mineral Oil	mg/l	0.01 (0.03)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
42	Pesticides	mg/l	Absent(0.001)	Absent	Absent	Absent	Absent	Absent	Absent
43	E.Coli	-	Absent (-)	Absent	Absent	Absent	Absent	Absent	Absent
44	Total Coliforms	MPN/ 100 ml	10 (-)	--	--	--			--

Note: Values in paranthesis are 'Permissible limit in the absence of Alternate source'.
NR: No relaxation
$: Limits not specified
IS: 10500 (the standard prescribes the requirements for the essential and desirable characteristics required to be tested for ascertaining the suitability of water for drinking purpose).

TABLE-3.7.2 (B)
GROUND WATER QUALITY- POST MONSOON AND PART OF WINTER SEASON-2010

Sr. No	Parameters	Unit	IS:10500 Requirement (Desirable limit)	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8
1	pH	-	6.5-8.5 (NR)	7.7	7.8	7.9	7.7	7.2	7.7	8.0	7.7
2	Color	Hazen	5 (25)	4	3	3	4	3	4	6	6
3	Taste	-	Agreeable	Ag	Ag	Ag	Ag	Ag	Ag	Ag	Ag
4	Odour	-	UO	UO	UO	UO	UO	UO	UO	UO	UO
5	Conductivity	μδ/cm	$	451	620	452	450	564	431	512	595
6	Turbidity	(NTU)	5 (10)	3	4	2	2	3	2	3	2
7	Total Dissolved Solids	mg/l	500 (2000)	316	446	294	306	406	310	348	428
8	Total Hardness	mg/l	300 (600)	200	276	204	194	248	196	220	264
9	Alkalinity as $CaCO_3$	mg/l	200 (600)	188	240	190	188	240	180	230	208
10	Calcium as Ca	mg/l	75 (200)	48.0	60.8	48.0	32.0	54.4	52.8	55.5	57.6
11	Magnesium as Mg	mg/l	30 (100)	19.4	30.1	20.4	27.7	27.2	15.6	26.7	29.2
12	Residual Free Chlorine	mg/l	0.2 Min. (-)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
13	Boron	mg/l	1 (5)	0.02	0.04	0.02	0.02	0.04	0.03	0.03	0.06
14	Chlorides as Cl^-	mg/l	250 (1000)	10.6	35.5	9.2	8.5	9.2	10.6	9.9	24.1
15	Sulphates as SO_4^-	mg/l	200 (400)	9.4	7.8	14.3	19.5	17.9	11.6	6.6	43.2
16	Fluoride as F	mg/l	1.0 (1.5)	0.3	0.2	0.2	0.3	0.3	0.2	0.2	0.2
17	Nitrates as NO_3	mg/l	45 (NR)	12.1	11.4	8.5	4.5	6.1	5.3	4.9	11.6
18	Sodium as Na	mg/l	$	9.4	15.0	8.4	13.4	4.0	8.2	13.2	14.6
19	Potassium as K	mg/l	$	0.6	0.8	0.4	1.2	1.3	0.8	0.9	1.0
20	Phenolics as C_6H_5OH	mg/l	0.001(0.002)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
21	Cyanide as CN	mg/l	0.05 (NR)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
22	Anionic Detergents as MBAS	mg/l	0.2 (1.0)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
23	Mineral Oil	mg/l	0.01 (0.03)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
24	Cadmium as Cd	mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
25	Arsenic as As	mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
26	Copper as Cu	mg/l	0.05 (1.5)	0.02	0.02	0.03	0.01	0.02	0.01	0.04	0.002
27	Lead as Pb	mg/l	0.05 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
28	Manganese as Mn	mg/l	0.1 (0.3)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
29	Iron as Fe	mg/l	0.3 (1.0)	0.02	0.04	0.03	0.03	0.05	0.04	0.02	0.04
30	Chromium as Cr^{+6}	mg/l	0.05 (NR)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
31	Selenium as Se	mg/l	0.01 (NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
32	Zinc as Zn	mg/l	5 (15)	0.02	0.06	0.03	0.02	0.03	0.06	0.02	0.04
33	Aluminum as Al	mg/l	0.03 (0.2)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
34	Mercury as Hg	mg/l	0.001 (NR)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
35	Pesticides	mg/l	Absent(0.001)	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
36	E.Coli	-	Absent (-)	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
37	Total Coliforms	MPN/ 100 ml	10 (-)	--	--	--	-	--	--	--	--

Note: Values in paranthesis are 'Permissible limit in the absence of Alternate source'.
NR: No relaxation
$: Limits not specified
IS: 10500 (the standard prescribes the requirements for the essential and desirable characteristics required to be tested for ascertaining the suitability of water for drinking purpose).

TABLE-3.7.3(A)
SURFACE WATER QUALITY- PRE-MONSOON SEASON-2009

Sr. No.	Parameters	Units	IS:10500 Requirement (Desirable limit)	SW1	SW2	SW3	SW4
1	pH	-	6.5 to 8.5 (NR)	8.4	8.3	8.4	8.6
2	Colour	Hazen	5 (25)	2	1	2	3
3	Conductivity	µS/cm	$	422	473	414	403
4	Total dissolved solids (TDS)	mg/l	500(2000)	225	250	210	205
5	Dissolved oxygen	mg/l	$	6.2	6.8	5.6	5.9
6	BOD, 3day @ 27°C	mg/l	$	<3	<3	<3	<3
7	Total hardness as $CaCO_3$	mg/l	300(600)	160	190	168	182
8	Total Alkalinity as $CaCO_3$	mg/l	200(600)	204	224	182	194
9	Calcium as Ca^{+2}	mg/l	75(200)	46.4	48.8	44.8	57.6
10	Magnesium as Mg^{+2}	mg/l	30(100)	10.7	16.5	13.6	9.2
11	Chlorides as Cl	mg/l	250(1000)	4.3	6.4	5.7	2.1
12	Residual free Chlorine	mg/l	0.2 Min. (-)	<0.1	<0.1	<0.1	<0.1
13	Phosphates as PO_4	mg/l	$	0.2	0.2	0.1	0.2
14	Sulphates as SO_4^{-2}	mg/l	200(400)	6.1	5.5	7.2	5.9
15	Fluorides as F	mg/l	1.0(1.5)	0.1	0.2	0.2	0.4
16	Nitrates as NO_3	mg/l	45(NR)	3.8	6.3	6.7	1.4
17	Sodium as Na	mg/l	$	25	22	17	10
18	Potassium as K	mg/l	$	2.3	0.7	0.8	1.2
19	Total Boron as B	mg/l	1(5)	0.03	0.02	0.02	0.03
20	Cyanides as CN	mg/l	0.05(NR)	<0.02	<0.02	<0.02	<0.02
21	Phenolic Compounds as C_6H_5OH	mg/l	0.001(0.002)	<0.001	<0.001	<0.001	<0.001
22	Cadmium as Cd	mg/l	0.01(NR)	<0.01	<0.01	<0.01	<0.01
23	Arsenic as As	mg/l	0.01(NR)	<0.01	<0.01	<0.01	<0.01
24	Copper as Cu	mg/l	0.05 (1.5)	<0.01	<0.01	<0.01	0.01
25	Lead as Pb	mg/l	0.05(NR)	<0.01	<0.01	<0.01	0.01
26	Iron as Fe	mg/l	0.3 (1.0)	0.08	0.02	0.04	0.03
27	Chromium as Cr^{+6}	mg/l	0.05 (NR)	<0.05	<0.05	<0.05	<0.05
28	Selenium as Se	mg/l	0.01(NR)	<0.01	<0.01	<0.01	<0.01
29	Zinc as Zn	mg/l	5(15)	<0.01	0.01	0.01	<0.01
30	Aluminium as Al	mg/l	0.03 (0.2)	<0.01	<0.01	<0.01	0.01
31	Mercury as Hg	mg/l	0.001(NR)	<0.001	<0.001	<0.001	<0.001
32	Insecticides	-	Absent (0.001)	Absent	Absent	Absent	Absent
33	Anionic detergents as MBAS	mg/l	0.2(1.0)1	<0.1	<0.1	<0.1	<0.1
34	E.Coli	-	$	Absent	Absent	Absent	Absent
35	Total Coliforms	MPN/ 100ml	10(-)	13	17	11	14

Note: Values in paranthesis are 'Permissible limit in the absence of Alternate source'.
NR: No relaxation
$: Limits not specified
IS: 10500 (the standard prescribes the requirements for the essential and desirable characteristics required to be tested for ascertaining the suitability of water for drinking purpose).

TABLE-3.7.3(B)
SURFACE WATER QUALITY- POST MONSOON AND PART OF WINTER SEASON-2010

Sr. No.	Parameters	Units	IS:10500 Requirement (Desirable limit)	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
1	pH	-	6.5 to 8.5 (NR)	8.0	7.8	7.7	7.4	7.9	8.3	7.7	7.9
2	Colour	Hazen	$	4	4	6	6	3	2	3	3
3	Conductivity	µS/cm	$	559	570	649	640	459	447	438	463
4	Total dissolved solids (TDS)	mg/l	500(2000)	363	410	480	448	321	304	298	324
5	Dissolved oxygen	mg/l	$	5.4	5.2	5.8	5.8	5.0	5.3	5.2	5.2
6	BOD, 3day @ 27°C	mg/l	$	<3	<3	<3	<3	<3	<3	<3	<3
7	COD	mg/l	$	8	8	10	10	6	<3	<3	12
8	Total hardness as $CaCO_3$	mg/l	300(600)	256	252	288	272	206	204	200	208
9	Total Alkalinity as $CaCO_3$	mg/l	200(600)	250	252	268	264	194	188	188	196
10	Calcium as Ca^{+2}	mg/l	75(200)	49.6	52.8	62.4	60.8	50.4	52.8	48.8	53.6
11	Magnesium as Mg^{+2}	mg/l	30(100)	32.1	29.2	32.1	29.2	19.4	17.5	19.0	18.0
12	Chlorides as Cl	mg/l	250(1000)	9.9	7.1	25.5	22.7	10.6	9.2	9.2	9.9
13	Residual free Chlorine	mg/l	0.2 Min. (-)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
14	Phosphates as PO_4	mg/l	$	0.21	0.18	0.28	0.26	0.12	0.14	0.16	0.18
15	Sulphates as SO_4^{-2}	mg/l	200(400)	12.0	16.1	12.6	17.7	10.9	9.1	9.0	10.2
16	Fluorides as F	mg/l	1.0(1.5)	0.1	0.2	0.2	0.2	0.1	0.3	0.3	0.3
17	Nitrates as NO_3	mg/l	45(NR)	0.5	5.0	5.0	5.3	7.0	5.9	4.4	11.6
18	Sodium as Na	mg/l	$	10.2	13.4	14.8	19.0	7.0	7.4	8.2	8.4
19	Potassium as K	mg/l	$	0.4	1.3	1.6	2.3	0.2	0.2	0.4	0.3
20	Total Boron as B	mg/l	1(5)	0.02	0.06	0.08	0.02	0.04	0.03	0.02	0.02
21	Cyanides as CN	mg/l	0.05(NR)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
22	Phenolic Compounds as C_6H_5OH	mg/l	0.001(0.002)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
23	Cadmium as Cd	mg/l	0.01(NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
24	Arsenic as As	mg/l	0.01(NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
25	Copper as Cu	mg/l	0.05 (1.5)	0.04	0.03	0.08	0.06	0.04	0.02	0.03	0.02
26	Lead as Pb	mg/l	0.05(NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01
27	Iron as Fe	mg/l	0.3 (1.0)	0.02	0.02	0.04	0.04	0.08	0.02	0.03	0.02
28	Chromium as Cr^{+6}	mg/l	0.05 (NR)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
29	Selenium as Se	mg/l	0.01(NR)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
30	Zinc as Zn	mg/l	5(15)	0.03	0.03	0.06	0.06	0.02	0.02	0.04	0.04
31	Aluminium as Al	mg/l	0.03 (0.2)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01
32	Mercury as Hg	mg/l	0.001(NR)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
33	SAR	-	$	0.28	0.37	0.38	0.50	0.21	0.23	0.25	0.25
34	Anionic detergents as MBAS	mg/l	Absent (0.001)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

Note: Values in paranthesis are 'Permissible limit in the absence of Alternate source'.
NR: No relaxation
$: Limits not specified
IS: 10500 (the standard prescribes the requirements for the essential and desirable characteristics required to be tested for ascertaining the suitability of water for drinking purpose).

3.7.4 Observations

3.7.4.1 Pre-Monsoon Season-2009

- *Ground Water Quality*

Six ground water samples have been collected from the study area for estimating the water quality parameters.

- The analysis results indicate that the *pH* ranges in between 8.0 to 8.4, which is well within the specified standard of 6.5 to 8.5. The maximum pH of 8.4 was observed at GW2, GW4 and GW5 and the minimum pH of 8.0 was observed at GW3;

- Total *hardness* was observed to be ranging from 110 to 204 mg/l. The maximum *hardness* (204 mg/l) was recorded at GW1 and the minimum (110 mg/l) was recorded at GW2. The hardness was found to be within the permissible limit of 600 mg/l at all the water quality locations;

- *Chlorides* were found to be in the range of 1.4 mg/l to 17.0 mg/l, the maximum concentration of chlorides (17.0 mg/l) was observed at GW3, where as the minimum value of 1.4 mg/l was observed at GW4;

- *Sulphates* were found to be in the range of 4.6 mg/l to 21.5 mg/l. The maximum value observed at GW3 (21.5 mg/l) where as the minimum value observed at GW1 (4.6 mg/l);

- The Total Dissolved Solids (TDS) concentrations were found to be ranging in between 178 to 238 mg/l, the maximum TDS observed at GW3 (238 mg/l) and minimum concentration of TDS observed at GW5 (178 mg/l); and

- The heavy metal values observed are either below detectable limit or well within the limits.

The ground water quality in the study area does not indicate any industrial contamination.

- *Surface Water Quality*

Four surface water samples have been collected to estimate the quality of surface water quality in the study area:

- The analysis results indicate that the pH values in the range of 8.3 to 8.6, the maximum value was observed at SW4 and minimum value was observed at SW2;

- The TDS was observed in the range of 205 mg/l to 250 mg/l, the maximum TDS value was observed at SW2, and where as minimum value was observed at SW4;

- DO was observed to be in the range of 5.6 to 6.8 mg/l respectively;
- The chlorides and sulphates were found to be in the range of 2.1 to 6.4 mg/l and 5.5 to 7.2 mg/l respectively. It is observed that chlorides and sulphates are well within the permissible limits; and

- The calcium & magnesium were found to be in the range of 44.8 to 57.6 mg/l and 9.2 to 16.5 mg/l respectively.

3.7.4.2 Post monsoon and part of winter Season-2010

➢ *Ground Water Quality*

Eight ground water samples have been collected from the study area for estimating the water quality parameters.

- The analysis results indicate that the *pH* ranges in between 7.2 to 8.0, which is well within the specified standard of 6.5 to 8.5. The minimum pH of 7.2 was observed at GW5 and the maximum pH of 8.0 was observed at GW7;

- Total *hardness* was observed to be ranging from 194 to 276 mg/l. The minimum *hardness* (194 mg/l) was recorded at GW4 and the maximum (276 mg/l) was recorded at GW2. The hardness was found to be within the permissible limit of 600 mg/l at all the water quality locations;

- *Chlorides* were found to be in the range of 8.5 mg/l to 35.5 mg/l, the minimum concentration of chlorides (8.5 mg/l) was observed at GW4, where as the maximum value of 35.5 mg/l was observed at GW2;

- *Sulphates* were found to be in the range of 6.6 mg/l to 43.2 mg/l. The minimum value observed at GW4 (6.6 mg/l) where as the maximum value observed at GW8 (43.2 mg/l);

- The Total Dissolved Solids (TDS) concentrations were found to be ranging in between 294 to 446 mg/l, the minimum TDS observed at GW3 (294 mg/l) and maximum concentration of TDS observed at GW2 (446 mg/l); and

- The heavy metal values observed are either below detectable limit or well within the limits.

The ground water quality in the study area does not indicate any industrial contamination.

➢ *Surface Water Quality*

Eight surface water samples have been collected to estimate the quality of surface water quality in the study area:

- The analysis results indicate that the pH values in the range of 7.4 to 8.3, the minimum value was observed at SW4 and maximum value was observed at SW6;

- The TDS was observed in the range of 304 mg/l to 480 mg/l, the minimum TDS value was observed at SW6, and where as minimum value was observed at SW3;
- DO was observed to be in the range of 5.0 to 5.8 mg/l respectively;
- The chlorides and sulphates were found to be in the range of 7.1 to 25.5 mg/l and 9.0 to 17.7 mg/l respectively. It is observed that chlorides and sulphates are well within the permissible limits; and
- The calcium & magnesium were found to be in the range of 48.8 to 62.4 mg/l and 17.5 to 32.1 mg/l respectively.

The surface water quality does not indicate any industrial contamination.

3.8 Noise Level Survey

The physical description of sound concerns its loudness as a function of frequency. Noise in general is sound, which is composed of many frequency components of various types of loudness levels distributed over the audible frequency range. The most common and universally accepted scale is the A weighted scale, which is measured as dB (A). This is more suitable for audible range of 20 to 20,000 Hz. The scale has been designed to weigh various components of noise according to the response of human ear. The environmental impact of noise can have several effects varying from Noise Induced Hearing Loss (NIHL) to annoyance depending on loudness of noise.

The main objective of noise monitoring in the study area is to establish the baseline noise levels and assess the impact of the total noise expected to be generated during the project operations around the project site.

3.8.1 Identification of Sampling Locations

A preliminary reconnaissance survey has been undertaken to identify the major noise generating sources in the area. Noise at different noise generating sources has been identified based on the residential, industrial and commercial activities in the area. The noise monitoring has been conducted for determination of noise levels at eight locations in the study area. The noise levels at each location were recorded for 24-hrs. The environment setting of each noise monitoring location is given in **Table-3.8.1** and shown in **Figure-3.8.1**.

TABLE-3.8.1
DETAILS OF NOISE MONITORING LOCATIONS

Location Code	Locations	Distance w.r.t Project Site (Km)	Direction w.r.t Project Site	Remarks
N1	Datiyal Khari	7.7	N	Residential zone
N2	Dineshpur	7.8	WNW	Residential zone
N3	Chhantarpur	1.6	SW	Residential zone
N4	Plant site	--	--	Industrial zone
N5	Rudrapur	6.5	S	Commercial zone
N6	Tanda	5.1	NNE	Residential zone

N7	Haldi	4.7	E	Residential zone
N8	Pratappur	9.3	SE	Residential zone

Source: Vimta Labs Limited

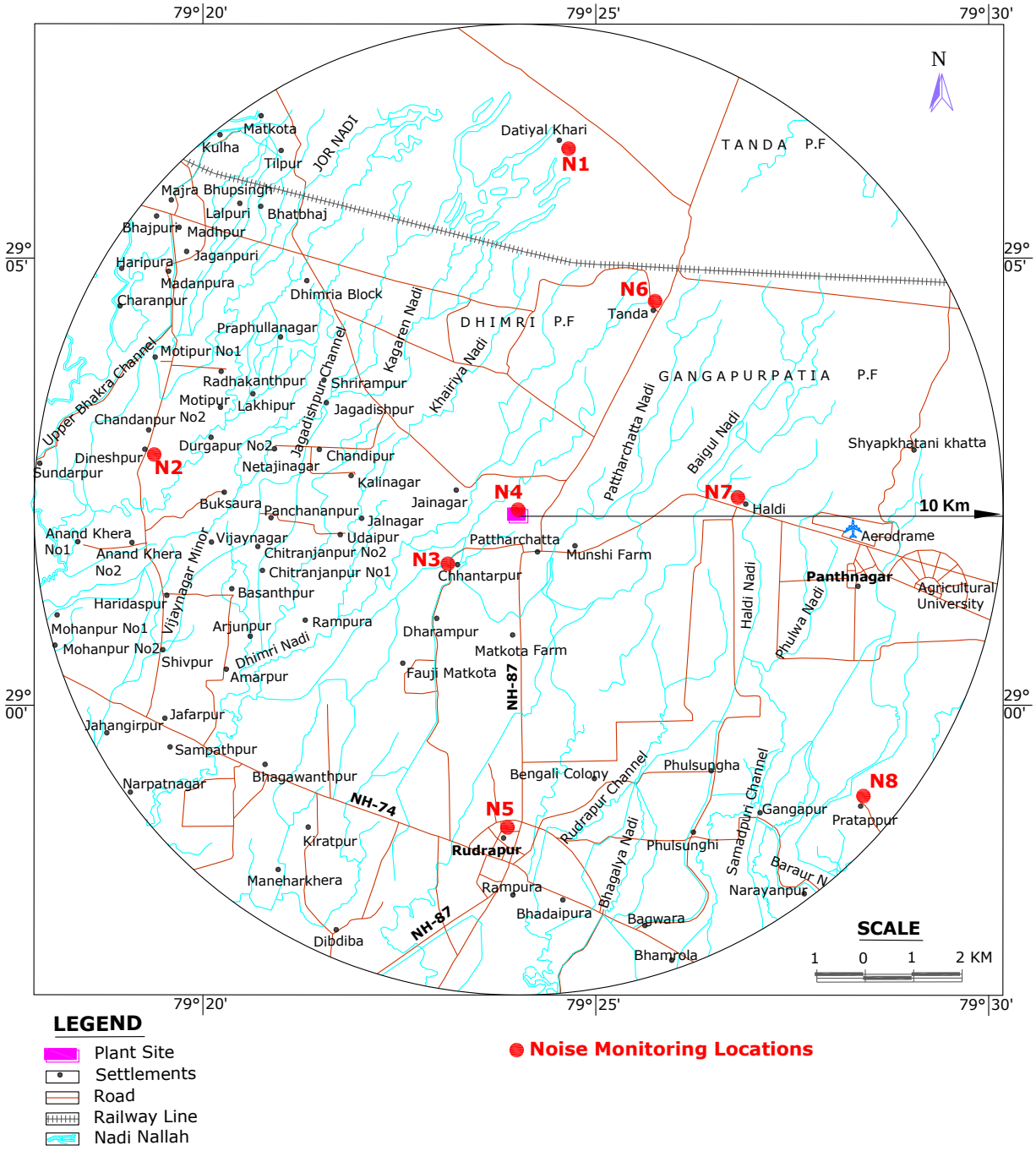


FIGURE-3.8.1
NOISE MONITORING LOCATIONS

3.8.2 Method of Monitoring

Sound Pressure Levels (SPL) measurements were recorded at eight locations. The readings were taken for every hour for 24-hrs. The day noise levels have been monitored during 7 am to 10 pm and night noise levels during 10 pm to 7 am at all the locations covered in the study area.

During each hour parameters like L10, L50, L90 and Leq were directly computed by the instrument based on the sound pressure levels.

3.8.3 Presentation of Results

The statistical analysis is done for measured noise levels at eight locations in the study area. The parameters are analyzed for L_{day}, L_{night}, and L_{dn}. The statistical analysis results are given in **Table-3.8.2.**

TABLE-3.8.2(A)
AMBIENT NOISE LEVELS IN THE STUDY AREA [dB (A)]
PRE-MONSOON SEASON-2009

Location	Zone	L10	L50	L90	Leq	Lday	Lnight	Ldn
Datiyal Khari (N1)	Rural/Residential	49.8	46.2	42.4	47.1	48.0	44.2	51.4
Dineshpur (N2)	Rural/Residential	43.6	39.8	36.0	40.8	41.8	38.1	45.3
Chhantarpur (N3)	Rural/Residential	42.5	38.6	34.9	39.6	40.4	36.8	43.9
Plant site (N4)	Industrial	37.7	33.2	29.8	34.2	36.2	31.3	38.8
Rudrapur (N5)	Commercial	54.3	50.1	46.2	51.2	52.8	47.8	55.4
Tanda (N6)	Rural/Residential	48.2	44.3	40.6	45.3	46.1	42.5	49.6
Haldi (N7)	Rural/Residential	45.1	40.3	36.7	41.5	43.3	37.8	45.6
Pratappur (N8)	Rural/Residential	39.3	34.5	30.9	35.7	37.8	32.0	39.9

TABLE-3.8.2(B)
AMBIENT NOISE LEVELS IN THE STUDY AREA [dB (A)]
POST MONSOON AND PART OF WINTER SEASON-2010

Location	Zone	L10	L50	L90	Leq	Lday	Lnight	Ldn
Datiyal Khari (N1)	Rural/Residential	41.2	36.4	32.8	37.6	39.7	33.9	41.8
Dineshpur (N2)	Rural/Residential	44.2	39.7	36.3	40.7	42.7	37.8	45.3
Chhantarpur (N3)	Rural/Residential	43.8	39.9	36.2	40.9	41.7	38.1	45.2
Plant site (N4)	Industrial	49.9	46.4	42.6	47.3	48.1	44.4	51.6
Rudrapur (N5)	Commercial	52.6	48.8	45.0	49.8	51.0	47.1	54.3
Tanda (N6)	Rural/Residential	46.7	42.5	38.6	43.6	44.6	40.2	47.6
Haldi (N7)	Rural/Residential	42.8	39.0	35.2	40.0	41.6	37.3	44.6
Pratappur (N8)	Rural/Residential	39.2	35.3	31.4	36.3	37.2	32.6	40.0

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

3.8.4 Observation of Results

- **Pre-Monsoon Season-2009**

a) Day time Noise Levels (L_{day})

Industrial Zone: The daytime (L_{day}) noise levels are observed to be 36.2 dB (A) at plant site (N4).

Residential Zone: The daytime (L_{day}) noise levels are observed to be in the range of 37.8 – 48.0 dB (A). The maximum noise level of 48.0dB (A) was observed at Datiyal Khari (N1) and the minimum noise level of 37.8 dB (A) was observed at Pratappur (N8).

Commercial Zone: The daytime (L_{day}) noise levels at location Rudrapur (N5) was observed to be 52.8 dB (A).

It is observed that the day time noise levels are broadly in accordance with the prescribed limit of 55 dB (A) for rural / residential areas, 65 dB (A) for commercial areas and 75 dB (A) for industrial zones.

b) Night time Noise Levels (L_{night})

Industrial Zone: The nighttime (L_{day}) noise levels are observed to be 31.3 dB (A) at plant site (N4).

Residential Zone: The nighttime (L_{night}) noise levels are observed to be in the range of 32.0–44.2 dB (A). The maximum noise level of 44.2 dB (A) was observed at Datiyal Khari (N1) and the minimum noise level of 32.0 dB (A) was observed at Pratappur (N8).

Commercial Zone: The nighttime (L_{night}) noise levels at Rudrapur (N5) was observed to be 47.8 dB (A).

It is observed that the nighttime (L_{night}) noise levels are in broadly in accordance to the prescribed limit of 45 dB (A) for rural / residential areas, 55 dB (A) for commercial areas and 70 dB (A) for industrial zones.

- **Post monsoon and part of winter Season-2010**

a) Day time Noise Levels (L_{day})

Industrial Zone: The daytime (L_{day}) noise levels are observed to be 48.1 dB (A) at plant site (N4).

Residential Zone: The daytime (L_{day}) noise levels are observed to be in the range of 37.2 – 44.6 dB (A). The minimum noise level of 37.2 dB (A) was observed at

Pratappur village (N8) and the maximum noise level of 44.6 dB (A) was observed at Tanda village (N6).

Commercial Zone: The daytime (L_{day}) noise levels at location Rudrapur (N5) was observed to be 51.0 dB (A).

It is observed that the day time noise levels are broadly in accordance with the prescribed limit of 55 dB (A) for rural / residential areas, 65 dB (A) for commercial areas and 75 dB (A) for industrial zones.

b) Night time Noise Levels (L_{night})

Industrial Zone: The nighttime (L_{day}) noise levels are observed to be 44.4 dB (A) at plant site (N4).

Residential Zone: The nighttime (L_{night}) noise levels are observed to be in the range of 32.6 –40.2 dB (A). The minimum noise level of 32.6 dB (A) was observed at Pratappur village (N8) and the maximum noise level of 40.2 dB (A) was observed at Tanda village (N6).

Commercial Zone: The nighttime (L_{night}) noise levels at Rudrapur (N5) was observed to be 47.1 dB (A).

It is observed that the nighttime (L_{night}) noise levels are in broadly in accordance to the prescribed limit of 45 dB (A) for rural / residential areas, 55 dB (A) for commercial areas and 70 dB (A) for industrial zones.

3.9 Ecological Studies

An ecological survey of the study area was conducted particularly with reference to recording the existing biological resources.

3.9.1 Terrestrial Ecological Studies

3.9.1.1Objectives of Ecological Study

The objectives of the present study are intended to:

- Generate baseline data from field observations from various terrestrial and aquatic ecosystems;
- Compare the data so generated with authentic past records to understand changes;
- Characterize the environmental components like land, water, flora and fauna; and
- Understand the impact of the proposed project on vegetation structure in and around the project site.

3.9.1.2Methods Adopted for the Study

To accomplish the above objectives, a general ecological survey covering an area of 10 km radius from proposed project site was selected. The survey included:

- Reconnaissance survey for selection of sampling sites in and around project site on the basis of meteorological conditions;
- Generation of primary data to understand baseline ecological status, important floristic elements;
- Generation of primary data to understand baseline fauna structure; and
- Collection of secondary data from Forest Working Plans and Gazetteers.

3.9.1.3Criteria adopted for Selection of Sampling Locations

Reconnaissance survey was conducted to identify the phyto-sociological sampling location on the basis of following criteria:

- Proximity to the proposed project site;
- Downwind direction of the proposed project site; and
- Upwind direction of the proposed project.

Eight locations were identified for phyto-sociological aspects to assess the current status. Phyto-sociological studies were carried out by using list count quadrate method. Trees and shrubs were sampled by taking quadrates of 100 m^2 distributed randomly. Their girths [Girth Basal Height (GBH)] at 132 cm from the ground) were recorded. The data obtained was further used to estimate Relative Frequency (RF), Relative Density (RD) and Relative Basal Area (RBA) and Importance Value Index (IVI). The sampling locations and directions with respect to the proposed project site are presented in **Table-3.9.1** and shown in **Figure-3.9.1.**

TABLE-3.9.1
DETAILS OF PHYTO-SOCIOLOGICAL SAMPLING LOCATIONS

Location Code	Location	Distance (km)	Direction
TE-1	Plant site	--	--
TE-2	Jainagar	1.1	WNW
TE-3	Jalnagar	3.0	W
TE-4	Rudrapur	6.5	S
TE-5	Pratappur	9.3	SE
TE-6	Haldi	4.7	E
TE-7	Tanda	5.1	NNE
TE-8	Datiyal khari	7.7	N

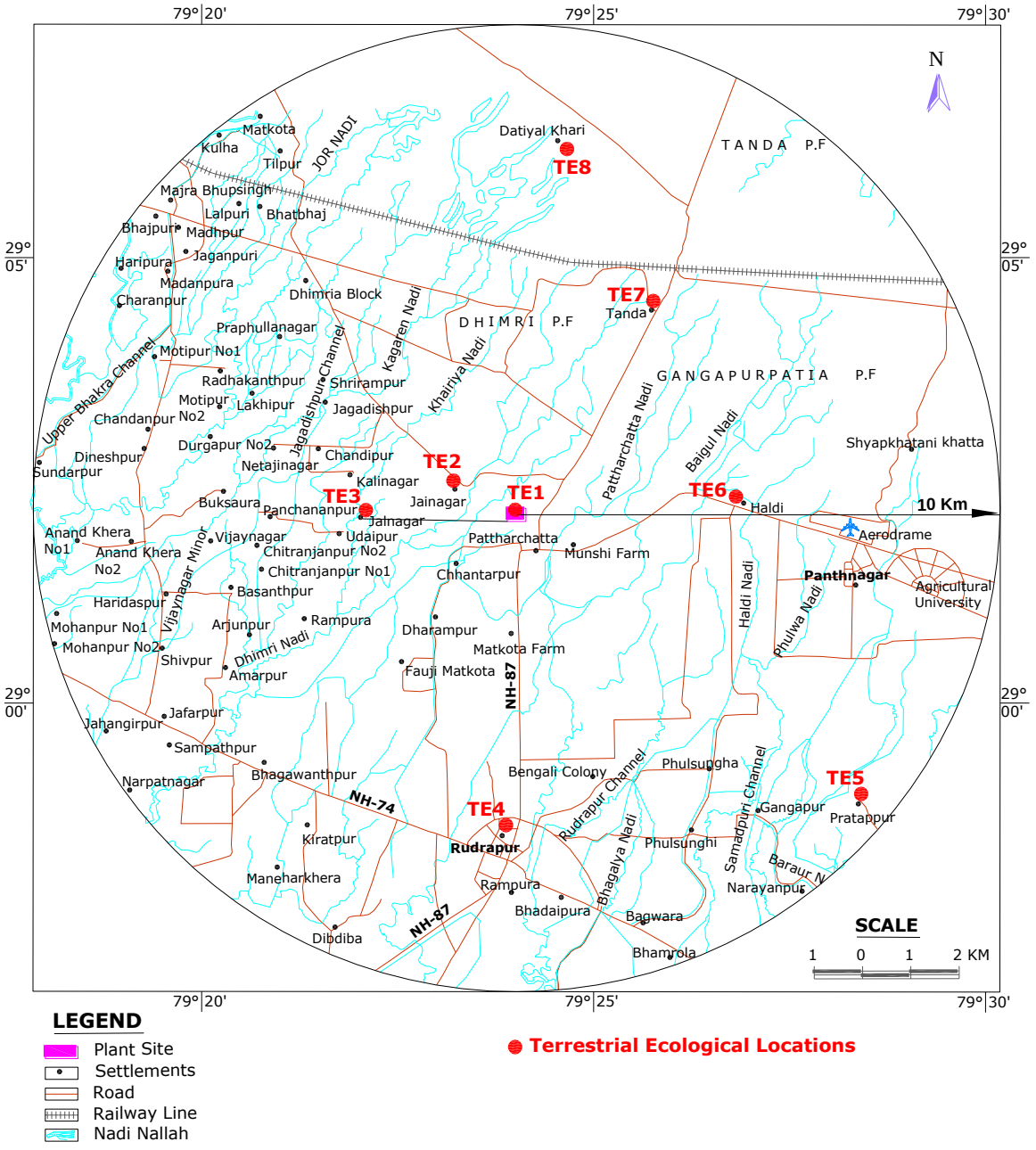

79°20'
79°25'
79°30'
29°05'
29°00'
N
TE1
TE2
TE3
TE4
TE5
TE6
TE7
TE8
Datiyal Khari
TANDA P.F
DHIMRI P.F
GANGAPURPATIA P.F
Tanda
Dhimria Block
Praphullanagar
Motipur No1
Radhakanthpur
Motipur
Lakhipur
Shrirampur
Jagadishpur
Chandanpur No2
Durgapur No2
Chandipur
Netajinagar
Kalinagar
Jainagar
Panchananpur
Udaipur
Buksaura
Dineshpur
Sundarpur
Anand Khera No1
Anand Khera No2
Vijaynagar
Chitranjanpur No2
Chitranjanpur No1
Basanthpur
Haridaspur
Mohanpur No1
Mohanpur No2
Arjunpur
Rampura
Shivpur
Amarpur
Dharampur
Matkota Farm
Fauji Matkota
Chhantarpur
Pattharchatta
Munshi Farm
Haldi
Aerodrame
Shyapkhatani khatta
Panthnagar
Agricultural University
Haldi Nadi
Phuliwa Nadi
Patharchatta Nadi
Baigul Nadi
Kagaren Nadi
Khairiya Nadi
Jagadishpur Channel
Upper Bhakra Channel
Dhimri Nadi
Vijaynagar Minor
JOR NADI
Matkota
Kulha
Tilpur
Majra Bhupsingh
Lalpuri
Bhatbhaj
Bhajpur
Madhpur
Jaganpuri
Haripura
Madanpura
Charanpur
Jafarpur
Jahangirpur
Sampathpur
Narpatnagar
Bhagawanthpur
Kiratpur
Maneharkhera
Dibdiba
Rudrapur
Rampura
Bhadaipura
Bengali Colony
Phulsuggha
Phulsunghi
Gangapur
Pratappur
Narayanpur
Bagwara
Bhamrola
Rudrapur Channel
Samadpuri Channel
Bhagalya Nadi
Baraur N
NH-74
NH-87
NH-87
10 Km
SCALE
1 0 1 2 KM
LEGEND
Plant Site
Settlements
Road
Railway Line
Nadi Nallah
Terrestrial Ecological Locations

FIGURE-3.9.1
ECOLOGICAL SAMPLING LOCATIONS

3.9.2 Review of Secondary Data

Owing to the variation in altitudes and aspects the flora of the district varies from tropical to alpine species. Different types of forests and varying species of shrubs, climbers and grasses, depending upon their aspect, altitude and soil condition are found in the district.

Sal and coniferous forest are predominant in northern part of the district. Chir is the only coniferous species in the reserved forest areas. Besides other associates of chir, a few deodhar trees are also seen in the district. Wide ranges of sal forest occur in this part of the tehsil. Sal is the main timber species and is generally pure towards the siwalik ridges. A mixture of miscellaneous species is found in the lower parts.

3.9.2.1 Wildlife Sanctuaries and National Parks

There are no wildlife sanctuaries, national parks within 15 km radius of the proposed project site. There are three protected forests in the study area and are given in the **Table-3.9.2**. Sanjay van chetna Kendra forest block has been observed opposite to the plant main gate, other side of the approach road. The District Forest Officer has been approached for the requisite letter regarding the forests status in the study area and the application letter is enclosed in **Annexure-IX.**

TABLE-3.9.2
LIST OF FORESTS IN STUDY AREA

Sr. No.	Name of the Forest Block	Distance from Plant Site Boundary (km)	Direction from the Plant Site
1	Dhimri P.F.	2.2 km	NNE
2	Gangapur Patiya P.F.	2.7 km	NE
3	Tanda P.F.	9.8 km	NE

3.9.3 Floristic Composition- Primary Survey

- ***Floristic Richness***

- *Cryptogamic Vegetation*

The area shows many algae, fungi, bryophytes and ferns. Algae are present in aquatic bodies or in marshy places. Fungi, particularly from ascomycetes and basidiomycetes are located on ground or epiphytically. Lichens of crustose, foliose and fruticose types are present on different substrates (Lichens, Ascomycetes and Basidiomycetes could be observed near old house walls and agricultural waste dump areas.

- *Life Form Spectrum*

Raunkiaer defined life forms as the sum of adaptations of plants to climate. Braun-Blanquet (1951), whose system is adapted in this study, modified the Raunkiaer's system. Following five of the ten classes created by Braun-Blanquet are present in the study area. The details are presented in **Table-3.9.3**.

TABLE-3.9.3
BRAUN-BLANQUET CLASSIFICATION

Sr.No	Life Forms	Details
1	Phanerophytes	Shrubs and trees
2	Therophytes	Annuals including ferns
3	Hydrophytes	Water plants except plankton
4	Hemicryptophytes	Plants with perennial shoots and buds close to surface
5	Geophytes	Plants with parenting parts buried in substratum

During the field survey, a maximum number of 318 plant species (except algae, fungi and bryophytes) were recorded from the study area. **Table-1 of Annexure-IX** lists all the species recorded in the study area. The analysis of the data is presented in **Table-3.9.4**. Maximum number of species observed are therophytes (43.75%) followed by phanereophytes (37.5%). These classes are followed by hemicryptophytes (14.06%), geophytes, epiphytes and succulents were found in very few numbers. Hemicryptophytes (predominantly grasses and sedges) were found to be significant in the area. Presence of large number of therophytes (annuals or herbaceous vegetation) and phanerophytes (shrubs and trees) indicates semiarid to mixed deciduous type of vegetation structure.

TABLE-3.9.4
CLASS WISE DISTRIBUTION OF PLANT SPECIES IN THE STUDY AREA

Groups	**Number**	**Percentage**
Phanerophytes (P)	142	44.66
Therophytes (T)	126	39.62
Hydrophytes (H)	04	1.26
Hemicryptophytes (He)	35	11.00
Succulents (S)	3	0.95
Epiphytes (E)	2	0.63
Geophytes (G)	6	1.88
Total	**318**	**100**

- ***Comments on the Life Form Spectrum***

Life form spectrum is a reflection of plant community. A plant community is governed by several factors like climatic, edaphic, topographic and biotic. Even local variations in environment affect components of plant community.

3.9.4 Wildlife Studies

3.9.4.1Introduction

Wildlife being an important strand in the complex food web in most of the forest ecosystems, its status symbolises the functioning efficiency of the entire ecosystem. The forest management therefore, cannot be isolated from wood exploration and wild life conservation in the same vulnerable vegetation complex. Just as wild flora

needs special treatment for preservation and growth, wild fauna as well deserves specific conservatory pursuits for posterity. Unfortunately, our past efforts had been unscientific in rearing and preserving our valuable heritage resulting in dwindling of many interesting species, which the nature had bestowed on us. Wild animals move from one place to another place in search of food, water and other basic need. During the period, wild animals may visit the villages for search of food. The broad spectrum of colorful fauna is fading and some species are facing extinction.

3.9.4.2Fauna –Primary Survey

A detailed field observation studies were conducted in surrounding area and details are presented in **Table-3.9.5**. 67 birds, 4 reptiles and 11 mammals were recorded during study period, out of which one species belongs to Sch-I as per Wildlife Protection Act, 1972, majority of the animal species belong to Sch-IV of Wildlife Protection Act, 1972.

3.9.5 Aquatic Ecosystems

Protecting the environment and making efficient use of natural resources are two of the most pressing demands in the present stage of social development. The task of preserving the purity of the atmosphere and water basins is of both national and global significance since there are no boundaries to the propagation of anthropogenic contaminants in the water. An essential prerequisite for the successful solution to these problems is to evaluate ecological impacts from the baseline information and undertake effective management plan.

TABLE-3.9.5
LIST OF RECORDED WILDLIFE IN STUDY AREA (10-KM RADIUS)

Technical Name	English Name/Local Name	Conservation Status as per Wildlife Protection Act (1972)
Mammals		
Herpestres edwardsinyula	Common Moongoosa	Part-II of sch-II
Lapus nigricollis	Indian Hare	Sch-IV
Presbytus entellus	Indian langur	Part-I of sch-II
Bandicota indica	Rat	Sch-IV
Funumbuls palmarum	Squirrel	Sch-IV
Mus rattus	Indian rat	Sch-IV
Hystrix indica	Porcupine	Sch-IV
Boselaphus tragocamelus	Blue bull	Sch-IV
Canis aureus	Jackal	Sch-IV
Cynopterus sphinx	Indian Flying Fox	Sch-IV
Felis chaus	Wild cat	Sch-I
Macaca mulatta	Monkey	Sch-IV
Rattus rattus	Common house rat	Sch-IV
Vulpus bengalensis	Indian fox	Sch-IV
Mus musculus	Common Mouse	Sch-IV
Birds		
Acridotheres tristis	Common myna	Sch-IV
Acridotheros ginginianus	Black myna	Sch-IV
Actitis hypoleucus	Common sandpiper	Sch-IV
Amarourornis phoenicurus	White breasted waterhen	Sch-IV

Technical Name	English Name/Local Name	Conservation Status as per Wildlife Protection Act (1972)
Anas poicelorhyncha	Black shouldered duck	Sch-IV
Anhinga melanogaster	Darter	Sch-IV
Aquila hastate	Indian spotted eagle	Sch-IV
Ardea cineria	Grey heron	Sch-IV
Ardeola grayii	Indian pond heron	Sch-IV
Athene brama	Spotted owlet	Sch-IV
Bubulcus ibis	Eagle egret	Sch-IV
Capricmulgus asiaticus	Indian night jar	Sch-IV
Centropis sinensis	Greater coucal	Sch-IV
Cisticola juncidis	Streaked fantail wabler	Sch-IV
Columbia livia	Blue-rock pigeon	Sch-IV
Coracious bengahalensis	Indian roller	Sch-IV
Corvus macrorhynchus	Jungle crow	Sch-IV
Corvus splendens	House crow	Sch-IV
Corvus splendens	House crow	Sch-IV
Dicrurus macrocercus	Black drongo	Sch-IV
Egretta garzetta	Little egret	Sch-IV
Eudynamys scolopacea	Asian koel	Sch-IV
Francolinus francolinus	Black francolin	Sch-IV
Francolinus pondicerianus	Grey francolin	Sch-IV
Fulica atra	Common coot	Sch-IV
Grus antigone	Sarus crane	Sch-IV
Halcyon mysoorensis	White breasted kingfisher	Sch-IV
Heliaeetus leucoryphus	Pallas fish eagle	Sch-IV
Lonchura malabarica	White-throated munia	Sch-IV
Merops orientalis	Small bee-eater	Sch-IV
Mesophyos intermedia	Median egret	Sch-IV
Milvus migrans	Black kite	Sch-IV
Mirafra erythroptera	Red-winged bush lark	Sch-IV
Nectarinia asiatica	Purple sunbird	Sch-IV
Orcomela fusca	Indian chat	Sch-IV
Oriolus oriolus	Golden owl	Sch-IV
Orthotomus sutorius	Common tailor bird	Sch-IV
Passer domesticus	House sparrow	Sch-IV
Perdicula asiatica	Jungle Bush quail	Sch-IV
Phalacrocorax niger	Little coromant	Sch-IV
Phoeicopteris rubber	Greater flamingoes	Sch-IV
Ploceus benghalensis	Black-breasted weaver	Sch-IV
Ploceus philippinus	Baya weaver	Sch-IV
Prinia burnessi	Long tailed grass-warbler	Sch-IV
Prinia socialis	Ashy prinia	Sch-IV
Psittacula krammeri	Rose-ringed parakeet	Sch-IV
Pycnonotus cafer	Red-vented bulbul	Sch-IV
Saxcicoloides fulicata	Indian robin	Sch-IV
Saxicolides fulicata	Indian robin	Sch-IV
Treron phoenicoptera	Yellow legged green pigeon	Sch-IV
Saxcola caprata	Pied bush chat	Sch-IV
Sterna aurntia	Indian River tern	Sch-IV
Sterna hirundo	Common tern	Sch-IV
Strenus pagodorum	Bhraminy starling	Sch-IV
Streoptopelia chinensis	Spotted dove	Sch-IV
Streptopelia senegelensis	Little brown dove	Sch-IV
Streptopelia traquebarica	Red-collared dove	Sch-IV
Sturnus conta	Asian pied starling	Sch-IV
Turdiodes caudatus	Common babbler	Sch-IV

Technical Name	English Name/Local Name	Conservation Status as per Wildlife Protection Act (1972)
Turdiodes malcolmi	Large grey babbler	Sch-IV
Turdiodes striatus	Jungle babbler	Sch-IV
Tyto alba	Barn owl	Sch-IV
Upupa epops	Common hoppe	Sch-IV
Venellus indicus	Red wattled lapwig	Sch-IV
Venellus malabaricus	Yellow-wattled lapwig	Sch-IV
Zosperops palpebrosus	Oriental white-eye	Sch-IV
Gyps bengalensis	Bengal vulture	Sch-IV
Galoperdex spadicea *Gallus gallus*	Red spur fowl	Sch-IV
Reptiles		
Hemidactylus sp	House lizard	Sch-IV
Calotes vescicolor	Garden lizard	Sch-IV
Chameleon zeylanica	Lizard	Sch-IV
Naja naja	Cobra	Sch-IV
Chameleon species	Garden Lizard	

So the objective of aquatic ecological study may be outlined as follows:

- To characterize water bodies like fresh waters;
- To understand their present biological status;
- To understand the impact of proposed industrial and urbanization activities; and
- To suggest recommendations to counter adverse impacts, if any, on the ecosystem.

In order to get a clear picture and to assess the various parameters of water, two sampling locations were identified for sampling. Samples were collected during pre-monsoon season-2009 and post monsoon and part of winter season-2010. The sampling locations are presented in **Table-3.9.6** and shown in **Figure-3.9.1.**

TABLE-3.9.6
DETAILS OF AQUATIC SAMPLING LOCATIONS

Sr. No.	Code	Locations	Remarks
1	AE-1	Baigul nadi near Haldi village	Fresh water
2	AE-2	Dhimri nadi near Rampura vilage	Fresh water

3.9.5.1 Methodology Adopted for Aquatic Studies

Two water samples for plankton study were collected in pre-monsoon season-2009 and post monsoon and part of winter season 2010 from surface water of upstream of Baigul nadi and Dhimri nadi. The samples were collected at a depth of 0.30 m from surface of the water.

The samples were collected in one-liter capacity polyethylene cans and the samples were fixed with 4% buffered formaline solution. For the measurement of frequencies of various forms of phyto-plankton and zoo-plankton, one drop of the sedimented plankton was mounted on a microslide and as many as 10 different microscope fields situated at more or less even distances from each other were examined and the number of Importance organisms counted **(Lackey method,**

17th edition, APHA, AWWA 1992). The plankton forms were identified upto species level and Shannon Weaver's index was calculated.

3.9.5.2 Aquatic Fauna

The field studies indicate that the aquatic fauna consisting of crustaceans, aquatic insects, fishes, amphibians, reptiles and birds are listed in **Table-3.9.7.** The observed Planktonic flora and fauna are presented in **Table-3.9.8.**

TABLE-3.9.7
AQUATIC FAUNA FROM STUDY AREA

Sr. No.	Name of the Species	Lotic Water Bodies
1	*Notpterus notopterus*	Observed
2	*Esomus darnucus*	Observed
3	*Labeo rohita*	Observed
4	*Labeo catla*	Observed
5	*Cirrhinus mrigula*	Observed
6	*Mysticus vittatus*	Observed
7	*Clarias batrachus*	Observed
8	*Channa striatus*	Observed
9	*Rana cynophyctis*	Observed
10	*Phalacrocorax carbo*	Observed
11	*Bubulcus ibis*	Observed
12	*Egretta garzetta*	Observed
13	*Ardea cinerea*	Observed
14	*Alcedo athinis*	Observed
15	*Dendrocygna javanica*	Observed

TABLE-3.9.8
LIST OF OBSERVED PLANKTONIC FLORA AND FAUNA

Sr. No.	Phytoplankton	Zooplankton
1	Anabaena sp	Arcella
2	Oscillatoria sp	*Keratella sp*
3	Microcystis sp	*Asplancha sp*
4	Chrococcus sp	*Brachionus sp*
5	Scenedesmus sp	*Daphnia sp*
6	Scenedesmus bijuga	*Cerodaphnia sp*
7	Pediastrum sp	*Cyclops sp*
8	Ankistrodesmus sp	*Mesocyclops sp*
9	Oocystis sp	*Cypris sp*
10	Crucigenia sp	
11	Euglena sp	
12	Phacus sp	
13	Cosmarium sp	
14	Clostrium sp	
15	Navicula sphaerophora	
16	Synedra ulna	
17	Navicula rhyncocephala	
18	Gomphonema sp	

3.10 Demography and Socio-Economics

In this section, the prevailing socio-economic aspects of people in the study area around the project boundary, which would form the basis for making planning

efforts for the socio-economic development of people in the study area, have been described.

3.10.1 Methodology Adopted for the Study

The methodology adopted for the study mainly includes review of published secondary data. The study area comes under Kichha, Udham Singh Nagar district, Uttarakhand state. The district census statistics of 2001, Udham Singh Nagar district of Uttarakhand state has been considered for the parameters of demography, occupational structure of people within the study area of 10 km radial distance from the periphery of the project site.

The village wise demographic data as per 2001 census is presented in **Annexure-X**. The salient features of the demographic and socio-economic aspects are described in the following sections.

3.10.2 Demographic Aspects

3.10.2.1 Distribution of Population

As per 2001 census, the study area consists of 191294 persons inhabited in the study area of 10 km radial distance from the periphery of the project. The distribution of population in the study area is given in **Table-3.10.1**.

TABLE-3.10.1
DISTRIBUTION OF POPULATION IN THE STUDY AREA

Sr.No.	Particulars	0-3 km	3-7 km	7-10 km	Total
1	No. of Households	2044	22994	9427	34465
2	Male Population	5896	37479	27641	101016
3	Female Population	5310	60053	24915	90278
4	Total Population	11206	127532	52556	191294
5	Male Population (0-6 years)	968	11716	4849	17533
6	Female Population (0-6 years)	902	10499	4849	17533
7	Total Population (0-6 years)	1870	22215	9279	33364
8	Average Household Size	5.5	5.5	5.6	5.6
9	% of males to the total population	52.6	29.4	52.6	52.8
10	% of females to the total population	47.4	47.1	47.4	47.2
11	Sex Ratio (no of females per 1000 males)	901	1602	901	894

Source: District Primary Census Statistics of Kichha, Udham Singh Nagar District, Uttarakhand - 2001

The males and females constitute about 52.8% and 47.2% in the study area respectively.

3.10.2.2 Average Household Size

The study area had an average family size of 6 persons per household in 2001. This is moderate family size and is in comparison with the other parts of the district.

3.10.2.3 Sex Ratio

The configuration of male and female indicates that the males constitute to about 52.8% and females 47.2% of the total population. The sex ratio i.e. the number

of females per 1000 males indirectly reveals certain sociological aspects in relation with female births, infant mortality among female children and single person family structure, a resultant of migration of industrial workers. The study area on an average has 894 females per 1000 males.

3.10.3 Social Structure

In the study area, about 15.6% population belong to Scheduled Tribes (ST) and 3.2% Scheduled Castes (SC) indicating that about 20% of the population in the study area belongs to socially weaker sections. The distribution of population in the study area by social structure is shown in **Table-3.10.2**.

TABLE-3.10.2
DISTRIBUTION OF POPULATION BY SOCIAL STRUCTURE

Sr. No	Particulars	0-3 km	3-7 km	7-10 km	Total
1	Schedule caste	1976	17037	4770	23783
2	% To the total population	17.6	13.4	9.1	12.4
3	Schedule Tribes	17	713	5365	6095
4	% To the total population	0.2	0.6	10.2	3.2
5	Total SC and ST population	1993	17750	10135	29878
6	% To total population	17.8	13.9	19.3	15.6
7	Total population	11206	127532	52556	191294

Source: District Primary Census Statistics of Kichha, Udham Singh Nagar Dstrict, Uttarakhand - 2001

3.10.4 Literacy Levels

The analysis of the literacy levels in the study area reveals an average literacy rate of 54% as per 2001 census data. The distribution of literates and literacy rates in the study area is given in **Table-3.10.3.**

The male literacy i.e. the percentage of literate males to the total males of the study area works out to be 62%. The female literacy rate, which is an important indicator for social change, is observed to be 21.3% in the study area.

TABLE-3.10.3
DISTRIBUTION OF LITERATE AND LITERACY RATES

Sr. No	Particulars	0-3 km	3-7 km	7-10 km	Total
1	Male Population	5896	37479	27641	101016
2	Female Population	5310	60053	24915	90278
3	Total Population	11206	127532	52556	191294
4	Male Population (0-6 years)	968	11716	4849	17533
5	Female Population (0-6 years)	902	10499	4849	17533
6	Total Population (0-6 years)	1870	22215	9279	33364
7	Male literates	3759	41407	17514	62680
8	Female literates	2242	27518	10954	40714
9	Total literates	6001	68925	28468	103394
10	Male literacy rate (%)	63.8	110.5	63.4	62.0
11	Female literacy rate (%)	20.0	21.6	20.8	21.3
12	Total Literacy rate (%)	53.6	54.0	54.2	54.0

Source: District Primary Census Statistics of Kichha, Udham Singh Nagar District, Uttarakhand - 2001

3.10.5 Occupational Structure

The occupational structure of residents in the study area is studied with reference to main workers, marginal workers and non-workers. The main workers include 4 categories of workers defined by the census department consisting of cultivators, agricultural laborers, those engaged in manufacturing, processing and repairs in household industry; and others including those engaged in household industry, construction, trade and commerce, transport and communication and all other services.

The marginal workers are those workers engaged in some work for a period of less than six months during the reference year prior to the census survey. The non-workers include those engaged in unpaid household duties, students, retired persons, dependents, beggars, vagrants etc.; institutional inmates or all other non-workers who do not fall under the above categories.

As per 2001 census records altogether the main workers works out to be 25.8% of the total population. The marginal workers and non-workers constitute to 5.5% and 68.7% of the total population respectively. The distribution of workers by occupation indicates that the non-workers are the predominant population. The occupational structure of the study area is given in **Table-3.10.4.**

TABLE-3.10.4
OCCUPATIONAL STRUCTURE

Sr. No	Particulars	0-3 km	3-7 km	7-10 km	Total
1	Total Population	11206	127532	52556	191294
2	Total workers	3489	39579	16850	59918
3	Work participation rate (%)	31.1	31.0	32.1	31.3
4	Total main workers	2726	33218	13444	49388
5	% of main workers to total population	24.3	26.0	25.6	25.8
6	Marginal workers	763	6361	3406	10530
7	% of marginal workers to total population	6.8	5.0	6.5	5.5
8	Non-workers	7717	87953	35706	131376
9	% of non-workers to total population	68.9	69.0	67.9	68.7

Source: District Primary Census Statistics of Kichha, Udham Singh Nagar District, Uttarakhand – 2001

3.10.6 Infrastructure Facilities

The infrastructure and amenities available in the study area denotes the economic well being of the region. Reasonably good levels of infrastructure facilities are available in the study area, which consists of education, health care, communications, transportation, etc.

A review of infrastructure facilities available in the area has been done based on the available secondary data published in the Kichha, Udham Singh Nagar district primary census abstract. The infrastructure facilities available in about 51 villages of Kichha, Udham Singh Nagar district are covered within the study area. The village-wise infrastructure facilities available as per census records are presented in **Annexure-X**.

3.10.6.1 Educational Facilities

The educational facilities are almost evenly distributed in the area. In all, there are 83 primary schools, 14 middle schools and 2 secondary school. All the high schools are situated in larger villages. A few smaller villages are devoid of any educational

institutions. The available educational facilities in the area are given in **Table-3.10.5**.

TABLE-3.10.5
EDUCATIONAL FACILITIES IN THE STUDY AREA

Sr. No.	Institution	Total
1	Educational facilities	
2	Primary schools	83
3	Middle schools	14
4	Secondary schools	2
5	Adult Education Centers	0
6	Other Education Centers	0

Source: District Primary Census Statistics of Kichha, Udham Singh Nagar District, Uttarakhand – 2001

3.10.6.2 Health Facilities

Different types of health facilities including hospitals, dispensaries and clinics are available in the study area. The health facilities include health centers are 3, and primary health centers are 4; there is no dispensary and others as shown in **Table-3.10.6**.

TABLE- 3.10.6
HEALTH FACILITIES IN THE STUDY AREA

Sr. No.	Type of Institution	No. of Institutions in Study Area
1	Medical facilities	77
2	No. of Maternity and Child Welfare Center	0
3	No. of Maternity Home	5
4	No. of Child Welfare Center	7
5	No. of Health Center	3
6	No. of Primary Health Center	4
7	No. of Family Welfare Center	3
8	No. of Nursing Home	0
9	No. of Registered Private Medical Practitioners	4
10	No. of Subsided Medical Practitioners	0
11	Other Medical Facilities	1

Source: District Primary Census Statistics of Kichha, Udham Singh Nagar District, Uttarakhand – 2001

3.10.6.3 Transport Facilities

The study area has moderate level of communication network.

3.10.6.4 Post and Telegraphs

The study area has 11 Post offices and 1 Telegraphic service.

3.10.6.5 Electrification

Almost all villages in the study were electrified. Electricity was supplied for domestic, agricultural, industrial and public lighting purposes. Subsequently the electric connections have been given to many other villages.

3.10.6.6 Drinking Water Facility

Water supply in the study area is mainly from wells, hand pumps followed by Tube wells and tanks.

3.11 Traffic Density

The traffic studies have been conducted to know the prevailing traffic volumes on the existing roads. It is essential to consider these details for assessing the anticipated future traffic volumes as a part of overall impact assessment for the project.

The variations of traffic densities depend upon the working days and time and also vary in day and night times. In order to assess the prevailing traffic volumes on the roads, the survey was conducted during normal working days of the week by avoiding local holidays or abnormal situations to reflect the true picture of the traffic densities. The traffic study was conducted at four locations for 24 hours.

3.11.1 Methodology

3.11.1.1 Vehicle Count

The vehicles passing through the road (in both ways) were counted separately for 24 hours at the four selected locations from 0600 hrs to 0600 hrs next day continuously. Category-wise vehicle counting has been done continuously and recorded in the traffic volume count on hourly basis under respective categories.

3.11.1.2 Categorization of Traffic

The engine driven vehicles were categorized into various heads viz. Trucks/Bus, Light Carriage Vehicles (LCV), Car/Jeep, Multi Axle Vehicles, Two/Three Wheelers and Cycles/others.

3.11.2 Sampling Locations

The four traffic locations are represented in **Table-3.11.1.**

TABLE-3.11.1
DETAILS OF TRAFFIC MONITORING LOCATIONS

Location Code	Location Details
T-1	Rudrapur to Haldwani
T-2	Delhi to Haldwani
T-3	Plant site to Dineshpur road
T-4	Rudrapur to Pantnagar

3.11.3 Presentation of Results

The present level of traffic has been converted to Passenger Car Units (PCU) at all the locations as per the conversion factors stipulated by Indian Road Congress (IRC).

- **Pre-Monsoon Season-2009**

The Passenger Car Unit (PCU) recorded at the selected traffic locations ranged between 1680-4738. The maximum PCU of 4738 was recorded on the Rudrapur to

Haldwani (T1) and the minimum PCU of 1680 was recorded on Plant site to Dineshpur road (T3).

- **Post monsoon and part of winter Season-2010**

The Passenger Car Unit (PCU) recorded at the selected traffic locations ranged between 1822-4988. The maximum PCU of 4988 was recorded on the Rudrapur to Haldwani (T1) and the minimum PCU of 1822 was recorded on Refinery site to Dineshpur road (T3). The details of traffic volume at each location are summarized in **Table-3.11.2**.

TABLE-3.11.2 (A)
TRAFFIC DENSITY (VEHICLES/DAY) - PRE-MONSOON SEASON-2009

Code	Location	2/3 Wheelers	Car/Jeep	Tractors	Buses	Truck's/Multi Axels/ Trailors/Tankers	Total PCU'S
T1	Rudrapur to Haldwani	1012	560	416	81	727	4738
T2	Delhi to Haldwani	1186	575	237	84	496	3619
T3	Plant site to Rudrapur road	818	296	133	19	173	1680
T4	Rudrapur to Pantnagar	1054	527	207	52	524	3403

PCU rating: 2/3 wheelers: 0.5, Car/Jeep: 1.0, Tractor: 3.0, Buses: 3.0, Trucks/HMV: 3.0)

TABLE-3.11.2 (B)
TRAFFIC DENSITY (VEHICLES/DAY)- POST MONSOON AND PART OF WINTER SEASON-2010

Code	2/3 Wheeler	Car/Jeep	Tractor	Buses	Others	Total PCU
		LMV				
T1	**1055**	**599**	**433**	**95**	**759**	4988
T2	1139	588	248	99	445	3534
T3	876	301	158	30	173	1822
T4	1041	530	213	54	558	3526

PCU rating: 2/3 wheelers: 0.5, Car/Jeep: 1.0, Tractor: 3.0, Buses: 3.0, Trucks/HMV: 3.0)

With present level of traffic and the increase in existing traffic due to the project during operational phase has been estimated by comparison with the recommendations stipulated by Indian Road Congress (IRC). The IRC recommendations on traffic capacity are presented below in **Table-3.11.3**.

TABLE-3.11.3
RECOMMENDATIONS ON TRAFFIC CAPACITY - IRC

Sr. No.	Category of Road	Maximum PCU/day
1	Two lane roads (7-m) with earthen shoulders	15,000
2	4-lane highway with earthen shoulders	35,000

As per the above standards the roads are two lane roads having maximum capacity of 15000 PCU/day. The estimated peak traffic in terms of PCUs is compared with the stipulated standards by IRC for traffic capacity of the existing road network.

4.0 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.1 Introduction

This chapter presents identification and appraisal of various impacts from the proposed melting and casting facilities for zinc and lead in the study area based on the inventory of pollution sources as well as the baseline setting described. The proposed project site is a part of the notified industrial area of State Industrial Development Corporation Uttarakhand Limited (SIDCUL) Pantnagar, Uttarakhand where HZL is setting up a Silver Refinery. The silver refinery plant is under advance stage of implementation and likely to be commissioned by March 2011.

The environmental impacts are categorized as either primary or secondary. Primary impacts are those, which are attributed directly to the project and secondary impacts are those, which are indirectly induced and typically include the associated investment and changed pattern of social and economic activities by the proposed action.

The impacts have been assessed for the proposed melting and casting facilities for zinc and lead assuming that the pollution due to the existing activities has already been covered under baseline environmental monitoring and continue to remain same till the operation of the project.

The proposed project is likely to create impact on the environment in two distinct phases:

- During the construction phase which may be regarded as temporary or short term; and

- During the operation phase which would have long term effects.

The construction and operational phase of the proposed melting and casting facilities for zinc and lead comprises of various activities each of which may have an impact on some or other environmental parameters. Various impacts during the construction and operation phase on the environment parameters have been studied to estimate the impact on the environment. The details on impacts of the project activity on each of the environmental attributes are discussed in the subsequent sections.

Mitigation measures at the source level and an overall Management Plan at the study area level are elicited so as to improve the supportive capacity of the study area and also to preserve the assimilative capacity of the receiving bodies.

The environmental attributes, which are likely to be affected in the region, are air, noise, water, land, biological and socio-economic environment.

The Environment Management Plan aims at controlling pollution at the source level to the extent possible, with the available and affordable technology, followed by treatment measures before they are discharged.

4.2 Impacts during Construction Phase

This includes the following activities related to leveling of site, construction of related structures and installation of related equipment.

4.2.1 Impact on Land Use

Udham Singh Nagar was a portion of district Nainital before the Tarai belt was separated to form the present Udham Singh Nagar on 30/09/1995. In the past this land which is full of forest land was neglected till 1948 due to difficult climate. marshy lands, extreme heat, rains which lasted months, a place full of wild animals, diseases and no means of transportation prevented the human race to form a colony here. The history of development started with 1948, when the problem of partition brought refugee problem with it.

This area was actually a dense forest near Himalayan foothills and the government was using this area to rehabilitate Hindu/ Sikh migrants from West Pakistan, in the aftermath of the partition. Before 2002, the G.B. Pant University owned 16,000 acre (65 km^2), out of which 3,339 acre (13.51 km^2) was transferred to State Infrastructure and Industrial Development Corporation of Uttaranchal (SIDCUL) for developing an Integrated Industrial estate, thus leaving present 12,661 acre (51.24 km^2) with the university.

The plant site is of 10 ha area consisting industrial area land. The land has already been acquired and is in possession of HZL with the ongoing construction of the silver plant. This land is part of notified industrial estate of State Industrial Development Corporation Uttarakhand Limited (SIDCUL) Pantnagar, Uttarakhand. Documentary evidence for industrial area is attached as **Annexure-III.** However, it is proposed to develop adequate greenbelt to cover more than 33% of the plant area. Since the area is a notified industrial area there would not be any change in the industrial land use.

4.2.2 Impact on Soil

The soil at the project site predominantly consists of clay. The sub-strata of this area is not rocky and as such no blasting is envisaged for either leveling or during foundation work and the site needs some grading, filling and leveling.

The construction activities will result in loss of topsoil to some extent in the plant area. The topsoil requires proper handling like separate stacking so that it can be used for green belt development. Apart from localized construction impacts at the plant site, no significant adverse impact on soil in the surrounding area is anticipated.

4.2.2.1Mitigation Measures Proposed for Land Environment

The following measures shall be adopted:

- After completion of the construction phase, the surplus earth shall be utilized to fill up the low lying areas, the rubble shall be cleared and all un-built surfaces will be reinstated;

- The top soil from the excavated areas shall be preserved in separate stacks for reuse during the plantation;

- Green belt development and related activities shall be taken up so that plantation will grow to adequate height by the time of plant commissioning. Thus, green belt will be effective in containing the fugitive emissions during operation, if any;

- Species selected in this plantation shall be fast growing and they shall be adaptable to local conditions. Their ability to combat localized pollution is the prime factor for their selection and placement in the planting grid/pattern. Most of the varieties shall be eco-friendly i.e. generate lot of oxygen while helping reduce/absorb gases and dust;

- Entire plant shall be aesthetically landscaped and as much as feasible natural gradient shall be maintained; and

- Plantation outside the plant premises, in the near by villages shall be encouraged by supplying free saplings to the villagers.

4.2.3 Impact on Air Quality

During construction phase, suspended particulate matter will be the main pollutant, which would be generated from the site development activities and vehicular movement on the road. Further, concentration of NO_x and CO may also slightly increase due to increased vehicular traffic movement. However, increase in ambient concentrations of air quality will be negligible. As most of the construction equipment will be mobile, the emissions are likely to be fugitive. The dust generated will also be fugitive in nature, which can be controlled by sprinkling of water. The impacts will be localized in nature and the areas out side the project boundary are not likely to have any major adverse impact with respect to ambient air quality.

4.2.3.1Air Pollution Management

There will not be any major leveling operations required as the plant site is having a gradual gradient. Hence, no significant excavation of the area except for the purpose of foundations is envisaged. However, during dry weather conditions, it is necessary to control the dust generated by excavation and transportation activities. This will be achieved by regular water sprinkling. Ambient air levels of SO_2, NOx and SPM are likewise expected to increase due to operation of construction machinery such as bulldozers, pay loaders, trucks etc. However, these levels are expected to be insignificant since these machines will be operated intermittently. Moreover most of the items are movable. Hence, there will not be any concentration of emissions at any single point. It shall be ensured that both petrol and diesel powered construction vehicles are properly maintained

to minimize smoke in the exhaust emissions. Additional recommendations include the following:

- Sprinkling of water shall be done at frequent intervals by preferably using truck-mounted sprinklers;
- Sprinkling of water will be done along the roads and work zone areas to reduce the fugitive dust; and
- Construction equipment shall be maintained and serviced regularly such that the gaseous emissions from these equipment are maintained within the design specifications.

Since electrical power is available near to this plant, attempts shall be made to utilize the electrically powered machinery to the extent possible to minimize the emissions of SO_2 and NOx during construction.

4.2.4 Impact on Water Resources and Quality

The peak water requirement during construction will be about 100 m^3/day, which will be drawn from ground wells located suitably apart.

The wastewater generation during the construction period will be from the sanitary units provided for the workers. This waste will be treated in septic tanks and discharged into soak pits. Hence, there will not be any impact on the water regime due to discharge of treated wastewater.

4.2.4.1Water Quality Mitigation Measures

Settling pond is planned for storage and recycling of surface water for use in the plant area. Also development of green belt in and around plant will be taken up during the monsoon season. In plant roads will be concreted. Soil binding and fast growing vegetation will be grown within the plant premises to arrest the soil erosion.

4.2.5 Impact on Noise Levels

The major sources of noise during the construction phase are vehicular traffic, construction equipment like dozers, scrapers, concrete mixers, cranes, pumps, compressors, pneumatic tools, saws, vibrators etc. The operation of these equipments will generate noise ranging between 85-90 dB (A) near the source. These noises will be generated within the plant boundary and will be transient in nature.

4.2.5.1Noise Levels Mitigation

Equipments will be maintained appropriately to keep the noise level within 85 dB (A). Wherever possible, equipment will be provided with silencers and mufflers. High noise producing construction activities will be restricted to day time only. Greenbelt will be developed from construction stage. Further, workers working in

high noise areas will be provided with necessary protective devices e.g. ear plug, ear-muffs etc.

4.2.6 Impact on Ecology

The proposed project site is a part of the notified industrial estate of State Industrial Development Corporation Uttarakhand Limited (SIDCUL) Pantnagar, Uttarakhand where HZL is setting up a Silver Refinery. The initial construction works at the project site involves land clearance. Plantation will be developed during construction to improve the aesthetic value in the area and to screen out the fugitive dust generated during construction of melting and casting plant.

The removal of vegetation from the soil and loosening of the topsoil generally causes soil erosion. However, such impacts will be primarily confined to the project site during initial periods of the construction phase and will be minimized through adoption of mitigative measures like paving and surface treatment, water sprinkling and appropriate plantation program. The project site will be extensively landscaped with the development of plantation consisting of a variety of taxa, which would enrich the ecology of the area and add to the aesthetics.

The site is devoid of tree and appropriate measures will be taken to avoid the soil erosion.

The wastewater coming from heavy machinery will be treated to remove oil & grease and suspended solids in the detention tank before utilizing for plantation and sprinkling to suppress the dust.

4.2.6.1 Mitigation Measures

Greenbelt as per CPCB guidelines will be developed in plant area.

4.2.7 Impact on Socio-economics

It has been brought out during the socio-economic survey that non-workers constitute about 70% of the total population in 10 km radius study area. Some of them will be available for employment in the proposed project during construction activities. As the labourers are generally un-skilled, the locals would get opportunities for employment during construction activities. The peak labour force required during the construction period is estimated to be about 200 to 500 per day and preference will be given to local laborers particularly unskilled labours.

In addition to the opportunity of getting employment as construction labourers, the local population would also have employment opportunities in related service activities like petty commercial establishments, small contracts/sub-contracts and supply of construction materials for buildings and ancillary infrastructures etc. Consequently, this will contribute to economic upliftment of the area.

Normally, the construction activity will benefit the local populace in a number of ways, which include the requirement of construction labourers skilled, semi-skilled and un-skilled, tertiary sector employment and provision of goods and

services for daily needs including transport. In line with the above, some more recommendations are given below:

- Local people shall be given preference for employment;
- All the applicable guidelines under the relevant Acts and Rules related to labour welfare and safety shall be implemented during the construction work;
- The contractor shall be advised to provide fire wood/kerosene/LPG to the workers to prevent damage to trees; and

The construction site shall be secured with fencing and shall have guarded entry points.

4.2.8 Storage of Hazardous Material

The hazardous materials used during construction may include petrol, diesel, welding gas and paints. These materials shall be stored and handled carefully under applicable safety guidelines.

Some of the precautions of storage include the following:

- Dyked enclosures shall be provided so as to contain complete contents of the largest tank;
- Diesel and other fuels shall be stored in separate dyke enclosures;
- Tanks having a diameter of more than 30 m shall be separated by fire insulating walls from other storage tanks; and
- The distance between the storage tanks shall be at least half their height.

4.2.9 Facilities to be provided by the Labour Contractor

The contractor shall be asked to provide following facilities to construction work force:

*First Aid***:** At work place, first aid facilities shall be maintained at a readily accessible place where necessary appliances including sterilized cotton wool etc. shall be available. Ambulance facilities shall be kept readily available at workplace to take injured person to the nearest hospital.

*Potable Water***:** Sufficient supply of cold water, fit for drinking shall be provided at suitable places.

Sanitary Facility: Within the precinct of work place, latrines and urinals shall be provided at accessible place. These shall be kept in a good sanitary condition. The contractor shall conform to sanitary requirement of local medical and health authorities at all times.

Canteen: A canteen on a moderate scale shall be provided for the benefit of workers.

Security: HZL shall provide necessary security to work force in co-ordination with State authorities.

4.3 Impacts during Operational Phase

The following activities related to the operational phase will have varying impacts on the environment and are considered for impact assessment:

- Topography and climate;
- Land use;
- Soil quality;
- Air quality;
- Water resources and quality;
- Solid waste;
- Noise levels;
- Terrestrial ecology;
- Aquatic ecology;
- Demography and socioeconomics; and
- Infrastructural facilities.

4.4 Impact on Topography and Drainage

The area is characterized by plain topography with gradual slope. The average elevation of the site is about 220 m above mean sea level.

For this infrastructure, no surface drainage is required to be modified/diverted; as such no disturbance shall be caused to the natural drainage system. Hence, the impact on the topography and drainage of the core zone will not be significant.

4.5 Impact on Land Use

The proposed project site is a part of the notified industrial estate of State Industrial Development Corporation Uttarakhand Limited (SIDCUL) Pantnagar, Uttarakhand where HZL is setting up a Silver Refinery. The total land requirement for the melting and casting facilities for zinc and lead will be 3.5 ha. The landuse of melting and casting facilities for zinc and lead plant is broadly classified as given in **Table-4.1**.

There is no forest land involved in the project. The proposed project site is already a part of Notified Industrial Area administered by State Industrial Development Corporation Limited (SIDCUL), Dept. of Industries, Govt. of Uttarakhand hence there will be no change in the landuse of the area.

TABLE-4.1
LANDUSE PROPOSED FOR THE PLANT

Sr. No.	Facilities	Silver Plant (under Implementation) (ha)	Proposed Zinc & Lead Melting & Casting Plant (ha)	Total Area (ha)
1	Silver refinery section	1.5	-	1.5
2	Zinc Melting & Casting section	-	2.0	2.0
3	Lead Melting & Casting section	-	1.0	1.0
4	Utilities	0.5	0.5	1.0
5	Administration Block	0.3	-	0.3
6	Roads and Drains	0.2	0.3	0.5
7	Greenbelt	0.75	2.75	3.5
8	Open space	6.75	-	0.2
	TOTAL	**10.0**	**-**	**10.0**

4.6 Impact on Soil

Most of the impacts of proposed 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 probable sources of degradation of soil quality from melting and casting facilities for zinc and lead are:

1. Disposal of wastewater generated from the melting and casting facilities for zinc and lead; and
2. Deposition of fugitive dust or stack emissions emanating from the plant.

In the proposed project activity, wastewater will not be discharged outside the premises. There will be zero discharge from the project site. The sanitary and other wastewater will be treated suitably and will be reused for plantation development and other activities.

However, the fugitive emissions are likely to be controlled to a great extent through proposed control measures like bag filters. The plantation of adequate width around the plant will help in arresting the fugitive emissions. Due care will be taken for minimum damage of top soil. The proposed plantation in the plant area will act as an effective barrier for control of dust. The following management measures shall be adopted:

- As soon as construction is completed, the surplus earth shall be utilized to fill up the low lying areas, the rubbish is to be cleared and all unbuilt surfaces be reinstated;

- The proposed plantation shall be locally available and sustainable species shall only be chosen for plantation;

- Plantation shall be taken up along with the construction work so that plantation will grow to adequate height by the time of plant commissioning. Thus, plantation will be effective in containing the pollutants due to the plant operation; and

- The contractor shall arrange for free supply of kerosene/firewood to the migrant construction workers for their cooking needs to prevent the damage to trees.

4.6.1 Fugitive Emissions

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 bag filters. The plantation of adequate width around the plant will help in arresting the fugitive emissions.

4.7 Impact on Air Quality

4.7.1 Existing Silver Plant (Under Implementation)

The ambient air quality with respect to the buffer zone of 10 km radius around the periphery of proposed silver plant represents industrial environment. The major air pollutants emitting from the silver plant will be gaseous (NOx) and particulates. Proper control measures are being installed by project authorities to minimize the stack emissions within the stipulated permissible limits prescribed by National Ambient Air Quality Standards.

The major sources of air pollutants are:

- Off gases from furnaces;
- Fumes from furnace tap holes;
- NOx from silver electrolysis section;
- Dust collection system; and
- Emissions of DG set (emergency).

➢ ***Dust Collection***

According to the off-gas conditions and characteristic of the dust, the flow of dust collection is determined as below:

Noble furnace→ Cooling duct → Bag filter → Fan → Discharge

Cupel furnace → Cooling duct → Bag filter → Fan → Discharge

The off-gas of cupel furnace and noble furnace will be of small quantity of off-gas, having low dust content. The off-gas will be cooled first in cooling ducts and then filtered by the bag filter before letting out to atmosphere.

The collected dust from the cooling duct and bag filter will be conveyed by the drag chain conveyors and rotary valve before it is collected in dust pots. The

discharge from the stack will conform to the regulatory requirement of less than 50 mg/Nm^3 of dust. The gases will be discharged through a stack of 40 m height to ensure better dispersion of the pollutants.

- ***Hygiene Ventilation***

In the silver plant, pyro section (Cupel furnace and Noble furnace), there may be occasional fugitive emissions from the furnace tap holes & launders. To ensure the good operating & working condition, well designed hygiene ventilation system is provided. Industrial fans are used in the furnace area to lower the ambient temperature and improve the working conditions for operators.

Nitrogen oxide is formed when silver electrolyte is prepared. The NOx generated from the preparation tank is removed by effective hygiene system. This NOx containing gas is passed through a fiber glass purification tower where alkali solution (sodium hydroxide solution) is sprayed to absorb the NOx in the off-gas. Then, it is let out to the atmosphere. To improve efficiency, double-stage absorption tower is adopted and the total absorption efficiency is above 98%.

DG set will use HSD/LSHS/HFO as fuel. In case of HFO, Flue gas Desulphurisation (FGD) system shall be used to reduce sulphur dioxide emissions from exit gases. The efficiency of reduction in FGD's considered as 75% & above. The gases will be discharged through a stack of 20 m height to ensure better dispersion of the pollutants.

4.7.2 Melting & Casting Facilities for Zinc and Lead

The emissions from the plants will be;

- Suspended Particulate matter from stacks;
- Sulphur dioxide in flue gases;
- Fugitive emissions;
- Dust from raw material & fume handling; and
- Dust from vehicle movement.

The sources of pollution from zinc section will be particulate matter from the furnace. The source of pollution from lead section will be Lead fumes from melting pots. Proper control measures are being installed by project authorities to minimize the stack emissions within the stipulated permissible limits prescribed by National Ambient Air Quality Standards.

The furnace flue gases from zinc section will be collected and passed through bag filter where particulate matter will be removed in bag filters before letting it out to atmosphere through the stack of 30 m height. The stack will be provided for better dispersion and the Bag filters having 99.9 % efficiency will be provided to control Particulate Matter emission to less than 50 mg/Nm^3.

Lead fumes from lead section will be collected by suction hoods above the melting pots and passed through the bag filter where the lead dust will be collected and sent back to raw material handling section for recycling into the smelter.

Centrifugal fan will be used to circulate the air. After de-dusting the clean air will be ejected into the atmosphere ensuring lead emissions below stipulated norms through the stack of 40 m height. LSHS/HFO will be used as a source of energy for furnace, and the off-gas generating from the combustion chamber will also be passed through the same stack of 40 m. The stack of 40 m height will be provided for better dispersion and the PM emissions will be ensured less than 50 mg/ Nm^3. In case of using HFO as fuel, Flue gas Desulphurisation (FGD) system shall be used to reduce sulphur dioxide emissions from exit gases. The efficiency of reduction in FGD's considered as 75% & above.

The furnace system will be provided with a dedicated hygiene ventilation system comprising of hygiene suction hood, ducting, hygiene fan with bag filter to cover the secondary fugitive emission from the following points:

1. Raw material handling area;
2. Process intermediate handling area; and
3. Furnaces.

The fugitive emission collected from all these locations will pass though bag filters for the removal of particulate matter and the purified gas will be discharged through stack of adequate height. The dust collected by the bag filter will be returned to the raw material bin for feeding back to the furnace.

DG set used during the emergency will use LSHS/HFO/ HSD as fuel. The gases will be discharged through a stack of 20 m (1 DG set-500 KVA) and 50m (3 DG sets-5.5 MW) height to ensure the better dispersion of the pollutants. In case of using HFO as fuel, Flue gas Desulphurisation (FGD) system shall be used to reduce sulphur dioxide emissions from exit gases. The efficiency of reduction in FGD's considered as 75% & above.

4.7.3 Details of Mathematical Modelling

Prediction of impacts on air environment has been carried out employing mathematical model based on a steady state gaussian plume dispersion model designed for multiple point sources for short term. In the present case, **Industrial Source Complex [ISC3]** dispersion model based on steady state gaussian plume dispersion, designed for multiple point sources for short term and developed by United States Environmental Protection Agency [USEPA] has been used for simulations from point sources.

- ***Model Input Data***

The air pollution modeling carried out represents the worst case scenario. During worst case, all 4 DG sets will be in operation. During normal running hours, as the power required for the proposed plant will be supplied by state grid, there will not be any DG set operation. SO_2 and NOx emissions from the proposed project are due to the DG set and furnace operations. Hence during the normal operating conditions, the pollutant concentration will be much less than the worst case scenario projected in the following paragraphs. The pollutants considered for modeling include sulphur dioxide, suspended particulate matter, lead and Oxides

of Nitrogen. The details of the stack and emissions envisaged from the proposed plant are given in **Table-4.2.**

It may be noted that during the operation of the plant, all the units will not be in operation simultaneously. However, for the purpose of calculating the worst case impact, all the units are considered to be working simultaneously with the maximum emission limits. In actual practice, the stack emissions and the impact will be much less than the predicted values.

The proposed project site is a part of the notified industrial estate of State Industrial Development Corporation Uttarakhand Limited (SIDCUL) Pantnagar, Uttarakhand where HZL is setting up a Silver Refinery. The proposed silver refinery is also considered for modeling computations.

- ***Meteorological Data***

The hourly meteorological data recorded at site for the period from 1st March 2009 to 31st May 2009 covering Pre-monsoon season 2009 and 1st October to 31st December 2010 covering Post monsoon and part of winter season 2010 is converted to the mean meteorological hourly data as specified by CPCB and the same has been used in the model. The mean meteorological data recorded at the site has been used for the modelling. The detailed emission rate and stack height calculations are presented in **Annexure-XI**.

➢ **Presentation of Modeling Results**

The simulations were done to evaluate PM, SO_2, NOx and lead likely to be contributed by the proposed facility. For the short term simulations, the concentrations were estimated around 1200 receptor points chosen to obtain an optimum description of variations in concentrations over the site in 10 km radius covering 16 directions. The incremental concentrations are estimated for each season.

The predicted incremental ground level concentrations (GLCs) for PM, SO_2, NOx and lead likely to be contributed by the proposed melting and casting facilities for zinc and lead and the silver plant are presented in **Table-4.3**. The isopleth depicting short term 24 hourly incremental GLCs of PM, SO_2, NOx and lead for pre-monsoon and post monsoon and part of winter seasons in 10 km radius are shown in **Figure-4.1**.

TABLE-4.2
DETAILS OF STACK EMISSIONS

Sr. No.	Parameters	Units	Silver refinery (under implementation)		DG Set Stack		Zinc and Lead Melting and Casting Plant (Proposed)		
			Process stack	Hygiene stack	Stack-1 (under implementation)	Stack-2 (proposed)	Lead melting pot	Zinc plant	
			Stack#1	Stack#2				Melting Furnace 1+ Dross Plant	Melting Furnace 2+ Dross Plant
1	Stack height	M	40	30	20	50	40	30	30
2	Total number of flues in stack	no.	1	1	1	1	1	1	1
3	Diameter of stack	m	1.3	1.3	0.2	1.8	1.2	1.2	1.2
4	Flue gas velocity	m/sec	25	7.3	6.35	27.4	30.4	24.61	24.61
5	Flue gas temperature*	^{o}C	60	60	350	350	120	100	100
6	Volumetric flow rate	Nm^3/sec	33.6	9.7	0.2	33.3	34.4	22.2	22.2
7	Emissions								
A]	Sulphur dioxide	g/sec	2.50	Nil	0.6	21.54	7.08	Nil	Nil
B]	Oxides of Nitrogen	g/sec	0.65	2.91	0.14	23.31	1.85	Nil	Nil
C]	Suspended Particulate Matter	g/sec	1.68	Nil	0.01	1.67	1.72	1.11	1.11
D]	Lead	g/sec	-	-	-	-	0.34	-	-

* in case of using HFO, the temperature shall be approx. 50^0 C for DG set and melting pot

TABLE-4.3
SHORT TERM INCREMENTAL CONCENTRATIONS (GLCs)

Parameter	Concentration (μg/m³)	Distance (km)	Direction
Pre-Monsoon Season, 2009			
PM	2.3	1.4	NW
SO_2	13.7	1.4	NW
NOx	13.9	1.4	NW
Lead	0.1	1.4	NW
Post monsoon and part of winter Season, (October to December 2010)			
PM	5.9	1.4	E
SO_2	13.9	1.4	E
NOx	10.5	1.4	E
Lead	0.1	1.4	E

- ***Comments on Predicted Concentrations***

A perusal of results reveals that the maximum incremental short term 24 hourly ground level concentrations for Particulates, SO_2, NOx and lead to be encountered during pre-monsoon season are 2.3 μg/m³, 13.7 μg/m³, 13.9 μg/m³ and 0.1 μg/m³ respectively occurring at a distance of about 1.4 km in the NW direction and during post monsoon and part of winter season are 5.9 μg/m³, 13.9 μg/m³, 10.5 μg/m³ and 0.3 μg/m³ occurring at a distance of about 1.4 km in the East direction.

- ***Resultant Concentrations after Implementation of the Project***

The maximum incremental GLCs due to the proposed project for PM, SO_2 and NOx are superimposed on the maximum baseline PM, SO_2, NOx and lead concentrations recorded during the study period in the Northwest direction to arrive at the likely resultant concentrations during the same period after implementation of the proposed project. The cumulative concentrations (baseline+incremental) after implementation of the project are tabulated below in **Table-4.4**.

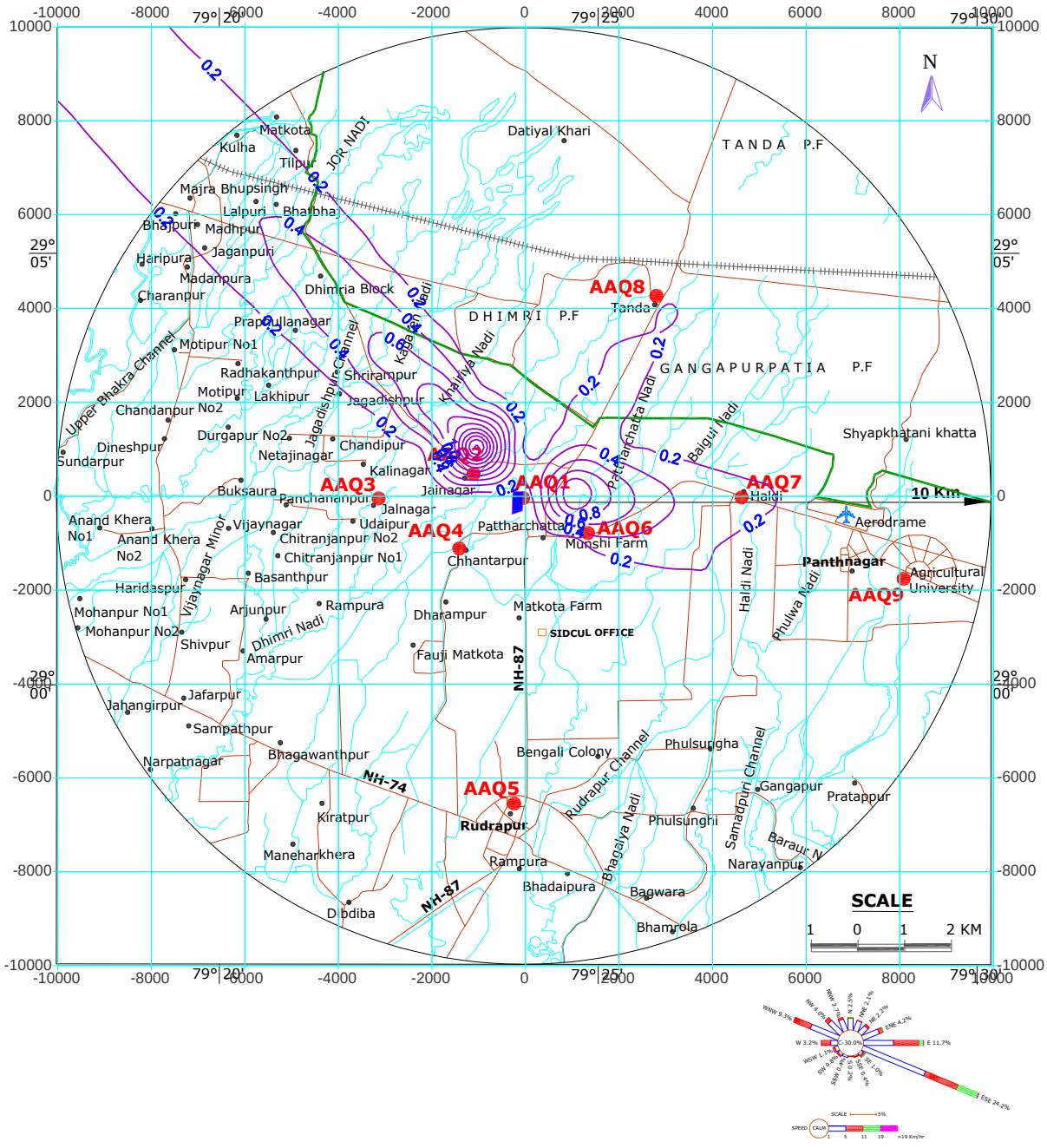


FIGURE-4.1 (A)
SHORT TERM 24 HOURLY INCREMENTAL GLCs OF PM-PRE-MONSOON SEASON

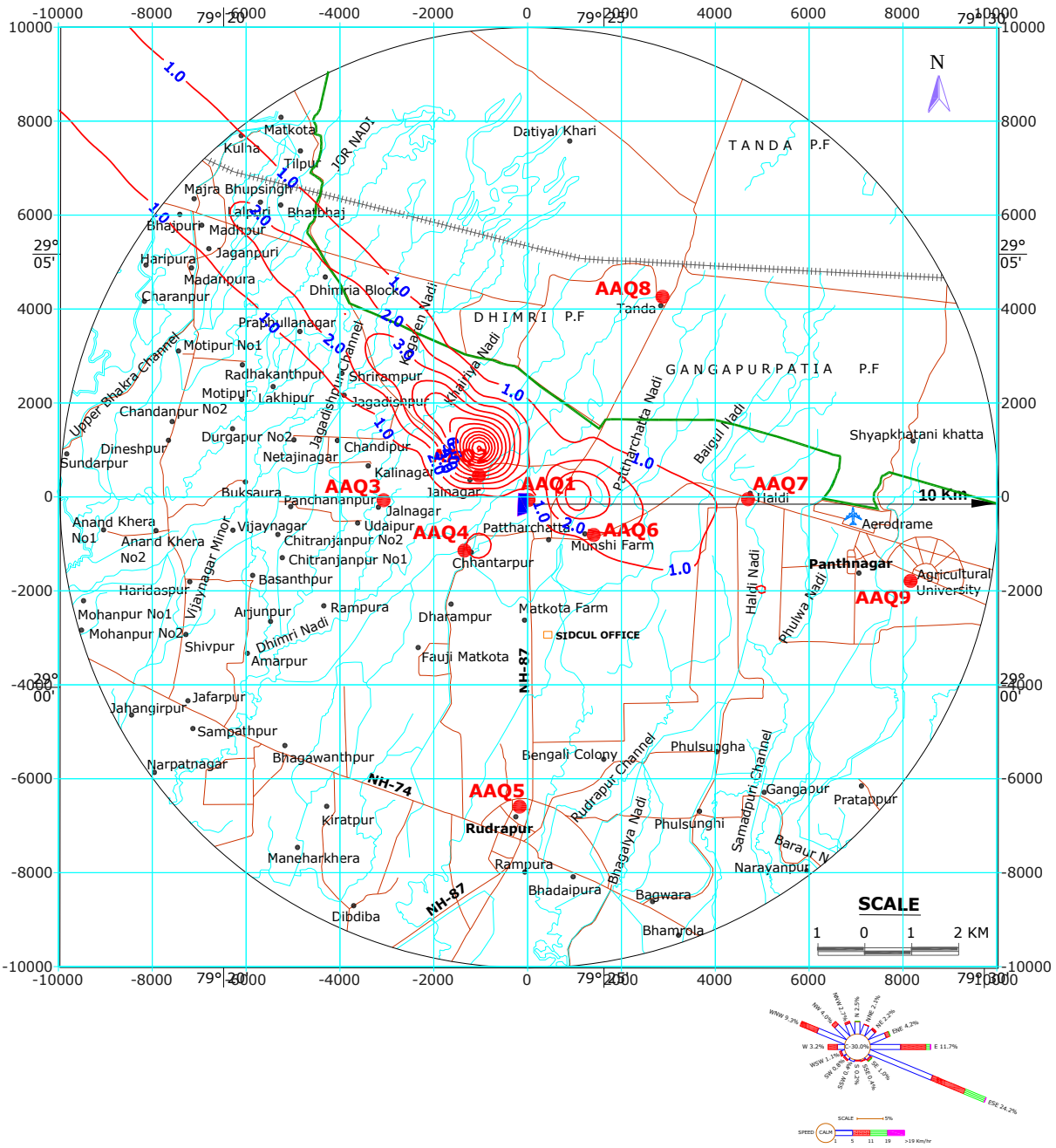


FIGURE-4.1 (B)
SHORT TERM 24 HOURLY INCREMENTAL GLCs OF SO_2-PRE-MONSOON SEASON

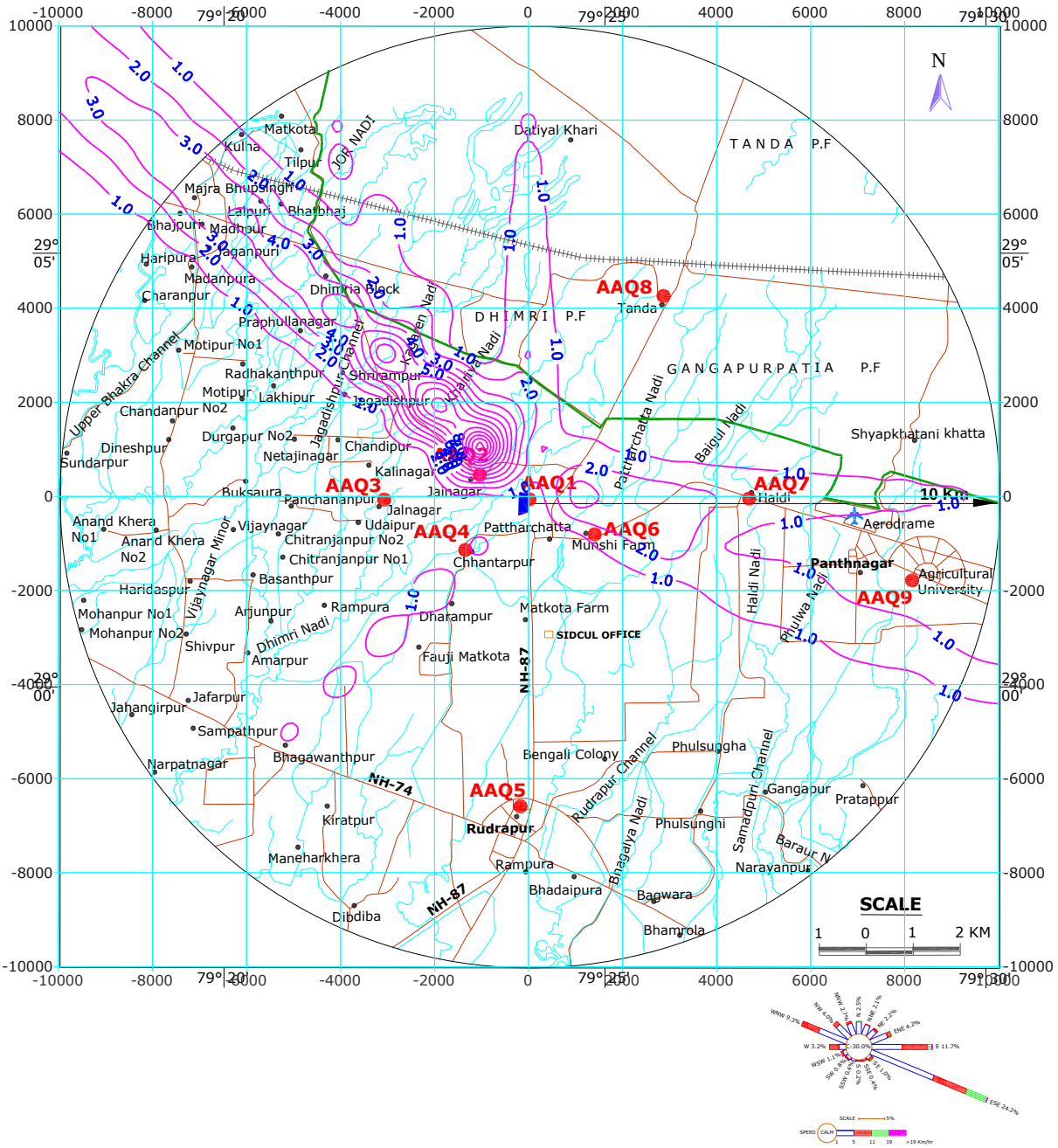


FIGURE-4.1 (C)
SHORT TERM 24 HOURLY INCREMENTAL GLCs OF NO_X-PRE-MONSOON SEASON

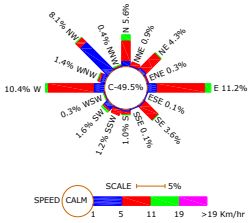

N 5.6%
NNE 0.9%
NE 4.3%
ENE 0.3%
E 11.2%
ESE 3.6%
SE 0.1%
SSE 0.1%
S 1.0%
SSW 1.2%
SW 1.6%
WSW 0.3%
W 10.4%
WNW 1.4%
NW 6.1%
NNW 0.4%
C 49.5%
SCALE 5%
SPEED CALM
1 5 11 19 >19 Km/hr

FIGURE-4.1 (D)

SHORT TERM 24 HOURLY INCREMENTAL GLCs OF SPM-POST MONSOON AND PART OF WINTER SEASON

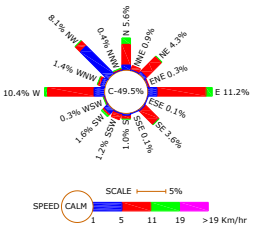


FIGURE-4.1 (E)

SHORT TERM 24 HOURLY INCREMENTAL GLCs OF SO_2- POST MONSOON AND PART OF WINTER SEASON

FIGURE-4.1 (F)

SHORT TERM 24 HOURLY INCREMENTAL GLCs OF NO_X- POST MONSOON AND PART OF WINTER SEASON

TABLE-4.4
RESULTANT CONCENTRATIONS DUE TO INCREMENTAL GLC's

Pollutant	Baseline Concentration ($\mu g/m^3$)	Incremental Concentration ($\mu g/m^3$)	Resultant Concentration ($\mu g/m^3$)	Limits (Industrial/ Residential, Rural) Concentration ($\mu g/m^3$)
Pre-monsoon season 2009				
PM	34.7	2.3	38.7	100
SO_2	9.4	13.7	23.1	80
NOx	9.9	13.9	23.8	80
Lead	-	0.1	0.1	1.0
Post monsoon and part of winter season (October to December 2010)				
PM	45.3	5.9	51.2	100
SO_2	12.7	13.9	26.6	80
NOx	15.5	10.5	26.0	80
Lead	<0.1	0.3	0.4	1.0

The proposed land site comes under the industrial zone and predictions indicate that the PM, SO_2, NOx and lead concentrations are likely to be well within the prescribed limit for industrial, residential and rural zone.

4.7.4 Air Pollution Management

Mitigative measures suggested for air pollution controls are based on the baseline ambient air quality of the area. From the point of view of maintenance of an acceptable ambient air quality in the region, it is desirable that air quality is monitored on a regular basis to check compliance of standards as prescribed by CPCB. In case of noncompliance, appropriate mitigation measures need to be checked. The control measures to be adopted are:

- Bag filters will be provided to collect the PM before discharge of off gases to atmosphere. The emissions from the stack will conform to the ToR requirement of less than 50 mg/Nm^3 of PM;
- Two stacks of 30 m height in the zinc section for bag filter discharge
- One stack of 40 m height in the lead section for bag filter and combustion off gases discharge;
- One stack of 20m (1 DG set-500 KVA) and one of 50m (3 DG sets-5.5 MW) for DG set emissions;
- One stack of 40 m (Process stack) and one stack of 30 m (Hygiene stack) height in the silver plant for bag filter discharge; and
- Regular monitoring of the stack emissions.

4.7.4.1 Reducing Air Pollution in Zinc and Lead Ingot and CGG Zinc Plant

- There will not be any emission from the zinc process except particular matter emitted from the furnaces.

- The furnace ventilation system consists of dust collector (bag house) compartments and a duct from each of the cathode melting furnaces, CGG main furnace and CGG holding furnace to the bag house.

- During furnace drossing, the system is operated under increased draught on the furnace being drossed. The increased draught prevents dust and fumes from the existing door and the ventilation hoods over door capture any fumes emitted from the hot dross in the bins waiting to be moved to the dross cooling bays.

4.7.4.2 Reducing Air Pollution from DG Set

Pollutants envisaged from the DG sets are Particulates, Sulphur dioxide and Oxides of Nitrogen. For the control of air pollution, DG sets will use LSHS/HFO/HSD fuel with sulphur content of not more than 1% as fuel to reduce the SO_2 emission level. The DG set will be provided with a stack of 20 m (DG set (500 KVA) for silver plant) and 50 m (DG sets (3 x 5.5MW) for zinc and lead plant) height to disperse gaseous pollutants like sulphur dioxide and nitrogen oxides. In case of using HFO as fuel, Flue gas Desulphurisation (FGD) system shall be used to reduce sulphur dioxide emissions from exit gases. The efficiency of reduction in FGD's considered as 75% & above.

4.7.4.3Stack Gas Monitoring

The emissions from the stacks shall be regularly monitored for exit concentration of particulate matter, sulphur dioxide, nitrogen oxides and lead. Sampling ports shall be provided in the stacks according to CPCB guidelines.

- *Control of Fugitive Dust Emissions*

Dust nuisance due to feed material will be minimized by providing suitable dust suppression/extraction systems at suitable locations as per requirements. Hygiene systems will be provided at metal and slag tapping areas of furnaces dross removal kettles in plant.

Adequate ventilation systems will be provided in various buildings to reduce the air pollution. In addition, personal protective equipments will also be used by personnel working to reduce the effects of air pollution on individuals. The control measures are given in **Table-4.5**.

TABLE-4.5
HANDLING OF RAW MATERIAL, BY-PRODUCTS & PRODUCTS

Material	Category	Packing	Transportation within the premises	Storage	Internal handling	Despatch transportation
Silver Plant						
Anode slime	Raw material	Sealed drum/ bags	Closed truck	Covered shed on concrete flooring	Mechanised	NA
Silver	Product	Wooden Pallets with wrapping	NA	Strong Room	manual/pallet trolley	closed, sealed vehicles
Antimony concentrate	By-product	Sealed drum/ bags	NA	Covered shed on concrete flooring	Mechanised	Closed truck
Bismuth concentrate	By-product	Sealed drum/ bags	NA	Covered shed on concrete flooring	Mechanised	Closed truck
Copper matte	By-product	Sealed drum/ bags	NA	Covered shed on concrete flooring	Mechanised	Closed truck

Material	Category	Packing	Transportation within the premises	Storage	Internal handling	Despatch transportation
Oxidation slag	By-product	Sealed drum/ bags	NA	Covered shed on concrete flooring	Mechanised	Closed truck
Melting & Casting Plant						
Zinc cathode	Raw materials	Strapped bundles	Tarpaulin covered trailers/ containers	Covered shed on concrete flooring	Mechanised	Closed truck/ containers
Zinc ingot	Product	Strapped bundles	NA	Covered shed on concrete flooring	Mechanised	Closed truck/ containers
Zinc dross	By-product	Sealed drum/ bags	NA	Covered shed on concrete flooring	Mechanised	Closed truck
Lead cathode	Raw materials	Strapped bundles	Tarpaulin covered trailers/ containers	Covered shed on concrete flooring	Mechanised	Closed truck/ containers
Lead ingot	Product	Strapped bundles	NA	Covered shed on concrete flooring	Mechanised	Closed truck/ containers
Lead dross	By-product	Sealed drum/ bags	NA	Covered shed on concrete flooring	Mechanised	Closed truck

Measures proposed for control of fugitive emissions are detailed below:

1. Hygiene ventilation system to capture the gases from zinc and lead plant, and melting furnaces;
2. Covered shed with ventilation hood for storing drosses;
3. Prevention of fugitive emission from all active operation and storage piles;
4. Utilization of the best available control measures like controlled damper operations to manage the suction points, covered trucks for transportation of goods to minimize the fugitive dust emission;
5. Sprinkling/washing of floors for controlling fugitive emissions;
6. Bag filters will have proper bag cleaning arrangement so as to avoid choking of filter bags, thereby to avoid pressurization of furnace ventilation system; and
7. Regular inspection at a pre-determined frequency will be carried out of all fugitive dust control system and records will be maintained.

For controlling the lead pollution, effective measures have been considered and planned in the proposed lead plant in regard to hHygiene ventilation, dust collection and control of dust emission at source. This has been done based on the rich experience of HZL operating team and the vast experience of the technology provider.

4.7.5 Impact of off-Site Traffic on Air Quality

The offsite traffic will be resulting due to movement of trucks in and out of the plant carrying raw materials and products. It is estimated that additionally about 149 trucks per day will move in and out of plant area. Hence, only these trucks are considered for modeling. The raw materials, products and byproducts will be packed in leak proof sealed drums/bags and transported in closed trucks or containers as shown in **Table-4.6**, hence the fugitive emissions will be avoided.

The vehicles will also comply with the standards prescribed by CPCB and shall be regularly checked for any emissions. The total proposed traffic details due to the project are given in **Table-4.7**. The additional traffic due to proposed zinc plant will be 149 trucks per day and 50 cars.

TABLE-4.6
PROPOSED PACKING AND TRANSPORT MEASURES

Material	Category	Packing	Inward Transportation	Despatch Transportation
Silver Plant				
Anode slime	Raw material	Sealed drum/ bags	Closed truck	NA
Silver	Product	Wooden Pallets with wraping	NA	closed, sealed vehicles
Antimony concentrate	By-product	Sealed drum/ bags	NA	Closed truck
Bismuth concentrate	By-product	Sealed drum/ bags	NA	Closed truck
Copper matte	By-product	Sealed drum/ bags	NA	Closed truck
Oxidation slag	By-product	Sealed drum/ bags	NA	Closed truck
Melting & Casting Plant				
Zinc cathode	Raw materials	Strapped bundles	Tarpaulin covered trailers/ containers	Closed truck/ containers
Zinc ingot	Product	Strapped bundles	NA	Closed truck/ containers
Zinc dross	By-product	Sealed drum/ bags	NA	Closed truck
Lead cathode	Raw materials	Strapped bundles	Tarpaulin covered trailers/ containers	Closed truck/ containers
Lead ingot	Product	Strapped bundles	NA	Closed truck/ containers
Lead dross	By-product	Sealed drum/ bags	NA	Closed truck

TABLE-4.7
PROPOSED ADDITIONAL TRAFFIC DUE TO THE PROJECT

Material	Quantity (TPA)	Quantity (TPD)	Capacity of trucks carrying material (Tonnes)	Number of daily trucks plying	Per Car unit
Zinc & Lead Melting and Casting Plant					
Zinc cathode sheet (input raw material)	485,000	1386	28	49	148
Lead cathode sheet (input raw material)	160,000	457	28	16	49
Aluminium metal	160	0.46	25	0.02	1
Ammonium chloride (process chemical)	465	1.33	15	0.09	1
LSHS/HFO	24000	69	15	5	14
LPG	500	1.43	25	0.06	1
Zinc ingot	465,000	1329	25	53	159
Lead ingot	150,000	429	25	17	51
Zinc dross	20,000	57	10	6	17
Lead dross	10,000	29	10	3	9
Silver Plant					
Anode slime (input raw material)	2900	8.29	10	0.83	2

Material	Quantity (TPA)	Quantity (TPD)	Capacity of trucks carrying material (Tonnes)	Number of daily trucks plying	Per Car unit
Silver	500	1.43	10	0.14	1
Antimony concentrate	1400	4.00	10	0.40	1
Bismuth concentrate	140	0.40	10	0.04	1
Copper matte	140	0.40	10	0.04	1
Oxidation slag	840	2.40	10	0.24	1
Administration/employee vehicles	-	-	-	50	50
Total	**1321045**	**3774**		**149**	**508**

The air quality predictions have been carried out by using the air quality model CALINE-4 developed by California Department of Transportation. The model is based on Gaussian diffusion equation and uses a mixing zone concept to characterize pollutant dispersion over the roadway.

- ***Details of CALINE-4***

CALINE-4 is a dispersion model that predicts pollutant impacts near roadways. Its purpose is to help planners protect public health from the adverse effects of excessive CO exposure.

CALINE-4 is a simple line source gaussian plume dispersion model. The user defines the proposed roadway geometry, worst-case meteorological parameters, anticipated traffic volumes and receptor positions. The user must also define CO emission factors for each roadway link.

CALINE-4 is a graphical windows-based user interface, designed to ease data entry and increase the on-line help capabilities of CALINE-4. The CALINE-4 setup program is self-contained with both programs (The CALINE-4 interface and the CALINE-4 dispersion model), so the user only needs to complete a single installation step.

- ***Details of Pollutants***

To account for the effect of the diurnal variations in model inputs (vehicular emissions and meteorological conditions), the averaging time for model predictions has been restricted to 60 minutes. The averaging time is so selected because the primary meteorological factors that influence the air quality predictions i.e. wind speeds and directions do not remain steady for longer time periods. Also, during the peak traffic hours, the traffic volumes typically show significant variations over periods longer than one hour.

Due to averaging time of 60 minutes, the project impacts on air quality are essentially assessed based on one hourly standard for CO. NOx levels however have been developed for peak traffic conditions and compared with WHO standard of 400 $\mu g/m^3$ for hourly average.

Hydrocarbon was not modeled since its limits are not specified for ambient levels in the Environment Protection Act. In the absence of Indian standards for HC, the predictions could not have been interpreted meaningfully.

- ***Emission Standards***

The emission standards for Indian vehicles as proposed by the Indian Institute of Petroleum (IIP) have been used to provide the emission factors for the different vehicle types. Emission factors after accounting for the vehicle speeds are as specified in **Table-4.8**.

TABLE-4.8
EMISSION FACTORS FOR VEHICULAR IMPACT PREDICTIONS

*All values are given in gm/km/vehicle**

Vehicle -->	**Trucks**	
	CO	**NOx**
Emission Rate	10.67	18.97

**: to be multiplied by 1.6 for converting into gm/mile for use in CALINE-4*

- ***Details of Plant Site to Rudrapur Road***

The National Highway (NH-87) is passing at a distance of 0.8 km, south from the plant. The width of the existing road is 8.0 m, which connects the plant and Rudrapur. For model computations, Right Of Way (ROW) of 7 m excluding 0.5 m shoulders on either side of the road has been considered for perusal of violations of standards and accordingly receptor locations have been chosen to account for its location with respect to edge of ROW.

The traffic mainly includes trucks, which are used to transport raw material, other consumables and products. Hence, only heavy traffic is considered in assessing the impact of traffic on National Highway via plant site to Rudrapur.

The concentrations of CO and NOx due to the present traffic have been accounted in the baseline ambient air quality monitoring. Hence, the impacts on air quality have been predicted only for the additional traffic due to the project.

- ***Results and Discussion for Traffic Impact***

The predicted CO and NOx concentrations from vehicular traffic are presented in **Table-4.9.**

The general observation from **Table-4.9** reveal that the maximum NOx and CO concentration of 14.1 $\mu g/m^3$ and 8.7 $\mu g/m^3$ occurs at 20 m from the edge of the road for Stability Class-A. The concentrations for other stability classes are observed to be negligible. The concentrations of NOx and CO are observed to be well within the permissible limit.

TABLE-4.9
PEAK HOURLY PREDICTED INCREMENTAL CONCENTRATIONS

Distance from the Edge of the Road (m)	Incremental Pollutant Concentrations (µg/m^3)	
	NOx	CO
20	14.1	8.7
40	7.8	5.4
60	4.9	4.9
80	5.0	3.1
100	3.1	2.6
125	2.4	1.2
150	1.8	1.1

4.8 Impact on Water Resources

The water requirement for the proposed project is 500 m^3/day. Groundwater from the area will be drawn to meet the water requirement of the project during operational phase. Therefore, no impacts on surface water resources of the area are envisaged.

4.8.1 Impact on Water Quality

Sources of wastewater generation are as follows:

- Bleeds of cooling tower;
- De-Mineralized Water plant regeneration water; and
- Diesel Generator cooling water

The wastewater generated from the silver plant will be treated in Common Effluent Treatment Section of capacity 80 KLD.

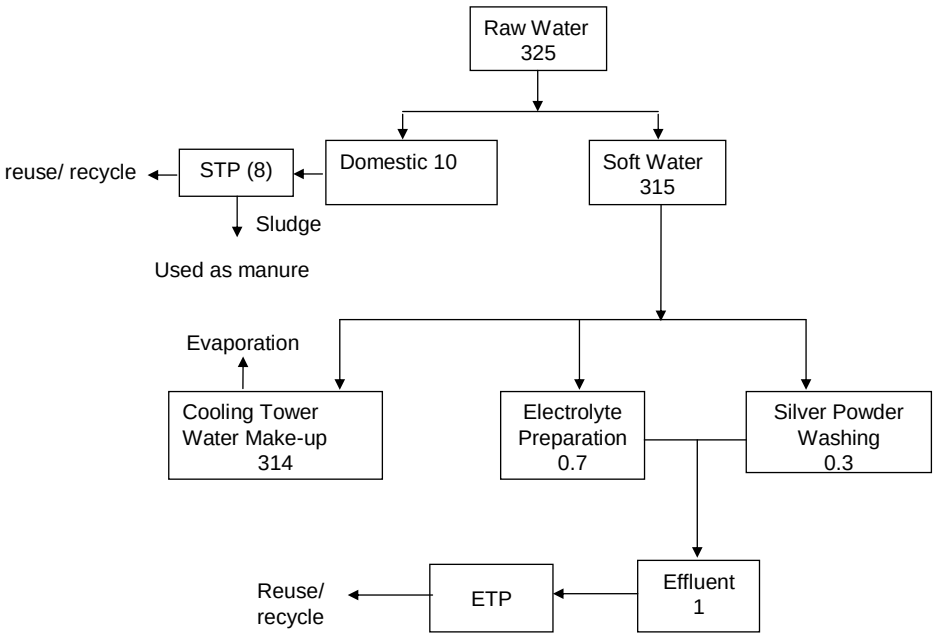
There will not be any process wastewater generated from the proposed zinc and lead melting casting section. The wastewater generated from the proposed plant will be cooling tower blow down, DM regeneration and DG set wastewater etc. Wastewater generated from the DM regeneration shall be sent to the ETP. Wastewater generated from the cooling tower shall be reused and recycled. Zero discharge will be maintained. The water balance for silver plant and melting and casting facilities for zinc and lead is shown in **Figure-4.2** and **Figure-4.3**.

Effluent generated from the melting and casting facilities for zinc and lead will be treated in Effluent Treatment Plant (ETP) of capacity 6 KLD (Process effluent section of ETP) and 80 KLD (Common effluent section of ETP). The effluents characteristics are as follows:

- **Process Effluent-**Waste-water consists of Colour, Oil- Grease, Heavy Metals etc.

- **Other Effluent-**Waste-water consists of Colour, Oil- Grease, Detergents & General Washing Chemicals generated from Utilities Blow-down, Washing & Cleaning process.

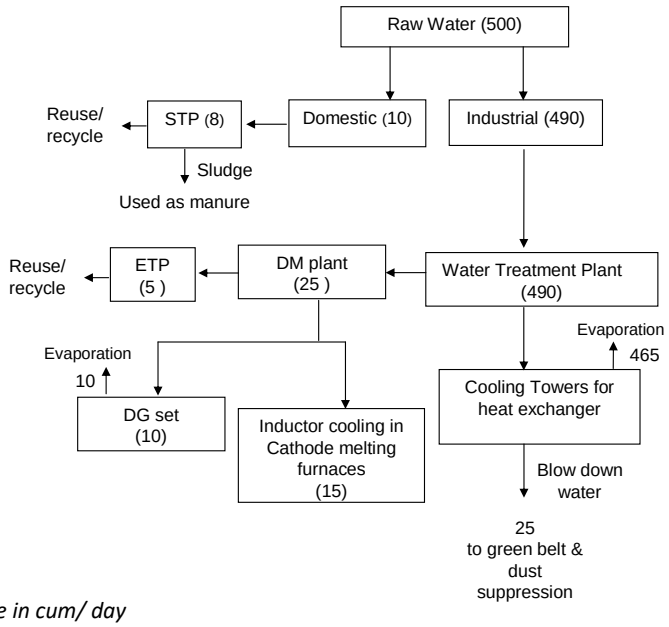
Water Balance for Silver Plant



All figures are in cum/ day

FIGURE-4.2
WATER BALANCE FOR SILVER PLANT

Water Balance for Zinc & Lead Melting Casting Plant



All figures are in cum/ day

FIGURE-4.3
WATER BALANCE FOR MELTING AND CASTING FACILITIES FOR ZINC AND LEAD

The effluent treatment will have the processes as given in **Table-4.10**. The primary effluent stream will pass through inlet chamber with bar screen to ensure the stream free from big/ larger contaminations, prior to collection cum equalization tank. This tank serves the dual purpose as it provides the reserve volume to handle/ store the effluents as well as it homogenize the contaminations to avoid the process variations. On availability of sufficient effluent volume into the collection tank, operator will start the transfer pump with pre-set chemical dosing for pH neutralization/ control, to feed the effluent stream into the Electro-oxidation chamber to remove/ separate the available contaminants (specially Heavy Metals) from water as sludge through the instant process called electro-coagulation. This sludge gets thick & settles in the conical bottom of tube settler/ primary clarifier. The clean/ clarified water over-flows from the upper part of settler and transferred to the Buffer Storage Tank and the sludge settled into conical bottom get transferred to the sludge drying beds. Excess water removed from sludge will be recycled back into the collection tank and the dried sludge in the beds can be disposed accordingly. Clarified water from Buffer storage tank, fed into Sediment Filter cum Heavy Metal removal unit with On-line Chlorine Injection Unit for removal/ reduction of residual heavy Metals & suspended solids.

The primary treated effluent alongwith other effluent streams (from Utilities, Washing/ Cleaning etc.) will be transferred into common ETP through inlet chamber with bar screen and oil- grease chamber to ensure the streams free from big/ larger contaminations and free floating oil, prior to Common collection cum equalization tank. On availability of sufficient effluent volume into the collection tank, operator will start transfer pump with pre-set chemical dosing (for pH balancing) to feed the common effluent into aeration (primary followed by secondary) tanks, where the biological decomposition takes place. This is achieved by the activated sludge – attached growth process, and the oxygen required for the bacterial growth is fed in the form of air, by twin lobe/ root air blowers and diffused through fine bubble air diffusers at the bottom of aeration tanks. Biological decomposition process converts the degradable impurities into the form of sludge flocks. Biologically/ secondary treated effluent stream overflows to the secondary clarifier/ tube settler for thickening - settling & separation of bio sludge. The clarified water over-flows from the upper part of settler into buffer storage (under- ground) tank with Chlorine Injection through the Dosing Unit, to ensure the proper disinfection prior to further processing/ distribution. Sludge will be transferred to the drying beds for compaction by removal of excess water. The dried sludge in the beds will be scrapped manually for suitable & safe disposal.

Treated water from Buffer tank, fed into Sediment Filter followed by Activated Carbon to ensure the removal/ reduction of residual Chlorine, traces of suspended & organic contamination, if any. Now the water/ treated effluent is ready for reuse into gardening. The parameters of the feed and treated wastewater are given in **Table-4.11.**

TABLE-4.10
ETP PROCESSES

Treatment	Process
Preliminary I	Removal/ reduction of contents rags, sticks, fibres, grits, by Screening.
Primary	Removal/ reduction of dissolved/ emulsified contents by pH balancing – Electro-oxidation/ Electro-Coagulation - Settling/ Primary clarification – Removal of Suspended Solids & residual Heavy Metals on HMR Media.
Preliminary II	Removal/ reduction of contents rags, sticks, fibres, grits, by Screening and Oil- grease separation by Trapping & Manual collection/ removal and collection cum homogenization of incoming effluent streams.
Secondary	Removal of organic matters & remaining suspended solids by two stage biological treatment /decomposition and Clarification.
Tertiary	Removal/ reduction of residual suspended & organic contents and disinfection of treated water stream through Chlorine Dosing – Sediment Filter – Activated carbon Unit.

TABLE-4.11
WASTE WATER PARAMETERS – FEED & TREATED

Description	Process Effluent Stream	Treated Water from Primary ETP	Common Effluent	Treated water from Common ETP
Appearance	Turbid	Clear	Clear/ Hazy	Clear
Colour	Coloured	Colourless	Colourless	Colourless
pH	2 – 5	6.0 – 8.0	6 – 8	6 – 8
TSS (ppm)	≤ 800	≤ 100	≤ 1000	≤ 100
Oil & Grease (ppm)	≤ 150	≤ 30	≤ 100	≤ 10
BOD (ppm)	≤ 150	≤ 30	≤ 350	≤ 30
COD (ppm)	≤ 700	≤ 150	≤ 650	≤ 250

The schematic flow diagram of the ETP is shown in **Figure-4.4**. Treated water will be reused/ recycled for water sprinkling, dedusting and greenbelt. Zero discharge of wastewater during operation phase of the plant will be maintained. Hence there will not be any discharge of effluent to water body or to the land.

The domestic wastewater collected will be treated in Sewage Treatment Plant (STP) of 12 KLD capacity. Another STP of 12 KLD capacity is proposed for the proposed zinc and lead melting casting section. The treated water from the STP will be recycled and reused for cooling tower makeup. The schematic flow diagram of the STP is shown in **Figure-4.5.**

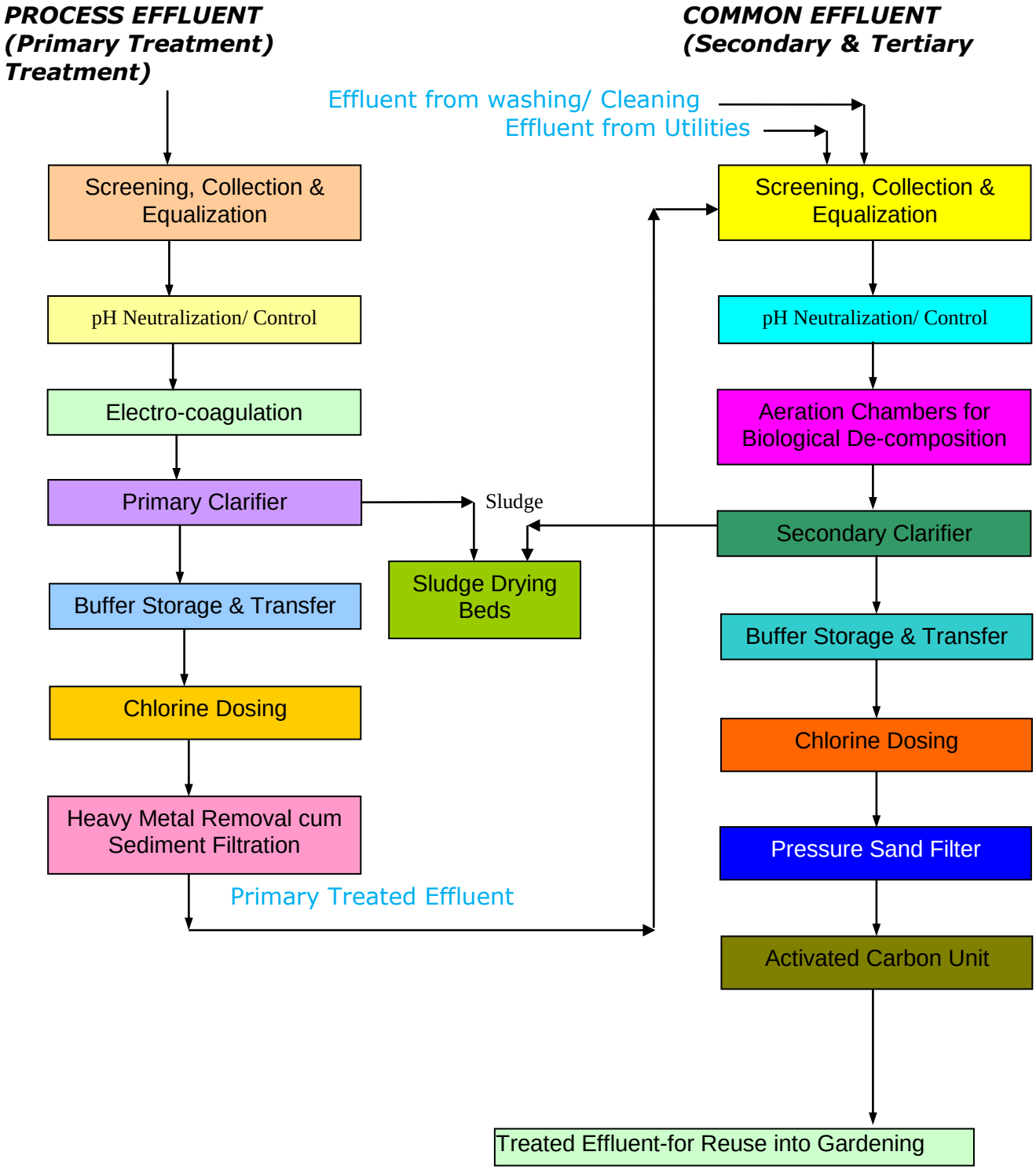


FIGURE-4.4
SCHEMATIC FLOW DIAGRAM OF THE ETP

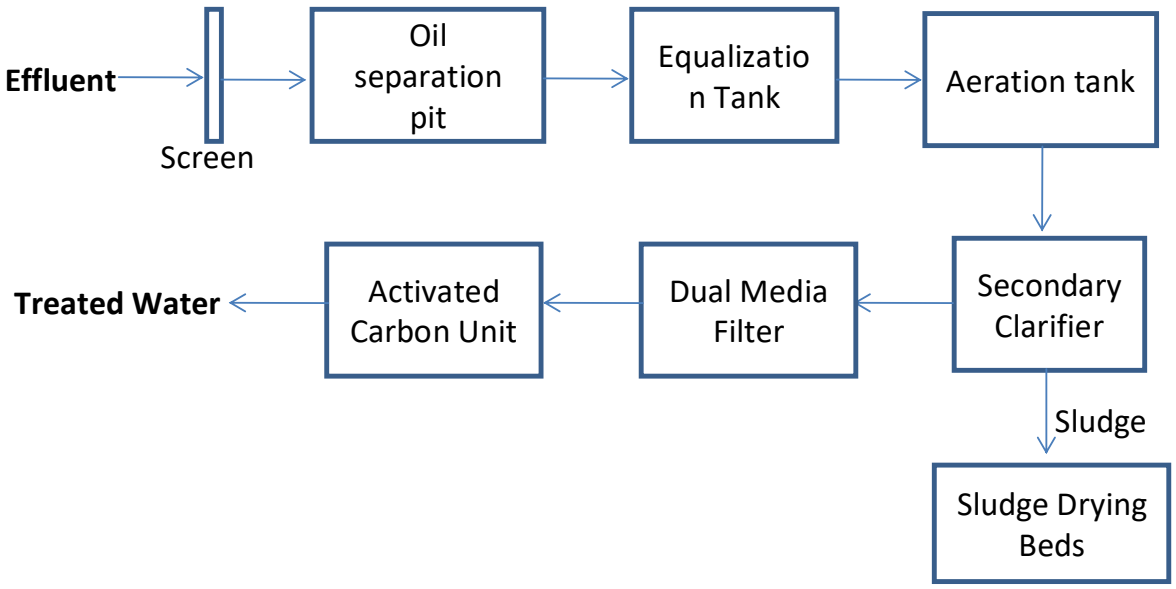


FIGURE-4.5
SEWAGE TREATMENT PLANT

4.8.2 Storm Water Management

Storm water management will be developed by installing intercepting drains in the plant area and storm water will be led to sump which will be located at lower level of the plant site. The run-off water thus collected will be discharged to nearby nalla. Surplus storm water which can not be used in plantation development during rainy season will be disposed off.

4.8.2.1 Mitigation/Management Measures

- The wastewater will be treated and reused for greenbelt development; and
- The plant shall be operated on the zero discharge except in monsoon season.

4.8.3 Rainwater Harvesting Measures

➢ ***Need for Artificial Recharge of Ground Water***

Although, there is no need for rain water harvesting as the plant and its buffer zone covering 1 km radius area lie in safe category and total water requirement of 825 m^3/day would be obtained from confined aquifer having artesian wells, it is being undertaken as advised by MoEF in its TOR and as it is national obligation and roof top rain water is available for ground water recharge. However, there is not much scope of ground water recharge as only 0.5 m of unsaturated zone is available with water table occurring at the 3.50 m below the land surface during post monsoon period.

With a view to recharge the ground water storage of the plant covering an area of 10 ha, it is proposed that whatever rain water is harness able in the plant area, would be recharged artificially in to the groundwater storage. Accordingly, rainwater harvesting program is being proposed so as to utilize the roof water rain water of main building of melting and casting shop.

As indicated earlier, hydrogeologically the plant area is composed of alluvium having unconsolidated sequence of sand, fine to medium with boulders with occasional bands of silty sand. The depth to water is shallow during post monsoon period, ranging from 3.50 to 4.50 m below the land surface. The sub-surface geological section reveals the presence of unconsolidated sand and boulders from surface to water table with occasional presence of loose gravel. These sands have moderate to good infiltration rate. The area therefore has ideal conditions for rain water harvesting through a permeable strata from land surface to the water table.

The water requirement of the melting and casting facilities for zinc and lead although water will be obtained from confined aquifer and will not influence the shallow aquifer, it is proposed that whatever rain water is harness able in the plant area, should be recharged artificially in to the groundwater storage. Accordingly, rainwater harvesting program is being proposed so as to utilize the roof water rain water from different plant buildings and open area.

As indicated earlier, hydrogeologically the plant area is composed of alluvium having unconsolidated sequence of sand, fine to medium with boulders with occasional bands of silty sand. The depth to water is shallow during post monsoon period, ranging from 3.50 m to 4.50 m below the land surface. The sub-surface geological section reveals the presence of unconsolidated sand and boulders from surface to water table with occasional presence of loose gravel. These sands have moderate to good infiltration rate. The area therefore has ideal conditions for rain water harvesting through a permeable strata from sandy surface to the water table.

- ***Basic Requirement for Artificial Recharge Project***

There are two basic requirements for taking up any artificial ground water recharge project and these are:

a) Availability of non-committed surplus monsoon runoff; and

b) Identification of suitable hydrogeological environment and sites for creating sub-surface reservoir through cost effective artificial recharge techniques.

While considering these two aspects in special reference to the plant, Pantnagar, it is observed that there is a definite availability of surplus monsoon water from the roof top buildings covering an area of 10 ha. Roof tops have sufficient area producing adequate quantity of water which could be collected and recharged to a central point where a suitable recharge structure could be constructed to store the roof top rain water duly filtered.

Another important aspect is to evaluate the storage potential of sub-surface reservoir having maximum unsaturated zone with maximum specific yield and hydraulic conductivity during the period when water is available for recharge. Artificial ground water recharge can not be undertaken where water level is within 3 m below the land surface during the monsoon period. Fortunately, the water table in alluvium in the plant area, which is at the higher elevation, during the post monsoon period remains at the depth of 3.50 to 4.50 m below the ground level indicating that 0.5 to 1.50 m of unsaturated horizon is available for ground water storage. This unsaturated zone of average thickness of 1 m can store additional 15,000 m^3 of water in the plant area of 10 ha taking the specific yield of 15%.

- ***Main Considerations for Selection of Recharge Structures***

Although there are many recharge structures in practice for artificial recharge of ground water, only those recharge structures are being proposed which are cost effective and most suitable for hydrogeological and hydrological setting of plant area. The following considerations have been kept in mind while designing the recharge structures for the project.

1. Only those recharge structures are being proposed which are cost effective and provide immediate ground water recharge. Generally, it is most economical to recharge directly existing open wells and tubewells but as there

are no existing wells and tubewells in the plant area, new recharge trenches and contour bunds are being proposed.

2. Accordingly, depending upon the source of water from roof top rain water from the plant buildings, suitable recharge trenches are being designed and proposed.

3. The recharge structures should be easy to maintain and do not have high recurring cost of annual maintenance.

4. Only such materials required for construction of recharge trenches are being proposed which are available in the nearby river beds and hills and can be procured easily.

Keeping these considerations in view, the following recharge structures are being proposed based on roof top rain water.

- ***Design of Recharge Structures***

While selecting a cost effective recharge structure, it is necessary that under the existing hydrogeological setting, the structure should be able to store the available roof top rain water which may percolate down to join the zone of saturation. The recharge structure should be such that its filter media could be easily taken out, washed so that clays deposited during filtration are removed to regain the original infiltration rate and reinstalled conveniently without much expenditure. Keeping this in view, recharge pits and recharge trenches are being proposed for this plant area.

Hydrogeologically, alluvium are considered a favorable formation for rain water harvesting as it has lofty storing capacity due to high hydraulic conductivity and high porosity.

Depth to water table in the plant area during pre–monsoon period (May - June) is around 5.00 to 6.00 m below the land surface while during the post monsoon period (Sept- Oct.) is between 3.50 to 4.50 m below the land surface.

- ***Roof top Rain Water Utilization Program***

Based on the above consideration, recharge trenches are proposed, in front of each building and shed. Under a normal construction of any building or industrial shed, roof top rain water is collected through drain pipes which join a cemented drain, just at the base of the building and drain is later taken to either a percolation pond or to a plantation. It is proposed that the cemented drains, as usual may be constructed but it may be used as recharge trench having naked/unlined bottom and having filter media. All the roof top rain water will be collected from properly spaced PVC drain pipes of 50 mm dia and water brought to recharge trench of 0.5 m width and 1 m depth. The trench will lined with cement except the bottom portion which will allow percolation of filtered water to the alluvium. Filter media as shown in **Figure-4.6** will be filled in the recharge trench with top layer of well rounded, quartz pebbles so that coarse sand laid

below the pebbles is not disturbed by water. The filter media of 1 m thickness will retain all the suspended solids, coming along with roof top rain water and only filtered water will percolate to the zone of saturation through alluvium exposed in the bottom of the recharge trench.

Only the Melting and Casting Unit is being considered for the recharge as the other relevant civil structures have already been dealt in the earlier report, which had roof top area more than 300 m^2 so that adequate quantity of rain water is available for recharge. It is therefore suggested that wherever the Civil Division has originally proposed a cemented drain for disposal of roof top rain water, it may be constructed as recharge trench by providing unlined bottom and filling it by filter media.

The following recharge system is proposed for Melting and Casting Unit, being constructed in the plant area.

- ***Proposed Melting and Casting Unit***

It is proposed to construct a melting and casting unit having corrugated cemented sheet roof top area of 4,800 m^2. All the roof top rain water will be collected through drain pipes and brought to two recharge trenches to be constructed at in front of the building as shown in **Figure-4.7.**
The availability of roof top water and the peak runoff from the roof top of the main office having total roof top area of 4800 m+ has been estimated as under, taking annual average rainfall as 1,184 mm, 0.80 as runoff coefficient for CS roof and rainfall intensity which is 60 mm/hour (15 mm/15 minutes) as peak rainfall for Pantnagar area.

Availability of roof top rain water 4,800 x 0.80x 1.095 = 4205 m^3

Peak availability of water during 15 minutes 4,800 x 0.80x 0.015= 58 m^3

It is proposed that roof top rain water from the unit (having total roof top area of around 4,800 m^2) may be collected through 50 mm PVC drain pipes and brought to the recharge trench which will be constructed in front of the building and will have minimum length of 80 m on both the sides of the building.

The capacity of the recharge trench is sufficient to accommodate the peak rainfall of 15 minutes taking 50% as void ratio.

0.5 x 1 x 160 x 0.5 = 40 m^3

W x D x L x void ratio = capacity

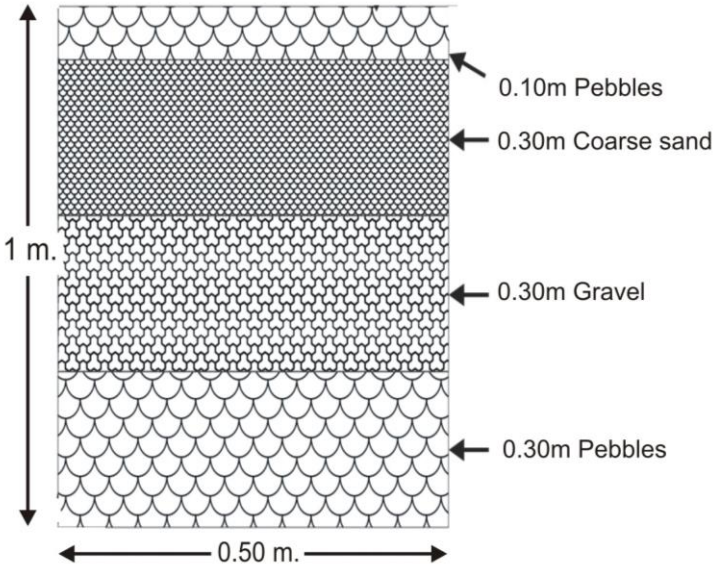


FIGURE-4.6
CROSS SECTION OF RECHARGE TRENCH

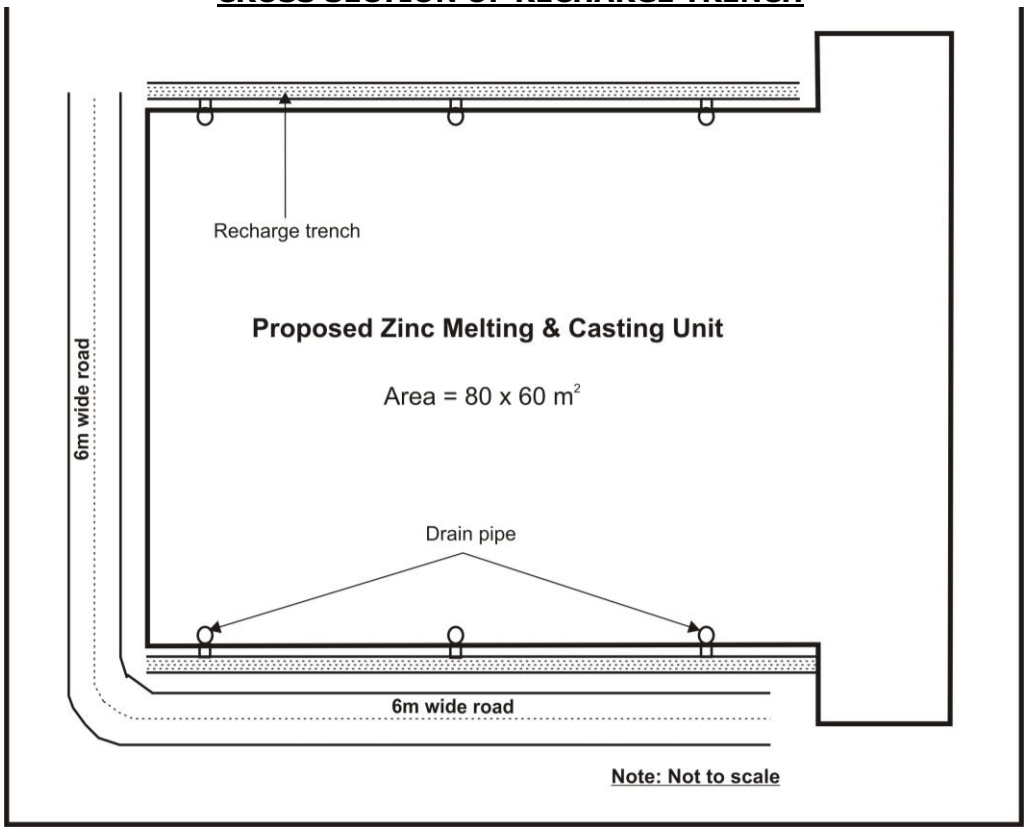


FIGURE-4.7
RECHARGE SYSTEM FOR PROPOSED MELTING & CASTING FACILITES FOR LEAD & ZINC

Any surplus water (during any cloud burst or slow infiltration rate of the trench) tank may be taken as overflow to another recharge trench to be constructed around the open area of the building of the similar design. The width and depth of the trench may be kept as half metre and one metre respectively. The trench will be cemented by the sides but remain unlined at the bottom. The trench will be filled at the bottom with 30 cm thick layer of pebbles, 30 cm thick layer of gravel, 30 cm thick layer of coarse sand and 10 cm thick layer of pebbles or of boulders. The water in the trench will gradually percolate and join the water table which is shallow, hardly 3.5 m below the land surface and having permeable horizon till water table. It is only 0.5 m of the unsaturated zone which could be recharged as raising the water table above 3 m will create the problems of soil salinization and alkalinization.

The recharge of 4,205 m^3 of roof top rain water would raise the water table of plant area of 10 ha by about 0.30 m taking 15 % as the specific yield of alluvial formation. Accordingly, no other rain water harvesting measures are being proposed as otherwise, it would create problems with the soil.

4.9 Impact of Solid Wastes

The solid wastes generated from the plant are given in **Table-4.12**. There will be no disposable solid waste produced from the proposed project. Zinc dross and lead dross generated from the process are process intermediate which will be fed as raw material at HZL smelters at other location. Normally there will be some transit storage during shifting to smelters.

ETP cake will be sent to TSDF. Discarded containers & liners will be crushed and decontaminated before disposal in TSDF. Waste oil and used oil will be safely stored in 200 liters drums/tanks in a covered shed and sold to authorized recyclers registered with MoEF/CPCB. The mode of disposal of the solid wastes is given in **Table-4.13.** The waste (sludge) generated from the FGD system, in case of using HFO as fuel, will be stored safely in intermediate storage yard and will be sold to authorized recyclers/transferred to TSDF. Alternatively, options will be explored to recycle it in industries like cement industry for gainful use.

TABLE-4.12
SOLID WASTES GENERATED FROM THE PLANT

Sr. No.	Waste	Category	Total Qty TPA	Characteristics	Silver Plant, TPA	Zinc Plant, TPA	Lead Plant, TPA	DG Set, TPA
1	Waste oil	5.2 Schedule 1	120	-	20	30	20	50
2	Used oil	5.1 Schedule 1	170 (KL)	-	30(KL)	40(KL)	30(KL)	70(KL)
3	ETP cake	7.4 Schedule 1	40	Zn-1 - 2 %, Pb- 0.2 0.5%	10	30		
	iETP sludge		15		5	10		
	ETP sludge		25		5	20		

TABLE-4.13
SOLID WASTE DISPOSAL

Waste	Treatment/ Disposal Method
ETP cake	It shall be sent to nearby Treatment Storage & Disposal Facility
Waste oil	It shall be sold to authorized reusers/ recyclers registered with CPCB/ MoEF
Used oil	It shall be sold to authorized reusers/ recyclers registered with CPCB/ MoEF

4.10 Impact on Noise Levels

The main sources of noise from the proposed melting and casting facilities for zinc and lead are:

- Furnaces;
- Compressors;
- Diesel generator set; and
- Blowers

The major noise generating sources from the proposed plant are listed in **Table-4.14.** These are considered as input to the noise model.

TABLE-4.14
NOISE GENERATING SOURCES

Sr. No.	Sources	Noise Level in dB(A) [1 m away]	Nature of Noise
1	Furnaces	85.0	Continuous
2	Diesel generator set	105.0	Intermittent

It can be seen from the above table that all the noise levels at 1m distance from the equipment will be in the range of about 75-85 dB(A). For computing the noise levels at various distances with respect to the plant site, noise levels are predicted using a user friendly model.

➢ Mathematical Model for Sound Wave Propagation During Operation

The noise dispersion from the plant units has been estimated through computer based mathematical model.

The major noise generating sources from the proposed plant are listed in **Table-4.15.** These are considered as input to the noise model.

TABLE-4.15
ESTIMATED NOISE LEVELS FROM THE PLANT

Sr.No.	Sources	Co-ordinates (m)		Noise level in dB(A)
		X	Y	
1	Zinc Furnace-1	0	0	85.0
2	Zinc Furnace-2	-6	-1	85.0
3	Lead Furnace	186	110	85.0
4	Silver plant	-1	124	85.0
5	Diesel generator set (1x500 KVA-Silver plant)	61	26	105.0
6	Diesel generator sets-3 (3x5.5 MW-Zinc and lead plant)	106	10	105.0

4.10.1 Presentation of Results

The predicted noise levels at the boundary due to various melting and casting facilities for zinc and lead activities are given in **Table-4.16**. It is seen from the simulation results that the incremental noise levels will be well within the CPCB standards. The model results are represented through contours in **Figure-4.8.**

TABLE-4.16
PREDICTED NOISE LEVELS AT PLANT BOUNDARIES

Sr. No.	Direction	Incremental Noise Level in dB(A)
1	N	51
2	NE	48
3	E	52
4	SE	51
5	S	51
6	SW	48
7	W	51
8	NW	48

The predicted noise levels at the boundary due to various plant activities are ranging in between 48 to 51 dB(A). The increment noise levels are less than 40 dB (A) at all the surrounding habitations. It is seen from the simulation results that the incremental noise levels will be well within the CPCB standards.

- **Impact on Work Zone**

There are no high noise equipment in the proposed melting and casting facilities for zinc and lead. The equipment with significant continuous noise levels are furnaces. 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.

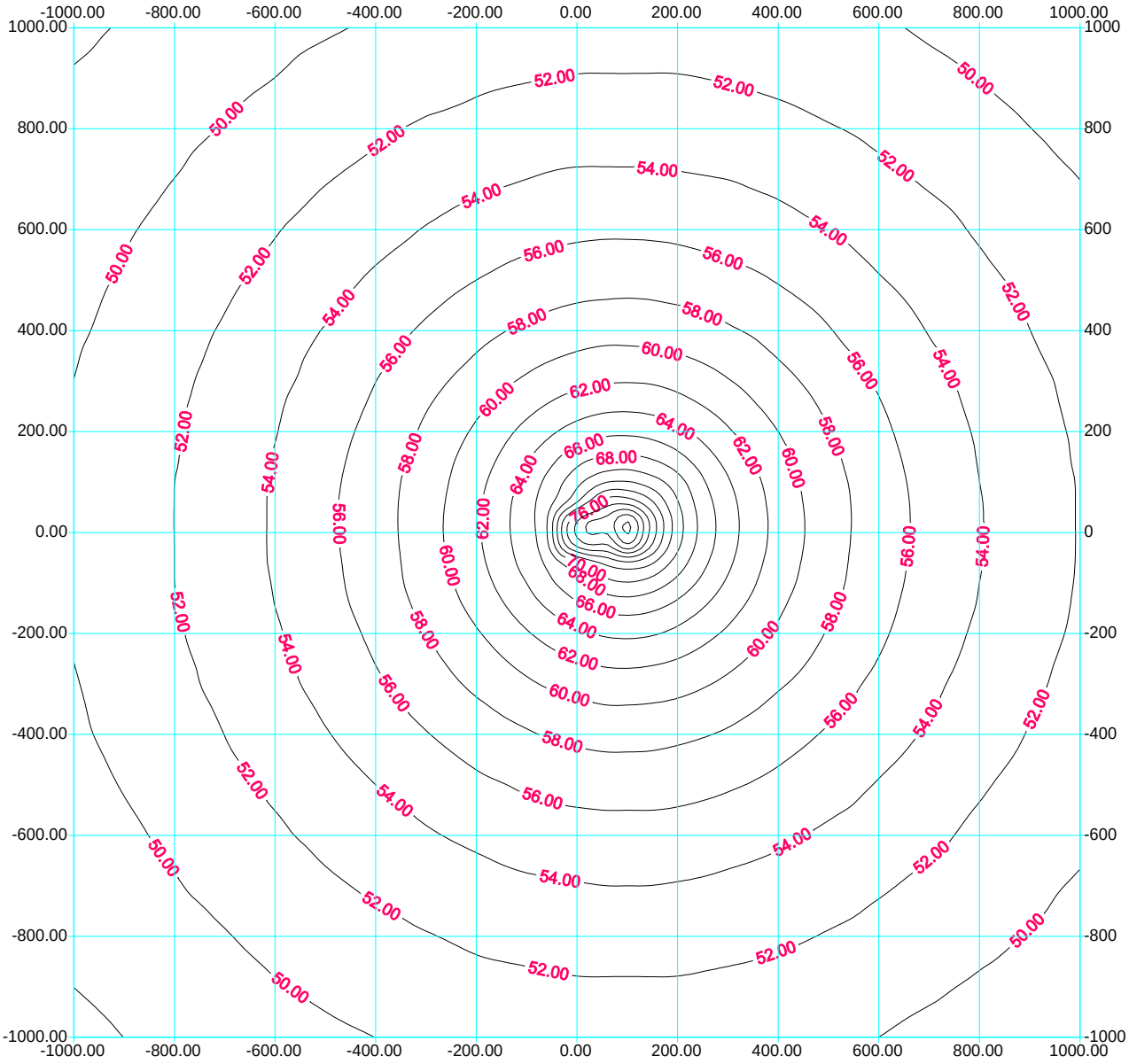


FIGURE-4.8
NOISE LEVELS AROUND PLANT SITE

4.10.2 Noise Pollution Management

As per model results the incremental noise levels due to the proposed plant will be in the range of 48 dB (A) to 51 dB (A) near the plant boundaries in all the directions. The ambient noise levels in the region are within permissible limits and are envisaged to be within the permissible limits even after commissioning of the proposed facilities.

The criterion for environmental noise control is that the design of the proposed plant will not exceed, in any continuous mode of operation, the level stipulated by MoEF and/or Pollution Control Board at any point on the site boundary.

The measured noise level produced by any equipment will not exceed 85 dB (A) at a distance of 1.0m from its boundary in any direction under any load condition. The noise produced in valves and piping associated with handling compressible and incompressible fluids will be attenuated to 75 dB(A) at a distance of 1.0 m from the source by the use of low noise trims, baffle plate silencers/line silencers, acoustic lagging (insulation), thick-walled pipe work as and where necessary.

All pipes and valves downstream of pressure control valve (including pressure control valve) will be one schedule higher than needed by pressure considerations to attenuate the noise. For safety relief valves the allowable noise level will not exceed 95 dB (A) for one-quarter hour or less per day. Safety valves will be provided on the stem drum and its number and capacity will conform to the code requirements.

4.10.3 Noise Attenuation Measures

- Noise level can be reduced by stopping leakages from various steam lines, compressed air lines and other high pressure equipment
- By providing padding at various locations to avoid rattling due to vibration
- By adopting new technologies for control of noise in various units
- Encasement of noise generating equipment where otherwise noise cannot be controlled
- Providing noise proof cabins to operators where remote control for operating noise generating equipment is feasible.
- The air compressor, process air blower, pneumatic valves should be provided with acoustic enclosure;
- All the design/installation precautions as specified by the manufacturers with respect to noise control shall be strictly adhered to;
- High noise generating sources shall be insulated adequately by providing suitable enclosures;

- Design and layout of building to minimize transmission of noise, segregation of particular items of plant and to avoid reverberant areas;
- Use of lagging with attenuation properties on plant components / installation of sound attenuation panels around the equipment
- The noise control system will be designed to form an integral part of the plant;
- Other than the regular maintenance of the various equipment, ear plugs/muffs are recommended for the personnel working close to the noise generating units;
- All the openings like covers, partitions shall be designed properly; and
- Inlet and outlet mufflers shall be provided which are easy to design and construct.

➢ *Noise Control at the Community Level*

- The proposed greenbelt under the projects under construction will help to attenuate the noise emitted by the various sources in the plant.

4.11 Biological Environment

- ***Impacts on Terrestrial Ecology - Operational Phase***

The impact on terrestrial ecology may be felt due to emission of gaseous pollutants like SO_2 PM and NOx. These pollutants at a very low dose act as atmospheric fertilizer for the vegetation. However at higher doses, they can be injurious to both vegetation as well as animals.

The main sources of air pollution from the proposed plant would be from the process stacks and DG set stacks. The pollutants from the proposed plant include Sulphur dioxide, Suspended Particulate Matter and NOx.

- ***Presentation of Modeling Results***

The impact of air pollutants on vegetation due to the proposed plant is identified and quantified by using Air Dispersion Modeling.

The simulations were done to evaluate SO_2, NOx and PM likely to be contributed by the proposed plant. The incremental concentrations are estimated as 2.31-µg/m^3 for PM, 13.7-µg/m^3 for SO_2 and 13.9 µg/m^3 for NOx concentrations for pre monsoon season, 5.9-µg/m^3 for PM, 13.9-µg/m^3 for SO_2 and 10.5 µg/m^3 for NOx concentrations for pre monsoon season which is within the limits as per National Ambient Air Quality Standards of 100 µg/m^3 for PM and 80 µg/m^3 for SO_2 and NOx. Hence, a marginal impact is envisaged due to proposed plant.

- ***Impact on Aquatic Ecology***

Since the unit will be operating on zero discharge process and no perennial nallahs or stream present in the study area, no impact on aquatic ecology is envisaged.

- ***Impact of Air Emissions on Forest***

The impacts on the reserve forest blocks have been computed based on the PM, SO_2 and NOx incremental concentration over the reserve forests. There are three protected forest blocks present in 10-km radius. The incremental concentrations over the protected forests are given in the **Table-4.17.**

The predicted concentrations are well with in the limits of 100 µg/m^3 for PM, 80-µg/m^3 for SO_2 and 80 µg/m^3 for NOx in sensitive areas as per NAAQMS. Hence, there will be minor impact on the forests in the study area.

TABLE-4.17
INCREMENTAL CONCENTRATION AT FOREST

Sr. No.	Name of the Forest Block	Distance from Plant Site Boundary (km)	Direction from the Plant Site	Incremental concentration (µg/m^3)		
				PM	SO_2	NOx
1	Dhimri P.F.	2.2 km	NNE	0.6	0.5-2.0	2.0-2.3
2	Gangapur Patiya P.F.	2.7 km	NE	0.4	1.2	1.0
3	Tanda P.F.	9.8 km	NE	-	0.5	0.5

- ***Impact on Migratory Paths for Wild life***

As per the Forest Working Plans, there are no identified migratory paths for major and minor wild life in the project site. The identified avi-fauna, which are observed in the project site and in the study area, are local migrants only. Therefore, the proposed plant operations are not likely to have any impact on the paths for avifauna. National Parks (sanctuaries) are not present in the project site and 10 km radius. The main pollutants from the proposed plant are PM, SO_2 and NOx and it is evident from the air quality modeling outputs that the resultant concentrations are well within the limits. DG sets will be operated during emergency, hence no continuous pollutants will be emitted from the DG sets. There will not be any adverse impact.

4.11.1 Impact on Aquatic Ecology

Zero wastewater discharge is envisaged from the zinc and lead melting and casting operations. The domestic sewage is treated and reused. Hence, no impact is envisaged from the zinc and lead melting and casting operations on aquatic bodies.

4.11.2 Mitigation Measures

No impact is envisaged on biological environment of the area. However, extensive plantation / green cover will be developed in and around zinc and lead melting and casting area as described in plantation development section below.

4.12 Impact on Traffic

With the proposed melting and casting facilities for zinc and lead, the traffic is likely to increase on the existing road network during the operation phase on National Highway (NH-87). The impact of the traffic is assessed on the basis of adequacy of the existing road network.

The traffic study was conducted to know the existing traffic volume and the data is presented in Chapter-3. The proposed estimated traffic was superimposed on the existing traffic to assess the adequacy of the road.

4.12.1 Traffic due to Proposed Project

It has been considered that the peak daily vehicle traffic due to proposed project would be about 149 heavy vehicles i.e. 508 PCU (Passenger Car Unit) during operation per day. The details of proposed traffic are presented in **Table-4.18**.

4.12.2 Adequacy of the Existing Road Network

The traffic count was conducted near the project site on the existing roads and the details of the locations and existing traffic details are presented in Chapter-3. The present level of traffic has been converted to Passenger Car Units (PCU) at all the locations as per the conversion factors stipulated by Indian Road Congress (IRC).

TABLE-4.18
EXISTING AND PROPOSED TRAFFIC ON NATIONAL HIGHWAY

Type of Vehicles	No. of Vehicle	PCU
Existing Traffic on Rudrapur Road		
2/3 wheeler	876	438
Cars	301	301
Trucks & Heavy Motor Vehicles	361	1083
Traffic contributed by proposed melting and casting facilities for zinc and lead		
Trucks	149	508
Total	**1687**	**2330**

(PCU Factors: Light Duty Vehicles=1.0, Trucks/Buses/tractors=3.0, 2/3 Wheelers=0.5)

With present level of traffic and the increase in existing traffic due to the project during operational phase has been estimated by comparison with the recommendations stipulated by Indian Road Congress (IRC). The IRC recommendations on traffic capacity are presented below in **Table-4.19.**

TABLE-4.19
RECOMMENDATIONS ON TRAFFIC CAPACITY - IRC

Sr. No.	Category of Road	Maximum PCU/day
1	Two lane roads (7m) with earthern shoulders	15,000
2	4-lane highway with earthen shoulders	35,000

As per the above standards the National Highway is four lane highway road having maximum capacity of 35000 PCU/day.

The estimated peak traffic in terms of PCUs is compared with the stipulated standards by IRC for traffic capacity of the existing road network. The road connecting to National Highway is four lane highway road, and is adequate for the present traffic volume and the traffic contributed from the proposed melting and casting facilities for zinc and lead. Hence, the impact on the existing road due to the traffic contribution from the melting and casting facilities for zinc and lead will be insignificant. However, the natural traffic projection on the National Highway is not considered.

4.13 Plantation/Greenbelt Development

With rapid industrialization and consequent deleterious impact of pollutants on environment, values of environmental protection offered by trees are becoming clear. Trees are very suitable for detecting, recognizing and monitoring air pollution effects. Monitoring of biological effects of air pollutant by the use of plants as indicators has been applied on local, regional and national scale. Trees function as sinks of air pollutants, besides their bio-aesthetical values, owing to its large surface area.

The plantation development not only functions as foreground and background landscape features resulting in harmonizing and amalgamating the physical structures of the plant with surrounding environment, but also acts as pollution sink.

Thus, implementation of afforestation program is of paramount importance. It will also check soil erosion, make the ecosystem more complex and functionally more stable and make the climate more conducive.

Total plantation in the plant will spread over an area of 3.5 ha, which is about 35% of the total plot area. The plantation will be developed and maintained around the plant site.

In the proposed plantation, about 5000 number of trees will be planted with a density of 1400 trees/ha. Complete plantation will be developed over a period of four years. Appropriate budget will be earmarked for this purpose.

The plantation schedule will be completed within four years from the construction period of the project. The plantation schedule is given in **Table-4.20**.

TABLE-4.20
PLANTATION DEVELOPMENT SCHEDULE

Sr. No.	Year	Area (ha)	No. of Saplings
1	2011-12	0.75	1000
2	2012-13	0.75	1000
3	2013-14	1.0	1500
4	2014-15	1.0	1500
Total		**3.5**	**5000**

The layout plan of the plantation and tree cover in plant area is shown in **Figure-4.9**.

- ***Design of Plantation***

The following guidelines will be considered in plantation development:

- Shrubs and trees will be planted in encircling rows around the project site;
- The short trees (<10m height) will be planted in the first rows (towards plant side) of the plantation. The tall trees (>10 m height) will be planted in the outer rows (away from plant side);
- Planting of trees in each row will be in staggered orientation (Triangular form);
- Since the trunks of the tall trees are generally devoid of foliage, it will be useful to have shrubs in front of the trees so as to give coverage to this portion; and
- The spacing between the trees will be maintained slightly less than the normal spaces, so that the trees may grow vertically and slightly increase the effective height of the plantation.

4.13.1 Plant Species for Plantation

While selecting the plant species for the proposed plantation, the following points will be taken into consideration:

- Should be a fast growing type;
- Should have a thick canopy cover;
- Should be perennially green;
- Should be preferably of native origin; and
- Should have a large leaf area index.

4.13.2 Recommended Species for Plantation

Based on climate and soil characteristics of the study areas, some species are recommended for plantation. The recommended species for plantation are given in **Table-4.21**. The mentioned species covers the ground quickly and also have wider soil adaptability.

FIGURE-4.9
PROPOSED PLANTATION IN PLANT AREA
TABLE-4.21
RECOMMENDED PLANT SPECIES FOR PLANTATION

Botanical Name of the Plant with Height	**Hindi Name**	**Size of Plant Type and Suitable site**
Acacia auriculaeformis (Mimosaceae) Height: 5m	Vilaiti	M; Semi-evergreen fragrant white flowers; suitable in green belts and on road sides
Adina cordifolia (Rubiaceae) Height: 20m	Haldu	L; deciduous, a light demander, suitable on open areas & near flares
Aegle marmelos(Rutaceae) Height: 12m	Bael	M; deciduous, good for green belts near temples
Anogeissus latifolia (Combretaceae)	Dhaura	M; deciduous suitable for green belts
Azadirachta Indica (Meliaceae) Height: 20m	Nim	L; evergreen ; Suitable in green belts and out side office & hospital buildings
Bauhinia variegate (Caesalpiniaceae) Height: 5m	Kachanar	M; deciduous, good in green belts in garden and as a second row avenue tree
Boswellia serrata (Burseraceae) Height: 4m	Kundur	M; deciduous suitable on green belt on shallow soils
Burera serrata (Bureraceae) Height: 4m		M; evergreen, suitable on shallow soil as a green belt or avenue tree
Buteas monosperma (Fabaceae; Papilionaceae) Height: 10m	Palas	M; deciduous for green belts and as a second row avenue tree
Caesalpinia pulcherrima (Leguminosae) Height: 4m	Gulutora	S; a large shrub, suitable for gardens out side offices and along channels
Callistemon lanceolatus (Myrtaceae) Height: 5m		M; deciduous for some time, ornamental plant in garden
Careva aroborea (Lecythidaceae)	Kumbi	L; deciduous, good in green belts
Carrisa carandas (Apocynaceae) Height: 3m	Karaunda	S; semi evergreen. Large bushy shrub, good as a hedge to protect against noise
Caryota urens (Palmae) Height: 5m	Mari	A lofty palm, good as a windbreak
Cassia fistula (Leguminopsaae) Height: 12m	Amaltas	M; deciduous, good ornamental tree in green belts
C. Siamea Height: 10-12m		L; evergreen, good an avenue tree
Cedrela toona (Meliaceae) Height: 5-8m	Mahanim	L; deciduous, good in open spaces, in green belts and along ponds
Cestrum diurnum (solanaceae) Height: 3m	Din-ka-raja	S; a shrub with white fragrant flowers, suitable around boilers and waste disposal sites
Cleistanthus collinus (Euphorbiaceae) Height: 3-5m	Garari	S; deciduous tree suitable in green belts
Dalberciasisso (Leguminosae) Height: 3-5m	Shisham	M; deciduous suitable on areas around flare sites and in green belts
Delomix regia (Leguninosae) Height: 15m	Gul Mohar	M; deciduous ornamental, suitable on road sides
Dillenia India Height: 3-5m	Chalta	L; evergreen, white fragrant flowers, good in green belts and around waste disposal sites.
D. Pentagyna Height: 5-8m	Aggai	L; deciduous , good in green belts and on site around flare

Botanical Name of the Plant with Height	**Hindi Name**	**Size of Plant Type and Suitable site**
Emblica officinalis (Euphorbiaceae) Height: 5m	Amla	M; deciduous, good as isolated trees in gardens.
Ervthrina suberosa (Leguminosae)	Dauldhak	M; deciduous, good in green belts
E.variegata Height: 10m	Dadap	M; deciduous, good in gardens out side office buildings
Ficus bengalensis Height: 20m	Bargad	L; deciduous, widely spaced avenue tree (15 m apart)
F. religiosa Height: 20m	Pipal	L; deciduous, widely spaced avenue tree also as a single tree in isolated sites
Gmelina arborea (Verbenaceae) Height: 3-5m	Sewan	M; deciduous , good in green belts around flare sites
Grewia tiloifolia (Tiliaceae) Height:3- 5m	Dhamim	M; good in green belts for use as timber
Hamelia patents (Rubiaceae) Height: 3m		S; evergreen shrub with dense attractive foliage of greenish bronze leaves; good in gardens
Hardwickia binata (Leguminosae) Height: 3-5m	Anjan	M; deciduous, good for green belts on shallow soils
Hibiscus mutabilis (Malvaceae) Height: 3-5m	Sthal kamal	S; large bushy shrub, semi evergreen good in green belts & in gardens, along channels
H. rosa sinensis Height: 3m	Jasut	S; evergreen woody showy shrub good for gardens
Lxora coccinea Height: 1-2m	Rangan	S; much branched evergreen; good in gardens and in green belts
Jasminum sbrahmanir (Oleaceae)	Moghra	S; much branched evergreen; good in gardens and in green belts
Kydia calycina (Malvaceae)	Pula	S; deciduous, good along canals and in green belts
Lagerstroemia speciosa (Lythraceae) Height: 10m	Jarul	M; deciduous, good along road sides and in garden
Lannea coramandelica (Anacardiaceae) Height: 3-5m	Jhingan	L; deciduous, good on well drained green belts and around flares
Lawsonia alba (Lythraceae) Height: 3-5m	Mehndi	S; glabrous much branched shrub, good along canal sides
Mallotus philippensis (Euphorbiaceae) Height: 5-8m	Sindur	S; small evergreen tree, good along canals
Millingtonia hortensis (Bignoniaceae) Height: 3-5m	Akas Nim	L; semi evergreen flowers fragrant, good along road sides
Mimusops elengi (Sapotaceae) Height: 10m	Maulsari	M; evergreen, good for avenues
Moringa oleifera (Moringaceae) Height: 10m	Sainjna	M; deciduous, with fragrant flowers
Murava koenigii (Rutaceae) Height: 3-5m	Mitha Neem	S; semi evergreen good in green belts suitable site and along small channels
Oreodoxa regia (Palmae)	Royal palm	L; semi- evergreen good along medium and

Botanical Name of the Plant with Height	Hindi Name	Size of Plant Type and Suitable site
Height: 5-8m		small road sides as an ornamental plant
Peltophorum inerma (Leguminosae, Caaesalpiniaceae) Height: 3-5m		M; Semi evergreen, suitable on road sides, in gardens & outside office buildings
Pliumeria acuuminata (Apocynaceae) Height: 3-4m	Golainchi	M; semi evergreen, fragrant white flowers, good in green belts
Plumeria alba (Apocynaceae) Height: 3-4m		S; semi evergreen good for gardens
Plumeria rubra Height: 3-4m	Golaonchi	S; semi evergreen good for gardens
Pterocarpus marsupium (Leguminosae, Papilionaceae) Height: 3-5m	Bija	M; deciduous, good on open areas with adequate light
Pogamia pinnata (Leguminosae, Papilionaceae) Height: 3-5m	Karanj	M; deciduous, good along roads and canals
Samalia malabarica (Bombaceae) Height: 3-5m	Semul	M; deciduous, good for avenues
Samanea saman (Leguminosae) Height: 20m		L; deciduous, a good tree along road sides for shade
Saraca indica (Leguminosae, Caesalpinaceae) Height: 5m	Asok	M; evergreen tree good on road sides within campus
Spathodia campanulata (Bignoniaceae) Height: 12m	Ruugtoora	L; iin gardens and avenues and in green belts, it is deciduous
Syzygium cuminii (Myyrtaceae) Height: 20m	Jaman	L; evergreen tree good in green belts, and with in campus road sides
Tabernamontana coronaria (Apocynaceae) Height: 2-3m	Chandni	S; an evergreen shrub, good in gardens and along cannels
Tamarindus indica (Leguminosae, caesalpiniaceae) Height: 20m	Imli	L; evergreen tree good along state national highways suitable site
Xylia xyicarpa (Leguminosae;Minosaceae) Height: 2m	Jambu	Good in gardens and along cannels and streams and on waste lands
Zanthoxyium(Rutaceae) Height: 2m	Badrang	M; deciduous in green belts.

4.14 Socio-Economic Environment

4.14.1 Prediction of Impacts on Socio-Economics

- ***Impacts on Employment Generation***

The requirement of 250 person skilled/unskilled manpower will be met from nearby villages during construction in addition to some regular employment during operation. The project will also help in generation of significant indirect 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 Infrastructure Development***

Infrastructure is already developed as part of SIDCUL which is a notified industrial estate.

4.14.2 Measure to Improve Socio-Economic Conditions of the Region

Corporate Social Responsibility (CSR) is an integral part of HZL's business which is accorded as much importance as a business project. HZL's sharp focus on CSR and long term objective are evident from the fact that it has a full fledged CSR team of 150 functionaries including qualified professionals and subject matter specialists. The team is rendering the services for the upliftment of under privileged rural masses in the operational villages. HZL CSR initiatives have been prioritized on local needs, which focus on Health, Education, Sustainable Livelihood, Social Mobilization, Infrastructure Development, Water Harvesting, Agriculture, Animal Husbandry and Environment Conservation.

- **R&R**

The area is a notified industrial area and hence no R & R activities are involved in the project.

4.15 Indirect Impacts

4.15.1 Impacts on Public Health and Safety

The discharge of waste materials (stack emission, wastewater and solid wastes), from process operations can have potential impact on public safety and health. The impact from the discharge of waste products is not expected to be significant since, the adverse impacts on ambient air, water and soil quality are predicted to below and suitable mitigation measures are planned. The public health and safety is dependent on the effective implementation of control measures suggested for pollution control.

4.15.2 Management of Public Interests

Based on the analysis of the socio-economic profile of the study area along with the prediction and evaluation of likely impacts arising out of the proposed activity, it has been possible to prepare a feasible environmental management plan. It is felt that this would help in minimizing the adverse impacts on the socio-economic environment to a considerable extent, while at the same time addressing to large extent the aspirations of the community. For the recruitment of semi-skilled and un-skilled workers particularly during construction, preference shall be given to the local people.

Inside the plant area a first aid will be provided with the basic medicines. In future the HZL plant will tie up with hospitals of Rudrapur city. Regular checking of the executives and plant workers will be done quarterly.

4.16 Occupational Health (Impacts and Mitigation Measures)

Occupational health needs attention both during construction and erection and operation and maintenance phases. However, the occupational risks vary both in magnitude and variety.

4.16.1 Assessment of Risks

Risks have been assessed separately for construction and operation phase. Details are given below:

- **Construction**

The occupational health problems envisaged at this stage can mainly be due to noise during construction.

To overcome these hazards, in addition to arrangements to reduce it within TLV's, people protective equipments will also be supplied to workers.

- **Operation**

Occupational risks assessed for operation phase are listed in **Table-4.22**.

TABLE-4.22
OCCUPATIONAL RISKS

Operation Area	Occupational Risks	Control Measures
Material handling	Dust	Suction hood shall be provided and connected to bag filters. This will ensure dust free work zone environment.
Zinc & Lead melting & casting section	Heat stress, noise, dust & metal fumes	Suction hood shall be installed above the furnaces and proper ventilation shall be maintained. Automatic temperature controller will be installed in furnaces to avoid excessive heat. Industrial fans will be used in the furnace area to lower the ambient temperature and improve the working conditions for operators. Properly designed equipment will maintain the noise level in the work zone. Building enclosure will further reduce the noise in surrounding. Well designed hygiene

Operation Area	Occupational Risks	Control Measures
		ventilation system will be provided comprising of hygiene suction hood, ducting, hygiene fan with bag filter to cover the secondary emission. After treatment in bag filters, emission will be made through stacks of adequate height. This will ensure dust & fumes free work zone environment.
DG set	Sox, NOx, PM and noise	LSHS or HSD or HFO (with FGD for SO_2) shall be used as fuel. Acoustic enclosures shall be provided for noise attenuations. Stacks of adequate height shall be provided for proper dispersion of gases.

4.16.2 Personal Protective Equipments

Apart from taking engineering & administrative controls, & adopting best work practices, personnel protective equipment (PPEs) will be used in conjunction with these controls to protect individuals, exposed to health and safety hazards, from the risk of injury by creating a barrier against workplace hazards.

PPE include devices for head protection, eye and face protection, protective clothing, hand protection, foot protection, hearing and respiratory protection. Hazard awareness and training shall be provided to all those working in the plant to make them aware of what hazards exist in their workplace.

The personal protective equipments will be given to all the workers based on their specific work requirements. PPEs include

- Industrial Safety Helmet;
- Crash Helmets;
- Face shield with replacement acrylic vision;
- Zero power plain goggles with cut type filters on both ends;
- Zero power goggles with cut type filters on both sides and blue color glasses;
- Welders equipment for eye and face protection;
- Cylindrical type earplug;
- Ear muffs;
- Canister Gas mask;
- Self contained breathing apparatus;
- Leather apron;
- Aluminized fiber glass fix proximity suit with hood and gloves;

- Safety belt/line man's safety belt;
- Leather hand gloves;
- Asbestos hand gloves;
- Acid/Alkali proof rubberized hand gloves;
- Canvas cum leather hand gloves with leather palm;
- Electrically tested electrical resistance hand gloves; and
- Industrial safety shoes with steel toe.

4.16.3 Occupational health facility

The proposed plant is small in scale of operation (employing 250 no of manpower) and good occupational health medical facilities are available in Rudrapur City and nearby area.

Nursing staff with other basic necessary facilities will be provided in the plant area for first- aid treatment round the clock for attending emergency arising out of accidents, if any.

Occupational health check ups and other for any emergency treatment, there will be a tie up with the near by hospitals. Occupational health survey shall be carried out at regular interval and their recommendations shall be implemented in time bound manner.

In order to increase health awareness, periodical in-house and external trainings will be arranged through external and internal faculty.

4.16.4 Occupational Health Monitoring Plan

Initial and periodical medical examination shall be done for all the workers as per their specific exposure.

Medical examinations will be carried out as per the tentative plan given in **Table-4.23**. The list of materials to be kept in centralized place is given in **Table-4.24.**

TABLE-4.23
OCCUPATIONAL HEALTH MONITORING PLAN

Sr. No.	Dept	OH Risk	Test	Frequency
1	Compressor House/DG house	Noise	Audiometry	Once in a Year
2	Drivers / Crane Operators / Lifter Operators	No Risk (Only preventive check)	Ophthalmologic	Below 45 Years (Once in a Year) More than 45 years old (Twice in a Year)
3	Lead melting & casting section	Lead fumes	Blood lead level	Once in three months
4	All Employees	General and Occupational Health Check	Periodical Medical Examination	Twice in a Year for (Process) and Once in a Year (For Non Process)

TABLE-4.24
LIST OF MATERIALS TO BE KEPT IN CENTRALIZED PLACE

Sr. No.	Materials		Number
I	Safety belts		10
II	Hand gloves (rubber & leather)		50
III	Rubber tubes		6
IV	Safety goggles		12
V	Stretcher	Vertical type	1
		Ordinary type	2
VI	Manila rope (1/2" & ¾")		20m each
VII	Hanging ladder way		20m, 1 sets
VIII	Submersible pump (complete set)		1 set
IX	Pipe fitting & valve (1", 2"' 3" & 4")		Sufficient numbers
X	Iron pans, pick axe, spades		10 no's each
XI	Screw props		2
XII	Wire rope slings & clamps (1/2", 2")		2 sets
XIII	Hose pipe (1/2" & 1")		50m each
XIV	Hose fittings and clamps of all size		Lot
XV	Chain pulley block of 1, 2 & 5 tone capacity. One each		
XVI	Eye bolts		6
XVII	Tripod		2
XVIII	Loose bars (3', 5' & 8')		1no's each
XIX	Carry strip roll		1
XX	Helmets		15
XXI	Cable roll		1
XXII	Telephone instrument		1
XXIII	First aid box		1
XXIV	Hand shovels		10

4.17 Summary of Anticipated Environmental Impacts and Mitigation

The summary of anticipated environmental impacts and mitigation measures are given in **Table-4.25**.

TABLE-4.25
ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Discipline	Potential Negative Impacts	Probable Source	Mitigative Measures	Remarks
Constructional Impact				
Water Quality	Increase in suspended solids due to soil run-off during heavy precipitation	Loose soil at construction site	During monsoon season run off from construction site will be routed to a temporary sedimentation tank for settlement of suspended solids.	_
Air Quality	Increase in dust and NOx concentration	Levelling activity and heavy vehicular movement	Sprinkling of water in the construction area and unpaved roads will be done. Proper maintenance of vehicles will be done.	The impact will be low, as the main approach road will be tarred.
Noise	Increase in noise	Construction	Equipment will be kept	Workers will be

Discipline	Potential Negative Impacts	Probable Source	Mitigative Measures	Remarks
	level	equipment	in good condition to keep the noise level within 85 dB (A). Workers, who are working in the high noisy areas, will be provided with protective equipment.	provided necessary protective equipment *e.g.* ear plugs, earmuffs.
Terrestrial Ecology	Clearing of vegetation including cutting of forest areas	Land acquisition and soil enabling activities	Landscaping and extensive plantation development and plantation in the open area will be carried out.	Extensive plantation in the surrounding areas including plant site will be done. The plantation will be developed in plant area.
Operational Impact				
Water Quality	Deterioration of surface water quality	Discharge from various plant units and other auxiliary units	Adequate treatment facilities will be provided so that the treated effluents conform to the regulatory standards. Treated water will be reused/ recycled for secondary purposes. Zero discharge shall be maintained except in monsoons.	The reuse of treated wastewater will help in conserving the fresh water resources.
Air Quality	Increase in PM, SO_2, and NOx levels in ambient air.	Stack emissions and fugitive emissions.	Bag filters having 99.9 % efficiency will be provided to control Particulate Matter emission to less than 50 mg/Nm^3. Stacks will be provided for the proper dispersion of gaseous pollutants. • Two stacks of 30 m height in the zinc section for bag filter discharge • One stack of 40 m height in the lead section for bag filter and combustion off gases discharge; • One stack of 20m (1 DG set-500 KVA) and one of 50m (3 DG sets-5.5 MW) for DG set emissions; and • One stack of 40 m (Process stack) and one stack of 30 m	The resultant air quality will conform to the stipulated standards.

Discipline	Potential Negative Impacts	Probable Source	Mitigative Measures	Remarks
			(Hygiene stack) height in the silver plant for bag filter discharge • FGD system in case of using HFO Motorable roads in the plant area will be paved to reduce dust emission. Afforestation programs will be undertaken at the periphery plant area.	
Noise Levels	Increase in noise levels in the plant area.	Equipment in main plant and auxiliaries.	Equipment will be designed to conform to noise levels prescribed by regulatory agencies. Provision of green belt and plantation would further help in attenuating noise.	Employees working in high noise areas would be provided earplugs/ earmuffs as protective device.
Demography and Socio-Economics	Strain on existing amenities like housing, water sources and sanitation, medical and infrastructure facilities.	Influx of people of proposed melting and casting facilities for zinc and lead employees as well as contractor's employees/ labourers.	Locals will be given preference in employment. No significant impact is envisaged as sufficient additional facilities are proposed by the project proponents.	Overall socio-economic status of the area is expected to improve considerably.
Storm Water Control	Impact on water resources	Rain water	Separate storm drains will be provided. The run-off water thus will be used in plantation development during rainy season. Surplus water will be disposed off to nearby nallah.	Separate storm water drains will ensure discharge of uncontaminated run-off water during rainy season. The collected run-off water from the drains will be used for rainwater harvesting within the plant premises.
Fire & Safety	Accidents and disasters related to fire & safety	Chemical and fuel storages	Disaster Management Plan (DMP) has been prepared	On-site and Off-site Emergency plan will be implemented during any disaster.

5.0 ANALYSIS OF ALTERNATIVE TECHNOLOGY & SITE

5.1 Selection of Technology

The proposed zinc and lead melting and casting plant will not have any smelting, processing and refining. Based on HZL prior experience and recent information from the market the proven and established technologies, induction melting furnaces for zinc and oil fired melting pot for lead shall be used. Efficient ventilation system with bag filters will be utilized to achieve good work zone atmosphere.

- *Pollution Prevention and Control*

The following pollution prevention measures will be implemented:

- Suction hood for collections of fugitives followed by bag filters
- Storing chemicals and other materials in such a way that spills, if any, can be collected.
- Controlling water consumption by recirculating cooling water after treatment.

- *Treatment Technologies*

  - Air Emissions

Dust emission control technologies include bag houses. Target values for emissions passing through a bag filter is 50 mg/Nm^3.

- Wastewater Treatment

Recycling 100 % of the wastewater after treatment and maintaining of zero discharge

5.2 Description of Alternative Site

For the proposed projects, basically two sites were evaluated. One in Haridwar and other one in Pantnagar. Based on detailed evaluation, the Pantnagar site is selected for the project.

➢ ***Criteria for Site Selection***

The Site Selection Survey to determine the most feasible site has been carried out. The site has been critically evaluated based on the feasibility to set up the proposed melting project. The alternative sites have been evaluated based on physical inspection geographical site conditions and validations.

5.2.1 Description of Potential Sites for the Project

- ***Alternative Site-I (*at notified industrial estate at SIDCUL, Haridwar, State Uttarakhand)**

- *Geographical Location*

The proposed project site is part of State Industrial Development Corporation Uttarakhand Limited (SIDCUL) , Haridwar, Uttarakhand.

- *Approx. Size*

The area is about 3.44 ha.

- *Land Use Pattern*

The land is Notified Industrial land

- *Terrain Type*

About 46% area under buffer zone forms a flat plain with minor undulations and a very gentle slope towards south and rest area forms Siwalik hills. The elevation within the buffer area varies from 260 m in south to 700 m above MSL in the north-eastern part of the area.

- *Other Details*

The proposed project site (3.44 Ha) is part of Notified Industrial Area administered by SIDCUL, Department of Industries, Govt of Uttarakhand. The average elevation of the site is about 294.7 m above mean sea level. Ganga river flows in nearby area.

Rajaji National Park is situated on the north and north east side of SIDCUL industrial estate at about 2 km away. Holy place Haridwar, a pilgrim centre, is situated around 10 km east of the proposed site on the right banks of Ganga river.

- ***Alternative Site-II (At notified industrial area of State Industrial Development Corporation Limited (SIDCUL), Pantnagar village, Kichha tehsil, Udham Singh Nagar district, Uttarakhand state)***

- *Geographical Location*

The proposed project site is a part of the State Industrial Development Corporation Uttarakhand Limited (SIDCUL) Pantnagar, Uttarakhand where HZL is already setting up a Silver Refinery.

- *Approx. Size*

The area is about 10 ha.

- *Land Use Pattern*

The land is Notified Industrial land

- *Terrain Type*

Major area of buffer zone forms a flat alluvial plain with minor undulations and has 3 to 5 m/km slope towards south west. The elevation within the buffer area varies from 300 m above msl in north east to 200 m above msl in the south-western part of the buffer zone.

- *Other Details*

There are neither any archaeologically important places nor any Protected areas as per Wildlife Protection Act, 1972 (Tiger reserve, Elephant reserve, Biospheres, National parks, Wildlife sanctuaries, community reserves and conservation reserves) in 10 km radius.

5.2.2 Evaluation of Potential Sites

The criteria for evaluating potential sites for implementing the project are as follows:

- Availability of sufficient land: Barren or Semi-fertile land, with minimum resettlement preferred.
- As per MOEF guidelines, no construction is allowed within 500 m from state & national highways, railway lines and HFL/HTL of river/sea and
- The region shall not be environmentally fragile and not in vicinity (< 25 km) of any wildlife sanctuary or national park

5.2.3 Recommendation

Based on the above mentioned evaluation criteria, alternate site no - II, i.e. notified industrial area of State Industrial Development Corporation Limited (SIDCUL), Pantnagar village, Kichha tehsil, Udham Singh Nagar district, Uttarakhand state has been recommended to setup the said project.
The major advantage in selecting the site for proposed may be summarized below:

- Adequate land is available for the installation of the proposed project with all facilities
- Site is well connected by Rail, and Road
- There are no ecologically sensitive areas in 10 km radius

6.0 ENVIRONMENT MONITORING PROGRAM

This chapter presents the details of environmental monitoring, schedule, institutional arrangements for pollution control, cost for environmental protection measures and details of greenbelt development for the proposed project.

6.1 Post Project Environmental Monitoring

Post project environmental monitoring is important in terms of evaluating the performance of pollution control equipments installed in the project. The sampling and analysis of the environmental attributes will be as per the guidelines of CPCB/UEPPCB and the fugitive emissions as per the latest permissible limits issued by the Ministry vide G.S.R. 414(E) dated 30th May, 2008. Following attributes will be covered in the post project environmental monitoring in and around the project site. The monitoring schedule is presented in **Table-6.1**.

TABLE-6.1
MONITORING SCHEDULE FOR ENVIRONMENTAL PARAMETERS

Sr. No.	Particulars	Monitoring Frequency	Method of Sampling	Important Monitoring Parameters
I	**Air Pollution & Meteorology**			
	Air Quality			
	A **Stack Monitoring**			
	1 Zinc Melting and Casting section stack	Once in two weeks	ISO-Kinetic, manual procedure	PM,
	Lead Melting and Casting Section stack	Once in two weeks		PM, SO_2, Nox, Lead
	Process stack of Silver plant	Once in two weeks		PM, SO_2, Nox
	Hygiene stack of Silver plant	Once in two weeks		NOx
	2 DG set stacks	Once in two weeks	ISO-Kinetic, manual procedure	PM, SO_2, NOx, CO
	3 Fugitive emissions monitoring at following locations- Zinc section • Zinc cathode charging point • Dross treatment section Lead section • Lead cathode charging point • Dross treatment section Silver plant • Raw material handling • Furnace area	Twice in a month	Low volume sampler	 PM PM, Lead PM
	B **Ambient Air Quality Monitoring**			
	Three locations in and around the plant	Twice in a week	24 hr. continuously	SPM, RPM, SO_2, NO_x CO, Zn, and Pb

Sr. No.	Particulars		Monitoring Frequency	Method of Sampling	Important Monitoring Parameters
		Dustfall			
		At ambient air quality locations	Once quarterly	24 hr. continuously	Dust, Zinc, Lead
	C	**Meteorology**			
		Wind speed, direction, temperature, relative humidity, atmospheric pressure, rainfall etc Shall be monitored at proposed project either through own set up or through near by meteorological station			
II	**Water and Wastewater Quality**				
	A	**Industrial Effluents**			
	1	Treated water from			
		ETP	Once in a Day	24 hr composite	pH, O & G, TSS, TDS
		Cooling tower	Once in a week	24 hr composite	pH, SS TDS
	B	**Water quality**			
		8 locations (surrounding villages)	Once in a month	Grab	Parameters specified under IS:2296 (Class C) and IS:10500, 1986
III	**Industrial Noise Levels**				
	1	Near Administrative Office	Once in a month in day and night	8 hr continuous with 1 hr interval	Noise levels in dB(A)
	2	Process Air Blower	-do-	8 hr continuous with 1 hr interval	Noise levels in dB(A)
	3	Near Zinc plant	-do-	8 hr continuous with 1 hr interval	Noise levels in dB(A)
	4	Near Lead plant	-do-	8 hr continuous with 1 hr interval	Noise levels in dB(A)
	4	Near DG set	-do-	8 hr continuous with 1 hr interval	Noise levels in dB(A)
	Ambient Noise Levels				
	1	On the Plant Boundary in Eight directions	Once in a month for the industry in day and night Once in each month for ambient noise levels in day and night	24 hr continuous with one hr interval	Noise levels in dB(A)
IV	**Soil Quality**				
		8 locations	Pre-Monsoon and Post Monsoon season	Grab	Physio-chemical parameters and metals covering Zn, Pb, Cd, As and Cu.

6.2 Institutional Arrangements for Pollution Control

The environmental monitoring cell will be headed by HSE Head having adequate experience in the fields of Environment, Safety and occupational health. He will be supported by following technical personnel:

- Environmental Engineer;
- Safety officer;
- Chemist; and
- Support Staffs

The department will be the nodal agency to co-ordinate and provides necessary services on environmental issues during construction and operation of the project. This group will be responsible for implementation of Environment Management Plan and interaction with the environmental regulatory agencies, reviewing draft policy and planning. This department will interact with Uttarakhand Environement Protection and Pollution Control Board (UEPPCB), Ministry of Environment and Forests (MoEF), Central Pollution Control Board (CPCB) and other environment regulatory agencies.

6.3 Cost Provision for Environmental Measures

It is proposed to invest about Rs. 12 Crores on pollution control equipments, adequate stack height, ETP, STP, noise enclosures, monitoring equipment etc., Around Rs. 75 lacs will be recurring cost for running pollution control equipments, wastewater treatment, solid waste management, monitoring and greenbelt management etc. The details of cost provision for environmental measures are given in **Table-6.2**. Thus, with the above described Environment Management Plan, the proposed zinc and lead melting and casting plant will usher positive development in the region.

TABLE-6.2
COST PROVISION FOR ENVIRONMENTAL MEASURES

Sr. No.	Particulars	Capital Cost (Rs in Crores)
1	Stacks & Scrubbers	5.00
2	Hygiene bag filters	3.50
3	ETP & STP	0.60
	Solid waste disposal	-
	Noise enclosures	0.30
	Environment lab & monitoring Equipments	0.40
	Rainwater harvesting	0.40
	Greenbelt	0.30
4	Storm water pond	0.50
5	Others	1.00
Total Value		**12.0**

7.0 ADDITIONAL STUDIES

The following additional studies/activities have been carried out on different aspects:

- HZL engaged Hydro-Geosurvey Consultants Private Ltd., Jodhpur (HCPL) to conduct the study 'Hydrological, hydrogeological and land use mapping of core and buffer zones of Silver refinery plant & proposed melting and casting in SIDCUL, Pantnagar, Uttarakhand'.

- Risk assessment studies were conducted and a disaster management plan was prepared.

7.1 Hydrological, Hydrogeological and Land Use Mapping of Core and Buffer zones of Silver Refinery Plant in SIDCUL, Pantnagar, Uttarakhand

HZL engaged Hydro-Geosurvey Consultants Private Ltd., Jodhpur (HCPL) to conduct the study 'Hydrological, hydrogeological and land use mapping of core and buffer zones of plant area in SIDCUL, Pantnagar, Uttarakhand'. The report containing the land use/land cover map and hydrological and hydrogeological studies of the core zone (plant area) and buffer zone (10 km radius) and the rain water harvesting system design by utilizing the roof top rain water for augmenting the ground water storage of the plant area. The details of the report are given below.

7.1.1 Comprehensive Hydrogeological Assessment of Core & Buffer Zones

The present study reveals that against the total ground water recharge of 2.46 mcm, including recharge from return flow of irrigation water of buffer zone, the ground water discharge is 1.91 mcm indicating the status of ground water development of buffer zone as 77.64%. The buffer zone therefore appears to be safe as no long term depletion of water table has been observed. Similarly, against the ground water recharge of shallow aquifer of 0.019 mcm of the plant area, there is no ground water abstraction from shallow unconfined aquifer of plant area. The total ground water abstraction of 0.30 mcm for the plant will be from the confined aquifer for which recharge values are not known.

The Central Ground Water Board in association with state ground water organization carry out estimation of dynamic ground water reserves of every taluka/mandal of the state by monitoring the water levels in key wells during pre and post monsoon periods every year along with estimation of ground water draft. The report is published once in two years and last report has been released in August, 2005 for the dynamic ground water reserves as on 1.4.2004. This report places all the talukas/ mandals in different categories like safe, semi-critical, critical and over-exploited depending on the status of ground water development and long term water level trend. This report has indicated the status of ground water development of Udham Singh Nagar district as 79% without any long term declining trend of water levels either in pre or post monsoon period thereby placing it under safe category.

The present study has also indicated the buffer zone in safe category because the buffer zone covers a limited area of Udham Singh Nagar and has less number of bore wells/tubewells for irrigation.

7.1.2 Land Use Mapping of Buffer Zone

- **Integrated land use of the area**

Based on the different themes prepared using satellite data, toposheet and field check, an integrated land use theme is prepared. The integrated map shows that the buffer zone is almost a plain to moderately undulating land having some higher elevation in the northeast portion. The .03% of the land is the plant area. Most of the buffer zone is agricultural land. A large portion of buffer zone in northwest and south west is under forest marked as Tanda, Gangapurpatia and Dhimri protected forest, but its major portion has been leased out for cultivation.

7.1.3 Rain Water Harvesting Program for the Project

The recharge of 4,205 m^3 of roof top rain water would raise the water table of plant area of 10 ha by about 0.30 m taking 15 % as the specific yield of alluvial formation. Accordingly, no other rain water harvesting measures are being proposed as otherwise, it would create problems with the soil.

7.2 Risk Assessment & Disaster Management Plan

7.2.1 Risk Assessment

Hazard analysis involves the identification and quantification of the various hazards (unsafe conditions) that exist in the plant. On the other hand, risk analysis deals with the identification and quantification of risks, the plant equipment and personnel are exposed to, due to accidents resulting from the hazards present in the plant.

Risk analysis follows an extensive hazard analysis. It involves the identification and assessment of risks the neighboring populations are exposed to as a result of hazards present. This requires a thorough knowledge of failure probability, credible accident scenario, vulnerability of population etc. Much of this information is difficult to get or generate. Consequently, the risk analysis is often confined to maximum credible accident studies.

In the sections below, the identification of various hazards, probable risks in the zinc plant after de-bottlenecking project, maximum credible accident analysis, consequence analysis are addressed which gives a broad identification of risks involved in the plant. Based on the risk estimation for fuel and chemical storage Disaster Management Plan (DMP) has been prepared.

7.2.1.1 Approaches to the Study

Risk involves the occurrence or potential occurrence of some accidents consisting of an event or sequence of events. The risk assessment study covers the following:

- Identification of potential hazard areas;
- Identification of representative failure cases;
- Visualization of the resulting scenarios in terms of fire (thermal radiation) and explosion;
- Assess the overall damage potential of the identified hazardous events and the impact zones from the accidental scenarios;
- Assess the overall suitability of the site from hazard minimization and disaster mitigation points of view;
- Furnish specific recommendations on the minimization of the worst accident possibilities; and
- Preparation of broad Disaster Management Plan (DMP), On-site and Off-site Emergency Plan, which includes Occupational and Health Safety Plan.

7.2.1.2 Hazard Identification

Identification of hazards in zinc and lead melting and casting plant is of primary significance in the analysis, quantification and cost effective control of accidents involving chemicals and process. A classical definition of hazard states that hazard is in fact the characteristic of system/plant/process that presents potential for an accident. Hence, all the components of a system/plant/process need to be thoroughly examined to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident. The following two methods for hazard identification have been employed in the study:

- Identification of major hazardous units based on Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 of Government of India (GOI Rules, 1989); and

- Identification of hazardous units and segments of plants and storage units based on relative ranking technique, viz. Fire-Explosion and Toxicity Index (FE&TI).

7.2.1.2.1 Classification of Major Hazardous Units

Hazardous substances may be classified into three main classes namely Flammable substances, unstable substances and Toxic substances. Flammable substances require interaction with air for their hazard to be realized. Under certain circumstances the vapours arising from flammable substances when mixed with air may be explosive, specially in confined spaces. However, if present in sufficient quantity such clouds may explode in open air also. Unstable substances are liquids or solids, which may decompose with such violence so as to give rise to blast waves. Finally, toxic substances are dangerous and cause substantial damage to life when released into the atmosphere. The ratings for a large number of chemicals based on flammability, reactivity and toxicity have been given in NFPA Codes 49 and 345 M. No additional storages are proposed for fuel and chemicals. The storage facilities planned for the projects under implementation will be utilized in the proposed project. The fuel and chemical storage in the plant are given in **Table-7.1.**

TABLE-7.1
CATEGORY WISE SCHEDULE OF STORAGE TANKS

Sr. No.	Material	No. of Tanks	Design Capacity (Total)	Classification
1	LSHS/HFO (Zinc and lead melting and casting plant)	3	3x250-KL	Flammable
2	HSD (Zinc and lead melting and casting plant)	2	2x50 & 2x15-KL	Flammable
3	LPG (Zinc and lead melting and casting plant)	2 Bullet	2x10-MT	Flammable
4	HSD (Silver plant)	1	2x15-KL	Flammable
5	LDO (Silver plant)	2	2x132-KL	Flammable

7.2.1.3Identification of Major Hazard Installations Based on GOI Rules, 1989

Following accidents in the chemical industry in India over a few decades, a specific legislation covering major hazard activities has been enforced by Govt. of India in 1989 in conjunction with Environment Protection Act, 1986. This is referred here as GOI rules 1989. For the purpose of identifying major hazard installations the rules employ certain criteria based on toxic, flammable and explosive properties of chemicals.

7.2.1.4Analysis of Units of Different Processes

A systematic analysis of the fuels/chemicals and their quantities of storage has been carried out, to determine threshold quantities as notified by GOI Rules, 1989 and the applicable rules are identified. Applicability of storage rules is summarized in **Table-7.2.**

TABLE-7.2
APPLICABILITY OF GOI RULES TO FUEL/CHEMICAL STORAGE

Sr. No.	Chemical/ Fuel	Listed in Schedule	Total Quantity	Threshold Quantity (T) for Application of Rules	
				5,7-9,13-15	10-12
1	LSHS/HFO	3(1)	750-KL	25 MT	200 MT
2	HSD	3(1)	130-KL	25 MT	200 MT
3	LPG	3(1)	20-MT	25 MT	200 MT
4	LDO	3(1)	264-KL	25 MT	200 MT

7.2.1.5Fire Explosion and Toxicity Index (FE&TI) Approach

Fire, Explosion and Toxicity Indexing (FE & TI) is a rapid ranking method for identifying the degree of hazard. The application of FE & TI would help to make a quick assessment of the nature and quantification of the hazard in these areas. However, this does not provide precise information. Respective Material Factor (RMF), General Hazard Factors (GHF), Special Process Hazard Factors (SPHF) is computed using standard procedure of awarding penalties based on storage handling and reaction parameters. Before hazard indexing can be applied, the installation in question should subdivided into logical, independent elements or units. In general, a unit can logically be characterized by the nature of the process

that takes place in it. In some cases, the unit may consist of a plant element separated from the other elements by space or by protective walls. A plant element may also be an apparatus, instrument, section or system that can cause a specific hazard. For each separate plant process, which contains flammable or toxic substances, a fire and explosion index F and/or a toxicity index T may be determined in a manner derived from the method for determining a fire and explosion index developed by the Dow Chemical Company.

7.2.1.5.1 FE and TI Methodology

Dow's Fire and Explosion Index (F and E) is a product of Material Factor (MF) and hazard factor (F3) while MF represents the flammability and reactivity of the substances, the hazard factor (F3), is itself a product of General Process Hazards (GPH) and special process hazards (SPH). An accurate plot plan of the plant, a process flow sheet and Fire and Explosion Index and Hazard Classification Guide published by Dow Chemical Company are required to estimate the FE & TI of any process plant or a storage unit.

7.2.1.5.2 Computations and Evaluation of Fire and Explosion Index

The Fire and Explosion Index (F&EI) is calculated from the following formula:

$$F\ \&\ EI = MF \times (GPH) \times (SPH)$$

The degree of hazard potential is identified based on the numerical value of F&EI as per the criteria given below:

F&EI Range	**Degree of Hazard**
0-60	Light
61-96	Moderate
97-127	Intermediate
128-158	Heavy
159-up	Severe

7.2.1.5.3 Toxicity Index (TI)

The toxicity index is primarily based on the index figures for health hazards established by the NFPA in codes NFPA 704, NFPA 49 and NFPA 345 m.

7.2.1.5.4 Classification of Hazard Categories

By comparing the indices F&EI and TI, the unit in question is classified into one of the following three categories established for the purpose **(Table-7.3).**

TABLE-7.3
FIRE EXPLOSION AND TOXICITY INDEX

Category	Fire and Explosion Index (F&EI)	Toxicity Index (TI)
I	F&EI < 65	TI < 6
II	65 < or = F&EI < 95	6 < or = TI < 10
III	F&EI > or = 95	TI > or = 10

Certain basic minimum preventive and protective measures are recommended for the three hazard categories.

7.2.1.5.5 Results of FE and TI for Storage/Process Units

Based on the GOI Rules 1989, the hazardous fuels and chemicals used by the zinc and lead melting and casting plant were identified. Fire and Explosion are the likely hazards, which may occur due to the fuel and chemical storage. Hence, Fire and Explosion index has been calculated for in plant storage. Detailed estimates of FE&TI are given in **Table-7.4.**

TABLE-7.4
FIRE EXPLOSION AND TOXICITY INDEX FOR STORAGE FACILITIES

Sr. No.	Chemical/ Fuel	Total Quantity (tonnes)	F&EI	Category	TI	Category
1	LSHS/HFO	750-KL	30.2	Light	Nil	Nil
2	HSD	130-KL	15.2	Light	Nil	Nil
3	LPG	20-MT	50.0	Light	Nil	Nil
4	LDO	264-KL	3.6	Light	Nil	Nil

7.2.2 Visualization of MCA Scenarios

7.2.2.1Introduction

A Maximum Credible Accident (MCA) can be characterized, as an accident with a maximum damage potential, which is still believed to be probable.

MCA analysis does not include quantification of the probability of occurrence of an accident. Moreover, since it is not possible to indicate exactly a level of probability that is still believed to be credible, the selection of MCA is somewhat arbitrary. In practice, the selection of accident scenarios representative for an MCA-Analysis is done on the basis of engineering judgment and expertise in the field of risk analysis studies, especially accident analysis.

As an initial step in this study, a selection has been made of the processing and storage units and activities, which are believed to represent the highest level of risk for the surroundings in terms of damage distances. For this selection the following factors have been taken into account:

- Type of compound viz. flammable or toxic;
- Quantity of material present in a unit or involved in an activity; and
- Process or storage conditions such as temperature, pressure, flow, mixing and presence of incompatible materials.

In addition to the above factors the location of a unit or activity with respect to adjacent activities is taken into consideration to account for the potential escalation of an accident. This phenomenon is known as the domino effect. The units and activities, which have been selected on the basis of the above factors are summarized, accident scenarios are established in hazard Identification studies,

while effect and damage calculations are carried out in Maximum Credible Accident Analysis studies.

7.2.2.2Methodology

Following steps are employed for visualization of MCA scenarios:

- Chemical inventory analysis;
- Identification of hazardous processes in individual units;
- Identification of chemical release and accident scenarios;
- Analysis of past accidents of similar nature to establish credibility to identified scenarios; and
- Short listing of MCA Scenarios.

7.2.2.3Common Causes of Accidents

Based on the analysis of past accident information, common causes of major chemical plant accidents are identified as:

- Poor house keeping;
- Improper use of tools, equipment, facilities;
- Unsafe or defective equipment facilities;
- Lack of proper procedures;
- Improvising unsafe procedures;
- Failure to follow prescribed procedures;
- Jobs not understood;
- Lack of awareness of hazards involved;
- Lack of proper tools, equipment, facilities;
- Lack of guides and safety devices; and
- Lack of protective equipment and clothing.

7.2.2.4Failures of Human Systems

An assessment of past chemical accidents reveals human factor to be the cause for over 60% of the accidents while the rest are due to other plant component failures. This percentage will increase if major accidents alone are considered for analysis. Major causes of human failures reported are due to:

- Stress induced by poor equipment design, unfavorable environmental conditions, fatigue, etc.;
- Lack of training in safety and loss prevention;
- Indecision in critical situations; and
- Inexperienced staff being employed in hazardous situations.

Often, human errors are not analyzed while accident reporting and accident reports only provide information about equipment and/or component failures. Hence, a great deal of uncertainty surrounds analysis of failure of human systems and consequent damages.

7.2.2.5Short Listing of MCA Scenarios

Based on the storage quantities and properties of the chemicals, the hazard identification has been done and given as follows for carrying out MCA analysis studies.

- Vapour Cloud Explosion due to vessel rupture;
- Pool fire due to rupture/leakage and accumulation;
- Toxic dispersion due to gas/vapour leaks or pool evaporation; and
- General fire hazards.

7.2.2.6Conclusion

Results of FE&TI analysis show that the storage of LSHS/HFO falls into ***Light*** category of fire and explosion index with a ***Nil*** toxicity index.

Results of FE&TI analysis show that the storage of HSD falls into ***Light*** category of fire and explosion index with a ***Nil*** toxicity index.

Results of FE&TI analysis show that the storage of LPG falls into ***Light*** category of fire and explosion index with a ***Nil*** toxicity index.

7.2.3 Hazard Assessment and Evaluation

7.2.3.1Introduction

Preliminary hazards analysis is based on the philosophy "PREVENTION IS BETTER THAN CURE". How safe are the operations? Safety is relative and implies freedom from danger or injury. But there is always some element of danger or risk in anything we do or build. When a chemical process facility is considered safe? This calls for identification of hazards, quantification of risk and further suggests hazard mitigating measures, if necessary.

The purpose of the preliminary hazards analysis is to identify early in the design process the potential hazards associated with, or inherent in a process design, thus eliminating costly and time consuming delays caused by design changes made later. This also eliminates potential hazard points at design stage itself.

Hence, preliminary hazard analysis is more relevant when a plant is at design/construction stage. This technique, applied early in the project life cycle, helps to eliminate hazards and thus to avoid costly design modifications later. This analysis fortifies the proposed process design by incorporating additional safety factors into the design criteria.

7.2.3.2Methodology

An assessment of the conceptual design is conducted for the purpose of identifying and examining hazards related to feed stock materials, major process components, utility and support systems, environmental factors, proposed operations, facilities, and safeguards.

7.2.3.3Preliminary Hazard Analysis (PHA)

A preliminary hazard analysis is carried out initially to identify the major hazards associated with storages and the processes of the plant. This is followed by consequence analysis to quantify these hazards. Finally, the vulnerable zones are plotted for which risk reducing measures are deduced and implemented. Preliminary hazard analysis for storage areas and whole plant are presented in **Table-7.5** and **Table-7.6**.

TABLE-7.5
PRELIMINARY HAZARD ANALYSIS FOR STORAGE AREAS

Unit	Capacity	Hazard Identified
LSHS/HFO	750-KL	Fire/Explosion
HSD	130-KL	Fire/Explosion
LPG	20-MT	Fire/Explosion
LDO	264-KL	Fire/Explosion

TABLE-7.6
PRELIMINARY HAZARD ANALYSIS FOR THE WHOLE PLANT IN GENERAL

PHA Category	Description of Plausible Hazard	Recommendation	Provision
Environ-mental factors	If there is any leakage and eventuality of source of ignition.	--	All electrical fittings and cables are provided as per the specified standards. All motor starters are flame proof.
	Highly inflammable nature of the chemicals may cause fire hazard in the storage facility.	A well designed fire protection including protein foam, dry powder, CO_2 extinguisher should be provided.	Fire extinguisher of small size and big size are provided at all potential fire hazard places. In addition to the above, fire hydrant network is also provided.

7.2.3.4Maximum Credible Accident Analysis (MCAA)

Hazardous substances may be released as a result of failures or catastrophes, causing possible damage to the surrounding area. This section deals with the question of how the consequences of the release of such substances and the damage to the surrounding area can be determined by means of models.

It is intended to give an insight into how the physical effects resulting from the release of hazardous substances can be calculated by means of models and how vulnerability models can be used to translate the physical effects in terms of injuries and damage to exposed population and environment. A disastrous situation is general due to outcome of fire, explosion or toxic hazards in addition to other natural causes, which eventually lead to loss of life, property and ecological imbalance.

Major hazards posed by flammable storage can be identified taking recourse to MCA analysis. MCA analysis encompasses certain techniques to identify the hazards and calculate the consequent effects in terms of damage distances of heat radiation, toxic releases, etc. A host of probable or potential accidents of the major units in

the complex arising due to use, storage and handling of the hazardous materials are examined to establish their credibility. Depending upon the effective hazardous attributes and their impact on the event, the maximum effect on the surrounding environment and the respective damage caused can be assessed. The MCA analysis involves ordering and ranking of various sections in terms of potential vulnerability. Inventory analysis and fire, explosion and toxicity index (FE&TI) are the two techniques employed for hazard identification process**.**

In the plant fuel storage area mainly poses flammable and explosion hazards due to unwanted release of fuels. Consequence analysis is basically a study of quantitative analysis of hazards due to various failure scenarios. It is that part of risk analysis, which considers failure cases and the damage caused by these failure cases. It is done in order to form and opinion on potentially serious hazardous outcome of accidents and their possible consequences. The reason and purpose of consequence analysis are many folds like:

- Part of Risk Assessment;
- Plant Layout/Code Requirements;
- Protection of other plants;
- Protection of the public;
- Emergency Planning; and
- Design Criteria (e.g. loading on Control Room).

The results of consequence analysis are useful for getting information about all known and unknown effects that are of importance when some failure scenario occurs in the plant and also to get information as how to deal with the possible catastrophic events. It also gives the workers in the plant and people living in the vicinity of the area, an understanding of their personal situation.

7.2.3.4.1 Damage Criteria

The fuel storage and unloading at the storage facility may lead to fire and explosion hazards. The damage criteria due to an accidental release of any hydrocarbon arise from fire and explosion. The vapors of these fuels are not toxic and hence no effects of toxicity are expected.

Tank fire would occur if the radiation intensity is high on the peripheral surface of the tank leading to increase in internal tank pressure. Pool fire would occur when fuels collected in the dyke due to leakage gets ignited.

- **Fire Damage**

A flammable liquid in a pool will burn with a large turbulent diffusion flame. This releases heat based on the heat of combustion and the burning rate of the liquid. A part of the heat is radiated while the rest is convected away by rising hot air and combustion products. The radiations can heat the contents of a nearby storage or process unit to above its ignition temperature and thus result in a spread of fire. The radiations can also cause severe burns or fatalities of workers or fire fighters located within a certain distance. Hence, it will be important to know beforehand the damage potential of a flammable liquid pool likely to be created due to leakage or catastrophic failure of a storage or process vessel. This will help to decide the

location of other storage/process vessels, decide the type of protective clothing the workers/fire fighters need, the duration of time for which they can be in the zone, the fire extinguishing measures needed and the protection methods needed for the nearby storage/process vessels. **Table-7.7** tabulates the damage effect on equipment and people due to thermal radiation intensity. The effect of incident radiation intensity and exposure time on lethality is given in **Table-7.8.**

TABLE-7.7
DAMAGE DUE TO INCIDENT RADIATION INTENSITIES

Sr. No.	Incident Radiation (kW/m^2)	Type of Damage Intensity	
		Damage to Equipment	**Damage to People**
1	37.5	Damage to process equipment	100% lethality in 1 min. 1% lethality in 10 sec.
2	25.0	Minimum energy required to ignite wood at indefinitely long exposure without a flame	50% Lethality in 1 min. Significant injury in 10 sec.
3	19.0	Maximum thermal radiation intensity allowed on thermally unprotected adjoining equipment	--
4	12.5	Minimum energy to ignite with a flame; melts plastic tubing	1% lethality in 1 min.
5	4.5	--	Causes pain if duration is longer than 20 sec, however blistering is un-likely (First degree burns)
6	1.6	--	Causes no discomfort on long exposures

Source: Techniques for Assessing Industrial Hazards by World Bank.

TABLE-7.8
RADIATION EXPOSURE AND LETHALITY

Radiation Intensity (kW/m^2)	Exposure Time (seconds)	Lethality (%)	Degree of Burns
1.6	--	0	No Discomfort even after long exposure
4.5	20	0	1 st
4.5	50	0	1 st
8.0	20	0	1 st
8.0	50	<1	3 rd
8.0	60	<1	3 rd
12.0	20	<1	2 nd
12.0	50	8	3 rd
12.5	--	1	--
25.0	--	50	--
37.5	--	100	--

- **Damage Due to Explosion**

Explosion is a sudden and violent release of energy accompanied by the generation of pressure wave and a loud noise. The rate of energy release is very large and has potential to cause injury to the people, damage the plant and nearby property etc. The effect of over-pressure can directly result in deaths to those working in the direct vicinity of the explosion. The pressure wave may be caused by a BLEVE (Boiling Liquid Expanding Vapour Cloud).

- **BLEVE - Fireball**

BLEVE is sometimes referred to as a fireball, a BLEVE is a combination of fire and explosion with an intense radiant heat emission within a relatively short time interval. This phenomenon can occur as a result of overheating of a pressurized vessel by a primary fire. If a pressure vessel fails as a result of a weakening of its structure the contents are instantaneously released from the vessel as a turbulent mixture of liquid and gas expanding rapidly and dispersing in air as a cloud. When this cloud is ignited a fireball occurs, causing enormous heat radiation intensity within a few seconds. This heat intensity is sufficient to cause severe skin burns and deaths at several hundred meters from the vessel, depending on the quantity of gas involved. A BLEVE can therefore be caused by a physical impact on a vessel or a tank, which is already overstressed.

7.2.3.5Scenarios Considered for MCA Analysis

7.2.3.5.1 Fuel Storage

In case of fuel released in the area catching fire, a steady state fire will ensue. Failures in pipeline may occur due to corrosion and mechanical defect. Failure of pipeline due to external interference is not considered as this area is licensed area and all the work within this area is closely supervised with trained personnel.

7.2.3.5.2 Modeling Scenarios

Based on the storage and consumption of various fuels and chemicals the following failure scenarios for the proposed zinc and lead melting and casting plant have been identified for MCA analysis and the scenarios are discussed in **Tables-7.9.**

TABLE-7.9
SCENARIOS CONSIDERED FOR MCA ANALYSIS

Sr. No.	Fuel/Chemical	Total Quantity	Pool Fire	BLEVE-Fire Ball
1	Failure of LSHS/HFO tank	3x250-KL	*	*
2	Failure of HSD tank	2x50 & 2x15-KL	*	*
3	Failure of LPG Bullet	2x10-MT	-	*
4	Failure of LDO tank	2x120-KL	*	*

Note: * Scenarios Considered

7.2.3.5.3 Methodology

A perusal of storages indicates that major material storage is either flammable liquids or gases under pressure. Fires could occur due to presence of ignition source at or near the source of leak or could occur due to flashback upon ignition of the traveling vapor cloud. Tank fires may be occurring due to the following:

- Ignition if rim seal leak leading to rim seal fire and escalating to full-fledged tank fire. Lighting is a major source of ignition of tank fires; and

- Overflow from tank leading to spillage, vapour cloud formation and its subsequent ignition, which flashes back to the tank leading to tank fire. The chance of overflow should be less unless operator has grossly erred in receiving HSD into the same tank. Spillage due to overflow may result in a dyke fire if ignition occurs after sufficiently long period.

For the present study, the scenarios under consideration assume that the peak level of radiation intensity will not occur suddenly. Based on the past experience, it is found that 20-30 minutes time will be required before a tank fire grows to full size. For radiation calculations, pool fire has been considered. From the above considerations, the criteria of 4.5 kW/m^2 have been selected to judge acceptability of the scenarios. The assumptions for calculations are:

- It is not continuous exposure;
- It is assumed that No fire detection and mitigation measures are initiated;
- There is not enough time available for warning the public and initiating emergency action;
- Secondary fire at public road and building is not likely to happen;
- The effect of smoke on reduction of source radiation intensity has not been considered; therefore hazard distances calculated tend to be conservative; and
- Shielding effect of intervening trees or other structures has not been considered. No lethality is expected from this level of intensity although burn injury takes place depending on time of exposure.

Based on the above assumptions each storage facility has been assessed with respect to Pool fires and BLEVE-fireball. The following assumptions are made for evaluating the risk on the storage facilities and personnel due to the failure scenarios.

- **Bulk Storage of Flammable Liquids**

For all bulk storage of LSHS/HFO and HSD, it is assumed that the complete liquid leaks due to tank failure or rupture and develops into a pool and gets ignited. In the second scenario it is assumed that the dense vapours from these storages are released due to failure or increase in internal pressure of storage tanks or operator negligence and the vapour cloud meets an ignition source and develops into a fireball.

For all the above storage liquids, hazard distances have been arrived due formation of Pool fire and formation of fireball. For MCA analysis full tank storage capacity has been considered for all the materials.

7.2.3.5.4 Properties of Fuels Considered For Modeling Scenarios

The chemical data for various fuels used for modeling is tabulated in **Table-7.10** and is compiled from various literatures.

TABLE-7.10
PROPERTIES OF FUELS CONSIDERED FOR MODELING

Sr. No.	Fuel	Molecular Weight kg/kg.mol	Boiling Point °F	Density Kg/m^3
1	LSHS/HFO	135	216	980
2	HSD	114.24	360	860
3	LPG	44.1	18.0	-
4	LDO	114.24	400	840

7.2.3.6Model Computations

Results and Discussion - Pool Fire

The results of MCA analysis are tabulated indicating the distances for various damages identified by the damage criteria, as explained earlier. Calculations are done for radiation intensities levels of 37.5, 25, 12.5, 4.5 and 1.6 kW/m^2, which are presented in **Table-7.11** for different scenarios. The distances computed for various scenarios are given in meters and are from the center of the pool fire.

TABLE-7.11
OCCURRENCE OF VARIOUS RADIATION INTENSITIES- POOL FIRE

Radiation and Effect	Radiation Intensities (kW/m^2)/Distances (m)					
	37.5	**25.0**	**19.0**	**12.5**	**4.5**	**1.6**
Failure of one LSHS/HFO tank (250-KL)	22.5	28.2	33.2	41.8	74.4	133.6
Failure of two LSHS/HFO tanks (500-KL)	30.3	39.4	45.2	56.8	102.3	181.4
Failure of three LSHS/HFO tanks (750-KL)	45.4	57.8	67.4	84.9	152.4	275.4
Failure of one HSD tank (50-KL)	10.2	13.7	15.9	20.3	36.5	66.5
Failure of three HSD tanks (130-KL)	13.2	16.5	19.8	24.7	43.1	82.4
Failure of one LDO tank of 132 KL	4.6	5.9	7.3	8.7	15.5	28.1
Failure of two LDO tanks of 264 KL each	6.4	8.5	10.8	11.8	20.9	36.2

- ***Pool Fire Due to Failure of LSHS/HFO Storage tank (250-KL)***

The maximum quantity of storage of LSHS/HFO will be 250-KL. The most credible failure is the rupture of the largest pipe connecting the storage tank. As the worst case, it is assumed that the entire contents leak out into the dyke forming a pool, which may catch fire on finding a source of ignition.

A perusal of the results clearly indicates that 37.5 kW/m^2 (100% lethality) occurs within the radius of the pool which is computed at 22.5-m in case of LSHS/HFO tank on pool fire. This vulnerable zone will damage fuel storage all equipment falling within the pool radius.

The threshold limit for 50% and 1% lethality is 25.0 and 19.0 kW/m^2. From the results, it can be concluded that the vulnerable zone in which the thermal fluxes above the threshold limit for 50% and 1% lethality is restricted to 28.2-m and 41.8-m.

Similarly, the threshold limit for first degree burns is 4.5 kW/m^2, this vulnerable zone in which the thermal fluxes above the threshold limit for first degree is restricted to 74.4-m in case of LSHS/HFO tank on pool fire.

- ***Pool Fire Due to Failure of LSHS/HFO Storage tanks (750-KL)***

The maximum quantity of storage of LSHS/HFO will be 750-KL(3 tanks of 250 KL capacity). The most credible failure is the rupture of largest pipe connecting both storage tanks. As the worst case, it is assumed that the entire contents leak out into the dyke forming a pool, which may catch fire on finding a source of ignition. **(Figure-7.1)**

A perusal of the results clearly indicates that 37.5 kW/m^2 (100% lethality) occurs within the radius of the pool which is computed at 45.4-m in case of LSHS/HFO tank on pool fire. This vulnerable zone will damage fuel storage all equipment falling within the pool radius.

The threshold limit for 50% and 1% lethality is 25.0 and 19.0 kW/m^2. From the results, it can be concluded that the vulnerable zone in which the thermal fluxes above the threshold limit for 50% and 1% lethality is restricted to 57.8-m and 67.4-m.

Similarly, the threshold limit for first degree burns is 4.5 kW/m^2, this vulnerable zone in which the thermal fluxes above the threshold limit for first degree is restricted to 152.4-m in case of LSHS/HFO tank on pool fire.

- ***Pool Fire Due to Failure of HSD Storage tanks (130-KL)***

The maximum quantity of storage of HSD will be 130-KL (2x50KL & 2x15kl). The most credible failure is the rupture of the largest pipe connecting the storage tank. As the worst case, it is assumed that the entire contents leak out into the dyke forming a pool, which may catch fire on finding a source of ignition. **(Figure-7.2)**

A perusal of the results clearly indicates that 37.5 kW/m^2 (100% lethality) occurs within the radius of the pool which is computed at 13.2 m in case of HSD tank on pool fire. This vulnerable zone will damage fuel storage all equipment falling within the pool radius.

The threshold limit for 50% and 1% lethality is 25.0 and 19.0 kW/m^2. From the results, it can be concluded that the vulnerable zone in which the thermal fluxes above the threshold limit for 50% and 1% lethality is restricted to 16.5-m and 19.8-m.

Similarly, the threshold limit for first degree burns is 4.5 kW/m^2, this vulnerable zone in which the thermal fluxes above the threshold limit for first degree is restricted to 43.1-m in case of HSD oil tank on pool fire.

7.2.3.7.1 Results and Discussion: BLEVE-Fireball

The results of MCA analysis for BLEVE-Fireball are tabulated indicating the distances for various damages identified by the damage criteria. Calculations are done for radiation intensities levels of 37.5, 25, 19, 12.5, 4.5 and 1.6 kW/m^2, which are presented in **Table-7.12** for different scenarios. The distances computed for various scenarios are given in meters and are from the center of the fireball. This type of release will be un-confined fire or explosion.

TABLE-7.12
OCCURRENCE OF VARIOUS RADIATION INTENSITIES- FIREBALL

Radiation and Effects Fuels	Capacity	Radiation Intensities (kW/m^2)/Distances (m)					
		37.5	**25.0**	**19.0**	**12.5**	**4.5**	**1.6**
Failure of one LSHS/HFO tank (250-KL)	250-KL	48.8	53.2	88.5	106.8	191.3	309.8
Failure of two LSHS/HFO tanks (500-KL)	500-KL	66.9	73.7	121.1	152.9	254.7	421.8
Failure of three LSHS/HFO tanks (750-KL)	750-KL	99.9	109.8	175.7	221.5	375.9	631.7
Failure of one HSD tank (50-KL)	50-KL	24.3	28.2	35.6	39.8	60.7	116.9
Failure of three HSD tanks (130-KL)	130-KL	33.1	37.5	49.7	55.4	88.1	152.2
Failure of LPG bullets	10-MT	10.1	13.2	14.8	18.3	21.5	35.5
Failure of LPG bullets	2X10-MT	12.4	18.5	25.4	32.8	46.5	53.8

- **Fireball Due to LSHS/HFO storage (250-KL)**

A perusal of the results clearly indicates that 37.5 kW/m^2 (100% lethality) and 25.0 kW/m^2 (50% lethality) occurs upto the distance of 48.8 and 53.2-m in case of fireball.
The radiation intensity of 12.5 kW/m^2 (1% lethality) occurs at 106.8-m in case of LSHS/HFO storage on fire. Similarly, the threshold limit for first degree burns is 4.5 kW/m^2, this vulnerable zone occurs at 191.3-m in case of LSHS/HFO tank BLEVE from the center of the fireball.

- **Fireball Due to LSHS/HFO storage (750-KL)**

A perusal of the results clearly indicates that 37.5 kW/m^2 (100% lethality) and 25.0 kW/m^2 (50% lethality) occurs upto the distance of 99.9 and 109.8-m in case of fireball.

The radiation intensity of 12.5 kW/m^2 (1% lethality) occurs at 221.5-m in case of LSHS/HFO storage on fire. Similarly, the threshold limit for first degree burns is 4.5 kW/m^2, this vulnerable zone occurs at 375.9-m in case of LSHS/HFO tank BLEEVE from the center of the fireball.

- **Fireball Due to HSD storage (130-KL)**

A perusal of the results clearly indicates that 37.5 kW/m^2 (100% lethality) and 25.0 kW/m^2 (50% lethality) occurs upto the distance of 33.1 and 37.5-m in case of fireball.

The radiation intensity of 12.5 kW/m^2 (1% lethality) occurs at 55.4-m in case of HSD storage on fire. Similarly, the threshold limit for first degree burns is 4.5 kW/m^2, this vulnerable zone occurs at 88.1-m in case of HSD tank BLEEVE from the center of the fireball.

- **Fireball Due to LPG Bullet storage (2x10MT)**

A perusal of the results clearly indicates that 37.5 kW/m^2 (100% lethality) and 25.0 kW/m^2 (50% lethality) occurs upto the distance of 12.4 and 18.5-m in case of LPG bullet fireball.

The radiation intensity of 12.5 kW/m^2 (1% lethality) occurs at 32.8-m in case of LPG bullet storage on fire. Similarly, the threshold limit for first degree burns is 4.5 kW/m^2, and this vulnerable zone occurs at 46.5-m in case of LPG bullet BLEEVE from the center of the fireball. The people are likely to be affected with first-degree burns, which fall in this zone.

7.2.3.6.3 Effect of Thermal Radiation on Population

A perusal of the damage effect on equipment and people due to thermal radiation intensity clearly indicates that 1.6 kW/m^2 represents the safe radiation intensity for human population even for long exposures. Hence, pool fire and fireball modeling has been done for all the scenarios and the distance for 1.6 kW/m^2 has been computed. The results of safe distance for pool fire and fireball are presented in **Table-7.13.**

All the radiation zones fall within the plant boundary. The Fireball results for the LSHS/HFO storage, the safe intensity of 1.6 kw/m2 spreads upto 421.8-m from the center of the storage tank. The safe distance of all the failures fall within the plant boundary and thus the failures of the fuel storages will not affect the surrounding population.

TABLE-7.13
OCCURRENCE OF SAFE RADIATION INTENSITY

Sr. No.	Fuel/Chemical	Total Quantity	Pool fire	BLEVE- Fire Ball
			1.6 kW/m^2 Radiation intensity distances (m)	
1	Failure of one LSHS/HFO tank (250-KL)	250-KL	133.6	309.8
2	Failure of two LSHS/HFO tanks (500-KL)	500-KL	181.4	421.8
3	Failure of three LSHS/HFO tanks (750-KL)	750-KL	275.4	631.7
4	Failure of one HSD tank (50-KL)	50-KL	66.5	116.9
5	Failure of three HSD tanks (130-KL)	130-KL	82.4	152.2
6	Failure of LPG bullets	10-MT	-	35.5
7	Failure of LPG bullets	2X10-MT	-	53.8

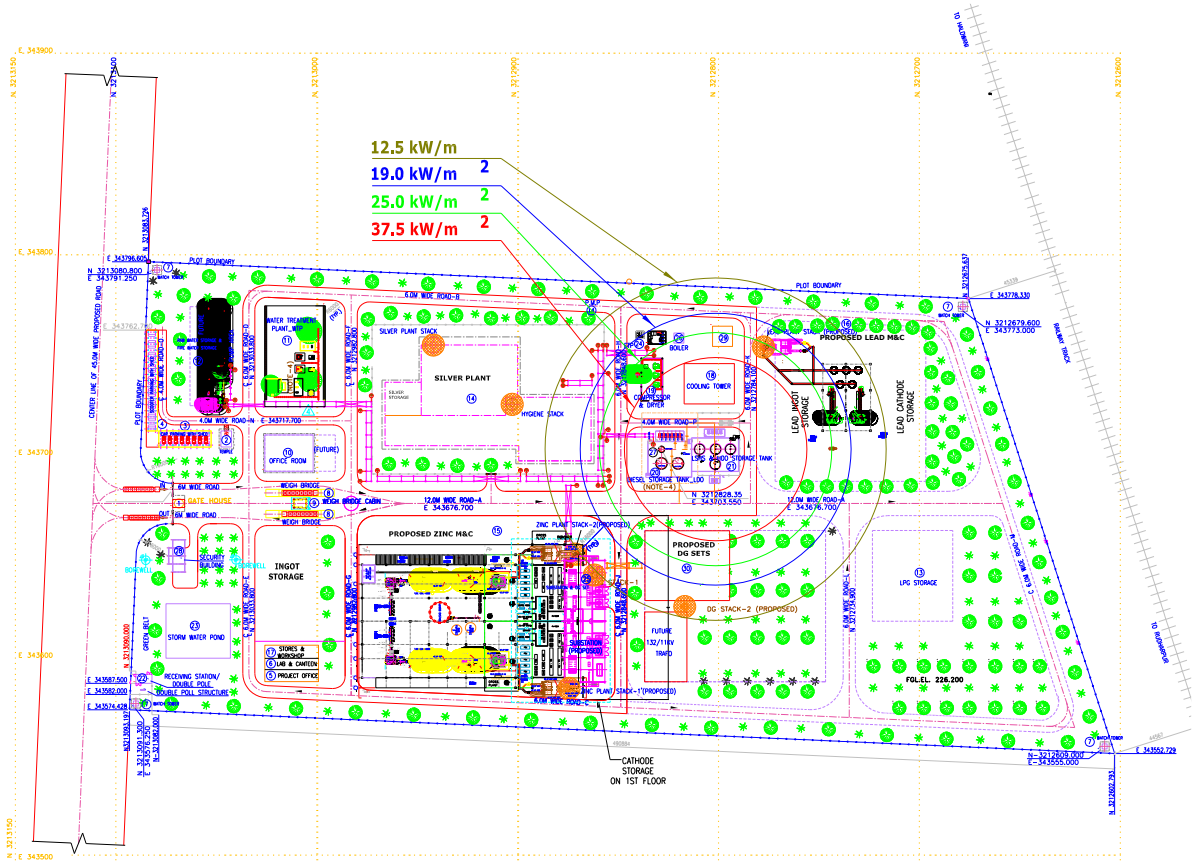


FIGURE-7.1
POOL FIRE: 750-KL LSHS/HFO

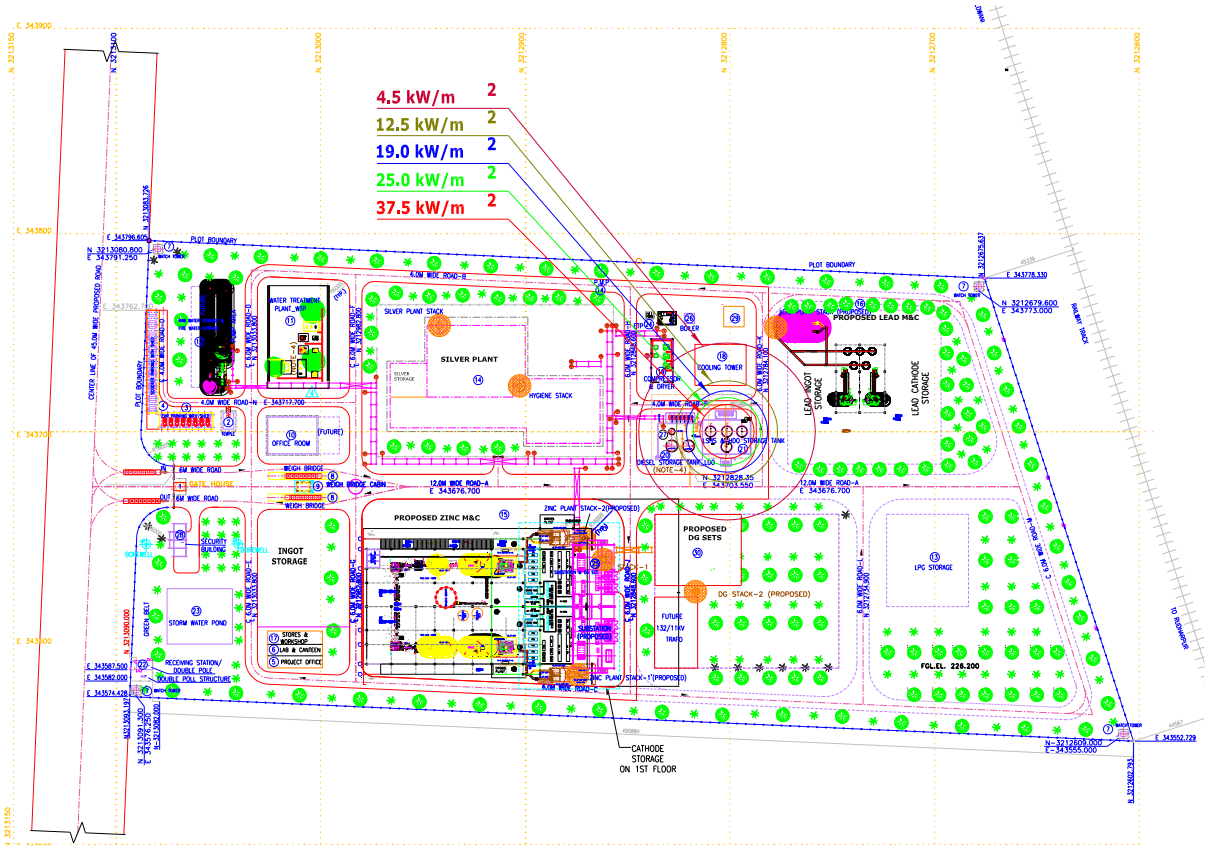


FIGURE-7.2
POOL FIRE: 130-KL HSD

7.2.6.6.4Cascade/Domino Potential of the Radiation

Many past accidents, like the famous LPG accident at Mexico (1984) and West Germany have resulted in a cascade of events. The single catastrophic events can therefore greatly multiply disaster potential if proper protection is not given to installations/units occupying adjacent sites. These secondary or tertiary events, often called ***Cascade or Domino effects***, include Pool fires, BLEVES, explosions and toxic gas releases.

In order to evaluate the overall risk due to consequences of various MCA scenarios, damage potential must be analyzed at both the levels, i.e. accident at equipment level and accident at plant level. Consequence analysis of an accident at equipment level would mean evaluation of harmful impacts due to identified MCA scenarios for equipment, i.e. LSHS/HFO or HSD or LPG tank.

For site level consequence analysis all the units are clubbed together, as due to domino or secondary effects there are substantial chances of propagation of fire or explosion in near by equipment, covering the whole plant.

Radiation Intensity (kW/m^2)	Observed Effect
37.5	Sufficient to cause damage to process equipment
25	Minimum energy required to ignite wood at indefinitely long exposures without a flame
12.5	Minimum energy required for piloted ignition of wood, melting of plastic tubing etc.

Engulfment of storage area with fires and explosions resulting in cascade events is examined as possible scenarios. Thermal radiation from the Fireball of LSHS/HFO, HSD and LPG tanks has been examined as possible fire initiators. The following criteria are internationally accepted for identifying the secondary and subsequent impacts.

Based on the above, for Cascade/Domino effect calculations, a radiation of 37.5 kw/m^2 is considered as the threshold value for identifying the secondary effects. The 100% lethality distances resulting from failure, due to fireball, of LSHS/HFO tank, HSD tank and LPG tanks are 99.9-m, 33.1-m and 12.4-m respectively. The overlapping of 37.5 kw/m^2 contours of various fuel storage tanks lead to the possibility of domino effect. However, in this case the contours of 37.5 kw/m^2 of the fuel storage tanks do not overlap with each other. Hence, there is no possibility of Domino effect.

In case of poolfire, the contours of 1.6 kw/m^2 radiation of all the fuel storage tanks do not overlap with each other and there is no possibility of Domino effect.

7.3 Disaster Management Plan

7.3.1 Disasters

A disaster is a catastrophic situation in which suddenly, people are plunged into helplessness and suffering and, as a result, need protection, clothing, shelter, medical and social care and other necessities of life.

Disasters can be divided into two main groups. In the first, the disasters are resulting from natural phenomena like earthquakes, volcanic eruptions, storm surges, cyclones, tropical storms, floods, avalanches, landslides, and forest fires. The second group includes disastrous events occasioned by man, or by man's impact upon the environment.

There can be no set criteria for assessing the gravity of a disaster in the abstract since this depends to a large extent on the physical, economic and social environment in which it occurs. What would be considered a major disaster in a developing country, ill equipped to cope with the problems involved, may not mean more than a temporary emergency elsewhere. However, all disasters bring in their wake similar consequences that call for immediate action, whether at the local, national or international level, for the rescue and relief of the victims. This includes the search for the dead and injured, medical and social care, removal of the debris, the provision of temporary shelter for the homeless food, clothing and medical supplies, and the rapid re-establishment of essential services.

A situation is potentially a "Disaster", if it entails any one or more of the following:

a) Risk of loss of human lives-10 or more in one single situation.
b) Loss of property as a consequence of the incident is over 1 million and or bears a potential to above.
c) A situation which goes beyond the control of the available resource of the mine.
d) Whose long-term severity could cause loss of life, production and property.

Causes which may lead to a disaster/accident in or about the mine are as under:

1. Fire in

a) Oil storage tank.
b) Conveyors or other rubber items.
c) Electrical substation or panels.
d) Wooden or other combustible materials.

2. Sudden in rush of water and slurry.
3. Collapse of major structure
4. Short-circuiting in electric installations and equipments.
5. Equipment failure
6. Other unforeseen causes.

7.3.2 Objectives of Disaster Management Plan (DMP)

The Disaster Management Plan is aimed to ensure safety of life, protection of environment, protection of installation, restoration of production and salvage operations in this same order of priorities. For effective implementation of the Disaster Management Plan, it should be widely circulated and personnel training through rehearsals/drills.

The Disaster Management Plan shall reflect the probable consequential severaties of the undesired event due to deteriorating conditions or through 'Knock on' effects. Further the management shall be able to demonstrate that their assessment of the consequences uses good supporting evidence and is based on currently available and reliable information, incident data from internal and external sources and if necessary the reports of outside agencies.

To tackle the consequences of a major emergency inside the factory or immediate vicinity of the factory, a Disaster Management Plan has to be formulated and this planned emergency document is called "Disaster Management Plan".

The objective of the Industrial Disaster Management Plan is to make use of the combined resources of the plant and the outside services to achieve the following:

1. Minimize damage to property and the environment;
2. Initially contain and ultimately bring the incident under control;
3. Identify any dead;
4. Provide for the needs of relatives;
5. Provide authoritative information to the news media;
6. Secure the safe rehabilitation of affected area; and
7. Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the Emergency.
8. Effect the rescue and medical treatment of causalities;
9. Safeguard other people;

In effect, it is to optimize operational efficiency to rescue , rehabilitation and render medical help and to restore normalcy.

7.4 Emergencies

7.4.1 General, Industrial, Emergencies

The emergencies that could be envisaged in the plant and tank farm are as follows:

1. A situation of fire at the tank farm of all storages;
2. Slow isolated fires;
3. Fast spreading fires;
4. Structural failures;
5. Contamination of food /water; and
6. Sabotage/Social disorder.

7.4.2 Specific Emergencies Anticipated

- **Fire and Explosion**

Fire consequences can be disastrous, since they involve huge quantities of fuel either stored or in dynamic inventory in pipe lines or in nearby areas. Toxic releases can affect persons working around. Estimation can be made by using various pool fire, tank fire consequence calculations. During the study of Risk Assessment, the nature of damages is worked out and probability of occurrence of such hazards is

also drawn up. Therefore, the risk assessment report is to be essentially studied in conjunction with disaster management plan.

7.5 Emergency Organization

As highlighted in the Disaster management plan of HZL, the PSP has already setup an Emergency Organization. As per the General Organization chart, Unit Head (Plant) is designated as the Site Controller. The Senior Managers are designated as Incident Controller. All the Incident Controllers would be reporting to the Site Controller.

All the Department Heads, Fire & Security Officer, Communication Officer and Personal manager are reporting to the Incident Controller. This team is responsible for controlling the incidence with the personnel under their control. Shift In charge is the reporting officer, who would bring the incidence to the notice of the Incidence Controller and Site Controller. The team co-ordinates during eventualities and responsible for fire fighting, rescue, rehabilitation, transport and provide essential and support services. For this purposes, Security In charge, HR Department, Essential services personnel are engaged. All these personnel are designated as Key personnel.

In each shift, electrical supervisor, electrical fitters, pump house in charge and other maintenance staff are drafted for emergency operations. In the event of power or communication system failure, some of staff members in the office/plant offices are drafted and their services would be utilized as messengers for quick passing of communications.

7.5.1 Emergency Communication

Whoever notices an emergency situation such as fire, growth of fire, leakage etc. informs his immediate superior and Emergency Control Center. The person on duty in the Emergency Control Center, will appraise the Site Controller. Site Controller verifies the situation from the Incident Controller of that area or the Shift In charge and takes a decision about an impending on Site Emergency. This would be communicated to all the Incident Controllers, Emergency Coordinators. Simultaneously, the emergency warning system would be activated on the instructions of the Site Controller.

7.6 Emergency Responsibilities

The responsibilities of the key personnel are appended below:

7.6.1 Site Controller

On receiving information about emergency he would rush to Emergency Control Center (ECC) and takes charge of ECC and the situation and:

- Assesses the magnitude of the situation on the advice of incident Controller and decides;
- Whether the affected area needs to be evacuated;

- Whether personnel who are at assembly points need to be evacuated;
- Declares Emergency and orders for operation of emergency siren;
- Organizes announcement by public address system about location of emergency;
- Assesses which areas are likely to be affected, or need to be evacuated or are to be alerted;
- Maintains a continuous review of possible development and assesses the situation in consultation with Incident Controller and other Key Personnel as to whether shutting down the plant or any section of the plant required and if evacuation of persons is required;
- Directs personnel for Rescue, rehabilitation, transport, fire brigade, medical and other designated mutual support systems locally available, for meeting emergencies;
- Controls evacuation of affected areas, if the situation is likely to go out of control or effects are likely to go beyond the premises of the factory, informs to District Emergency Authority, Police, Hospital and seeks their intervention and help;
- Informs Inspector of Factories, Deputy Chief Inspector of Factories, RSPCB and other statutory authorities;
- Gives a public statement if necessary;
- Keeps record of chronological events and prepares an investigation report and preserves evidence; and
- On completion of On Site Emergency and restoration of normalcy, declares all clear and orders for all clear warning.

7.6.2 Incident Controller

- Assembles the incident control team;
- Directs operations within the affected areas with the priorities for safety to personnel, minimize damage to the plant, property and environment and minimize the loss of materials;
- Directs the shutting down and evacuation of plant and areas likely to be adversely affected by the emergency;
- Ensures that all key personnel help is sought;
- Provides advice and information to the Fire and Security Officer and the Local Fire Services as and when they arrive;
- Ensures that all non-essential workers/staff of the affected areas evacuated to the appropriate assembly points, and the areas are searched for causalities;
- Has regard to the need for preservation of evidence so as to facilitate any inquiry into the causes and circumstances, which caused or escalated the emergency;

- Co-ordinates with emergency services at the site;
- Provides tools and safety equipments to the team members;
- Keeps in touch with the team and advise them regarding the method of control to be used; and
- Keeps the Site Controller of Emergency informed of the progress being made.

7.6.3 Emergency Coordinator - Rescue, Fire Fighting

- On knowing about emergency, rushes to ECC;
- Helps the incident Controller in containment of the emergency;
- Ensure fire pumps in operating conditions and instructs pump house operator to ready for any emergency with standby arrangement;
- Guides the fire fighting crew i.e. firemen, trained plant personnel and security staff;
- Organizes shifting the fire fighting facilities to the emergency site, if required;
- Takes guidance of the Incident Controller for firefighting as well as assesses the requirements of outside help;
- Arranges to control the traffic at the gate and the incident area;
- Directs the security staff to the incident site to take part in the emergency operations under his guidance and supervision;
- Evacuates the people in the plant or in the nearby areas as advised by Site Controller;
- Searches for casualties and arranges proper aid for them;
- Assembles search and evacuation team;
- Arranges for safety equipments for the members of this team;
- Decides which paths the evacuated workers shall follow; and
- Maintains law and order in the area, and if necessary seeks the help of police.

7.6.4 Emergency Coordinator-Medical, Mutual Aid, Rehabilitation, Transport and Communication

In the event of failure of electric supply and thereby internal telephone, sets up communication point and establishes contact with the ECC.

- Organizes medical treatment to the injured and if necessary will shift the injured to nearby hospitals
- Mobilizes extra medical help from outside, if necessary
- Keeps a list of qualified first aiders of the factory and seek their assistance
- Maintains first aid and medical emergency requirements
- Makes sure that all safety equipments are made available to the emergency team
- Assists Site Controller with necessary data and to coordinate the emergency activities
- Assists Site Controller in updating emergency plan, organizing mock drills verification of inventory of emergency facilities and furnishing report to the Site Controller
- Maintains liaison with Civil Administration
- Ensure availability of canteen facilities and maintenance of rehabilitation center
- He will be in liaison with Site Controller/Incident Controller
- Ensure transportation facility

- Ensures availability of necessary cash for rescue/rehabilitation and emergency expenditure
- Controls rehabilitation of affected areas on discontinuation of emergency and
- Makes available diesel/petrol for transport vehicles engaged in emergency operation.

7.6.5 Emergency Coordinator - Essential Services

- He would assist Site Controller and Incident Controller
- Maintains essential services like Diesel Generator, Water, Fire Water, Compressed Air/Instrument Air, power supply for lighting
- He would plan alternate facilities in the event of power failure, to maintain essential services such as lighting, refrigeration plant etc
- He would organize separate electrical connections for all utilities and emergency services so that in the event of emergency or fires, essential services and utilities are not affected
- Gives necessary instructions regarding emergency electrical supply, isolation of certain sections etc. to shift in-charge and electricians and
- Ensures availability of adequate quantities of protective equipment and other emergency materials, spares etc.

➢ **Security In-charge**

The chief of security agency is commanding officer of the security staff. On the instruction of Manager (P&A) the commanding officer shall arrange to record the entry of outside personnel at the main gate to avoid and hindrance during the course of rescue recovery operations. The Chief of Security shall keep close liaison within local police and district authorities too.

a) Control the vehicular/personnel traffic in and around the mine
b) Help local police in controlling the area of the mine, if necessary
c) Assist in Transporting injured persons
d) The security personnel on duty shall ensure that all roads at the scene of fire/emergencies are kept clear from obstruction. Persons arriving by motor transport at the scene of fire/emergency are not permitted to park their vehicles within 100 meters of fire, near fire hydrants, at road junctions and access roads. The ignition key should be left in the vehicles.
e) Assist local police in patrolling in township and work out adequatearrangements for protection of property.
f) Ensure separate entries of different materials received from external agencies for coping up emergency operations.

7.6.6 General Responsibilities of Employees during an Emergency

During an emergency, it becomes more enhanced and pronounced when an emergency warning is raised, the workers if they are in-charge of process equipment shall adopt safe and emergency shut down and attend any prescribed duty as essential employee. If no such responsibility is assigned, he shall adopt a safe course to assembly point and await instructions. He shall not resort to spread

panic. On the other hand, he must assist emergency personnel towards objectives of DMP.

7.7 Emergency Facilities

7.7.1 Emergency Control Center (ECC)

For the time being Office Block is identified as Emergency Control Center. It would have external Telephone, Fax, internet facility. All the Site Controller/Incident Controller Officers, Senior Personnel would be located here. Also, it would be an appropriate place. Various other materials that are to be maintained in the ECC are:

The following information and equipment are to be provided at the ECC:

- Intercom telephone;
- P & T telephone;
- Safe contained breathing apparatus;
- Fire suit/gas tight goggles/gloves/helmets;
- Hand tools, wind direction/velocities indications;
- Public address megaphone, hand bell, telephone directories (internal, P&T);
- Factory layout, site plan;
- Emergency lamp/torch light/batteries;
- Plan indicating locations of hazard inventories, plant control room, sources of safety equipment, work road plan, assembly points, rescue location vulnerable zones, escape routes;
- Hazard chart;
- Emergency shut-down procedures;
- Nominal roll of employees;
- List of key personnel, list of essential employees, list of Emergency Co-ordinators;
- Duties of key personnel;
- Address with telephone numbers and key personnel, emergency coordinator, essential employees; and
- Important address and telephone numbers including Government agencies, neighboring industries and sources of help, out side experts, chemical fact sheets population details around the factory.

7.7.2 Assembly Point

Number of assembly points depending upon the plant location would be identified wherein employees who are not directly connected with the disaster management would be assembled for safety and rescue. Emergency breathing apparatus, minimum facilities like water etc. would be organized.

In view of the size of plant, different locations are ear marked as assembly points. Depending upon the location of hazard, the assembly points are to be used. In the existing plant following points are earmarked for assembly points;

1. Area near Main Gate
2. Area near Gate No.2

3. Area near Admin Block
4. Near Canteen

The same assembling points can be considered during emergencies in future. The tankers and trucks will be moved out through gate no. 2 during emergency. Two assembly points are to be declared according to wind direction in case of emergency/Disaster.

Designated persons would take charge of these assembly points and mark presence of the people assembling at the point. Department & shift wise, list of employees, are available at these points and roll call would be taken by the designated person.

7.7.3 Emergency Power Supply

Plant facilities would be connected to Diesel Generator and would be placed in auto mode. Thus water pumps, plants lighting and emergency control center. Administrative building and other auxiliary services are connected to emergency power supply. In all the blocks flame proof type emergency lamps would be provided.

7.7.4 Fire Fighting Facilities

First Aid Fire Fighting equipment suitable for emergency are maintained in each section in the Complex. This is as per statutory requirements as well as per TAC Regulations. The fire hydrant line covering major areas are laid. The fire water system is available where water is allocated exclusively for fire fighting.

PSP has requisite fire crew under security. Trained fire fighting personnel are available at PSP. The Fire crew would report to Security officer. The details of fire fighting personnel are given in **Table-7.14**.

TABLE-7.14
FIRE FIGHTING PERSONNEL IN

Sr. No.	Particulars	Number
1	Fire Supervisior	1
2	Fireman	6

The Fire Tender would be requisitioned from nearby Town Municipal Corporation, Rudrapur, depending on the nature and size of Fire. The fire fighting facilities available at PSP are listed in **Table-7.15.**

TABLE-7.15
PROPOSED FIRE FIGHTING FACILITIES IN PSP

Sr. No.	Description	Location	Quantity	Capacity	Remark
1	Multi- purpose fire tender (water, foam, DCP etc)	Fire Station	Nil	-	Tie up would be there with municipal corporation for immediate availability
2	One Complete fire hydrant system with:- 1. Single way hydrant 63MM 2. fire hose pipe 15M 3. Short branch pipe 4. Hose box 5. Fire Brigade -4 way head	Plant area	 23 46 23 23 01	-	
3	Fire extinguishers:- 1.BC-CO2 type Fire Extinguisher 2. BC-DCP type Fire Extinguisher 3. BC-DCP type Fire Extinguisher 4. ABC type Fire Extinguisher 5. ABC type Fire Extinguisher 6. BC-DCP type Fire Extinguisher 7. BC-CO2 type Fire Extinguisher 8. BC-CO2 type Fire Extinguisher 9. AB-AFFF Mech Foam 10. AB-AFFF Mech Foam Supply from China (To be shifted from DLC): 1.MF/ABC4 2.MF/ABC2	Plant area and fire station	 4 4 2 8 8 15 2 6 3 4 36 10	 9 kg. 5 kg 10 kg 02 kg 5 kg 5 kg 4.5 ltr 09 ltr 09 ltr 50 ltr 4 Kg 2 Kg	
9	Sprinkler system	LPG	One Set		Water
11	Foam pouring system	LDO/LSHS/HFO storage	One System	1600 lit + 700 lit	Foam
12	Fire bucket	Plant area	20	09 ltr	
13	Fire water pump house (electric operated).	Fire pump house	01	137 m^3	For fire hydrants
15	Fire water pump house (diesel operated)	Fire pump house	01	137 m3	in case of electrical failure
16	Jockey Pump Set	Fire Pump House	01	10.8 M3	-
17	Sensor for LPG	LPG plant	One set		

7.7.5 Location of Wind Sock

On the top of the Main Gate, Zinc M & C section, Lead M& C section DG building and LPG/Propane Storage, wind socks shall be installed to indicate direction of wind for emergency escape.

7.7.6 Emergency Medical Facilities

Stretchers, gas masks and general first aid materials for dealing with chemical burns, fire burns etc. are maintained in the medical center as well as in the emergency control room. Private medical practitioners help would be sought. Government hospital would be approached for emergency help.

Apart from plant first aid facilities, external facilities would be augmented. Names of Medical Personnel, Medical facilities in the area would be prepared and updated. Necessary specific medicines for emergency treatment of Burns Patients and for those affected by toxicity would be maintained.

Breathing apparatus and other emergency medical equipment would be provided and maintained. The help of nearby industrial management's in this regard would taken on mutual support basis.

First aid center with trained First Aid Assistants will be made available round the clock. Besides this, Government Hospital Rudrapur (Nearby town) will also be consulted in case of emergency.

7.7.7 Ambulance

An ambulance with driver availability in all the shifts, emergency shift vehicle would be ensured and maintained to transport injured or affected persons. Number of persons would be trained in first aid so that, in every shift first aid personnel would be available.

7.8 Emergency Actions

7.8.1 Emergency Warning

Communication of emergency would be made familiar to the personnel inside the plant and people outside. An emergency warning system would be established.

7.8.2 Emergency Shutdown

There are number of facilities which can be provided to help deal with hazardous conditions, when a tank is in fire. The suggested arrangements are

1. Stop feed;
2. Dilute contents;
3. Remove heat;
4. Deluge with water; and
5. Transfer contents

Whether a given method is appropriate depends on the particular case. Cessation of agitation may be the best action in some instances but not in others. Stopping of the feed may require the provision of by pass arrangements.

Methods of removing additional heat include removal through the normal cooling arrangements or use of an emergency cooling system. Cooling facilities which use

vapourizing liquid may be particularly effective, since a large increase in vaporization can be obtained by dropping pressure.

7.8.3 Evacuation of Personnel

There could be more number of persons in the storage area and other areas in the vicinity. The area would have adequate number of exits, stair cases. In the event of an emergency, unconnected personnel have to escape to assembly point. Operators have to take emergency shutdown procedure and escape. Time Office maintains a copy of deployment of employees in each shift, at ECC. If necessary, persons can be evacuated by rescue teams.

7.8.4 All Clear Signal

Also, at the end of an emergency, after discussing with Incident Controllers and Emergency Co-ordinators, the Site Controller orders an all clear signal. When it becomes essential, the Site Controller communicates to the District Emergency Authority, Police, and Fire Service personnel regarding help required or development of the situation into an Off-Site Emergency.

7.9 General Information

7.9.1 Employee Information

During an emergency, employees would be warned by raising siren in specific pattern. The siren will sound continuously for 10 seconds for 5 times with 5 seconds interruption. The alarm code followed is as follows;

Sound	**Stop**	**Sound**	**Stop**	**Sound**	**Stop**	**Sound**	**Stop**	**Sound**	**Stop**
10	5	10	5	10	5	10	5	10	5

Employees would be given training of escape routes, taking shelter, protecting from toxic effects. Employees would be provided with information related to fire hazards, antidotes and first aid measures. Those who would designate as key personnel and essential employees shall be given training to emergency response.

7.9.2 Public Information and Warning

The industrial disaster effects related to this plant may mostly be confined to the plant area. The detailed risk analysis has indicated that the pool fire effects would not be felt outside. However, as an abundant precaution, the information related to chemicals in use would be furnished to District Emergency Authority for necessary dissemination to general public and for any use during an offsite emergency.

7.9.3 Co-ordination with Local Authorities

Keeping in view of the nature of emergency, two levels of coordination are proposed. In the case of an On Site Emergency, resources within the organization

would be mobilized and in the event extreme emergency local authorities help shall be sought.

In the event of an emergency developing into an off site emergency, local authority and District emergency Authority (normally the Collector) would be appraised and under his supervision, the Off Site Disaster Management Plan would be exercised. For this purpose, the facilities that are available locally, i.e. medical, transport, personnel, rescue accommodation, voluntary organizations etc. would be mustered. Necessary rehearsals and training in the form of mock drills shall be organized.

7.9.4 Mutual Aid

Mutual aid in the form of technical personnel, runners, helpers special protective equipment, transport vehicles, communication facility etc. shall be sought from the neighboring industrial management's.

7.9.5 Mock Drills

Emergency preparedness is an important on that of planning in Industrial Disaster Management. Personnel would be trained suitably and prepared mentally and physically in emergency response through carefully planned, simulated procedures. Similarly, the key personnel and essential personnel shall be trained in the operations. Announced and unannounced types of mock drills will be conducted for familiarization and to ensure the preparedness to meet the disaster.

7.9.6 Important Information

Once the Plant goes into stream, important information such as names and addresses of key personnel, essential employees, medical personnel out side the plant, transporter address, address of those connected with Off Site Emergency such as Police, Local Authorities, Fire Services, District Emergency Authority shall be prepared and maintained.

7.9.7 Key Personnel at Pantnagar Silver Plant

Team of key personnel on site emergency plan at project site is listed in **Table-7.16.** The existing team will be strengthened as per requirement under the proposed project. The on-site emergency organization chart for various emergencies is shown in **Figure-7.3.**

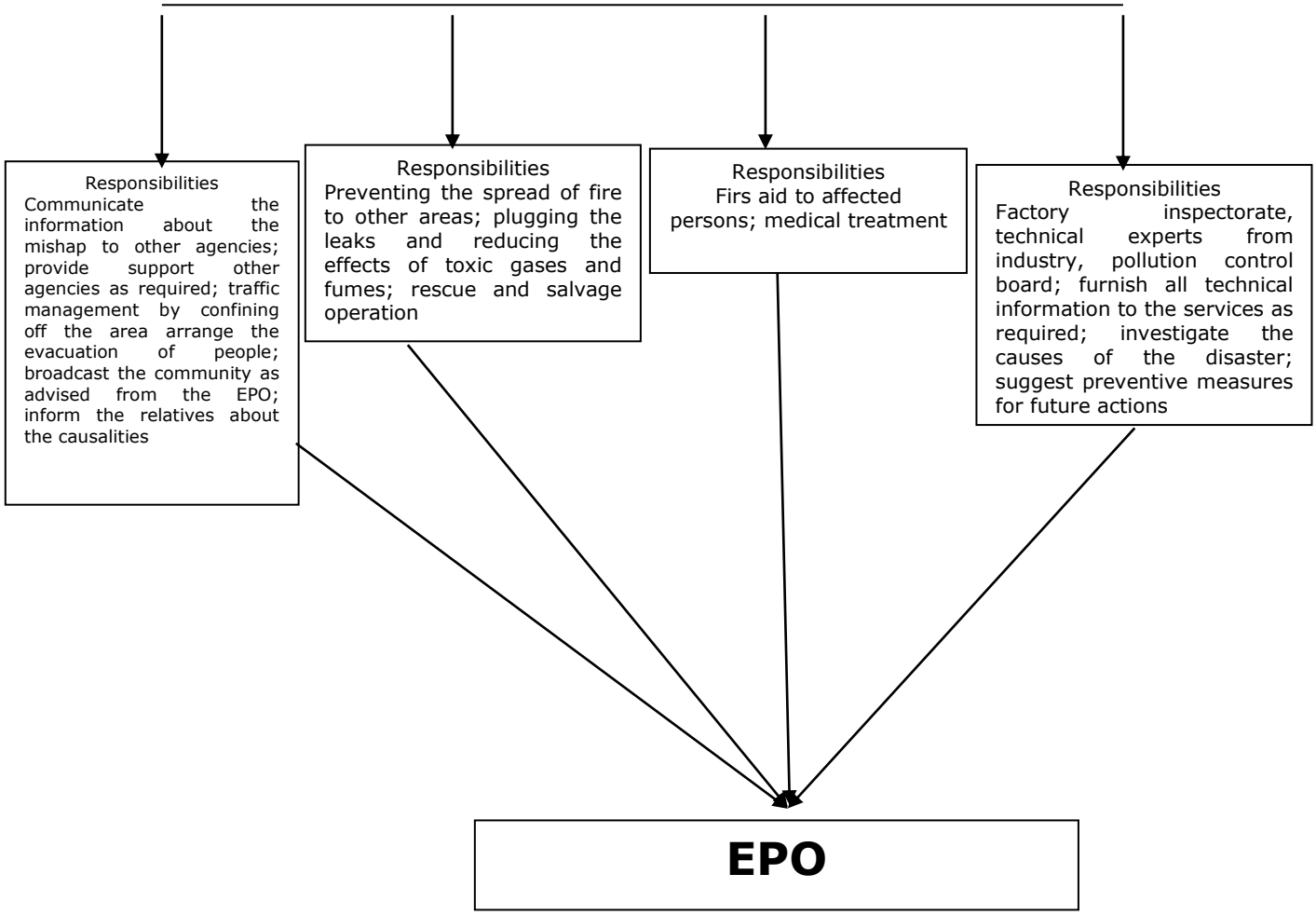


FIGURE-7.3
ONSITE EMERGENCY ORGANIZATION CHART

TABLE-7.16
KEY PERSONNEL

Category	Key Personnel	Alternate Key Personnel
Site Controller Mobile	Project Manager 09568001097	Unit Head 09568005519
Incident Controller Mobile	Head-Operations 09568005515	Head –SHEQ 09568001100
Communication Officer Mobile	Head -Security 09568005511	Head -SHEQ 09568001100
Safety and Fire Officers Mobile	Safety and Fire Officer HZL-09690013168.	Safety and Fire Officer 1.KLA-09690906760 2.E&C-08791425310
Personnel/Administrative Officer. Mobile	Head (HR) 09568001093	
Medical Officer Mobile	To be appointed on contract basis.	In-charge Dispensary
Security Officer Mobile	Head Security 09568005511	Security Supervisor 09219447230

7.9.8 Emergency Procedures adopted in handling of Hazardous Chemicals

PSP has standardized the emergency procedures for safe handling of hazardous chemicals and fuel.

7.9.8.1 Safe Handling of LPG

LPG is normally stored in tanks called bullets in liquid form. The main hazard associated with the storage and handling is of leakage of LPG from the storage tank, cylinder or pipeline, which can lead to fire and explosion. This can be very disastrous.

LPG is liquefied compressed colorless gas and is a mixture of propane, Butane and Propylene. Mercaptone is added for odour warning in case of leakage. The emergency procedures will be practiced at PSP in handling of LPG is discussed below;

1. In case of leakage, clear all the personnel except those involved in emergency operations, from the area affected.
2. The personnel should proceed up wind and at a right angle to wind direction.
3. Only specially trained and fully equipped personnel should be permitted in the area.
4. Shut off all the ignition sources in the area surrounding the leakage.
5. Isolate the leaking equipment of pipeline by shutting off the relevant valves.
6. If the leak is from small cylinder, shift the cylinder to an open, well- ventilated area taking all the precautions.
7. Shut off leak if possible without risk.
8. Start water sprinkler on the leaking as well as the adjoining tanks containers.
9. Keep the storage tanks cool by directing water by hose and nozzle from a long distance.

10. Try to stop leak, if it is not possible, transfer the material from the affected tank to a standby storage tank by controlled method.
11. In case fire breaks out, never go near the tank for fear of explosion. Keep the leaking and the adjacent tank cool by water spray.
12. Use dry chemical powder fire extinguisher for fighting fires.

It should be noted that utmost care is necessary during stoppage of leakage or transfer of material from the leaking container to a standby container to ensure that there is no ignition source in the surrounding area, which can cause fire. Once the fire is started, no emergency operations of stopping leakage or transfer of material could be carried out as the risk of explosion is very high.

7.9.8.2 Protective Equipments

Self contained breathing apparatus for high concentration of LPG. Rubber or PVC gloves and suit for hand and body protection from liquid contact.

7.9.8.3 First Aid

1. If inhales :

a) Remove from exposure area to fresh air immediately
b) Loosen the clothes and remove the shoes
c) If breathing has not stopped, place the patient on his back with head and back elevated and keep him warm and at rest.
d) If breathing has apparently ceased, give artificial respiration. Administer oxygen (by qualified personnel) if available.
e) Treat symptomatically and supportively.

2. In case the skin contact, remove contaminated clothing and shoes immediately. Wash affected area with large amounts of water for at least 15 minutes.
3. Incase of eye contact, wash eyes immediately with large amounts of water for at least 15 minutes.

7.9.8.4 Safe handling of Chlorine

Chlorine under ordinary conditions of temperature and pressure is a greenish yellow gas with a characteristic pungent and suffocating odor. Gaseous chlorine is approximately 2.5 times heavier than water. Chlorine is only slightly soluble in water.

Chlorine reacts readily with lime and caustic soda to form hydrochlorides. Hence lime and caustic soda solutions are generally used for handling chlorine leaks.

Chlorine gas is primarily a respiratory irritant. It is extremely irritating to the mucous membrane, the eyes and respiratory tract. The threshold limit value of chlorine is 1 ppm or 3 mg/m^3 of air. If the duration of exposure or the concentration of chlorine is excessive, it will cause restlessness, throat irritation, sneezing and copious salivation. In extreme cases, lung tissues may be attacked resulting in pulmonary edema.

a. Emergency Procedure

1. Evacuate the people from the affected area as quickly as possible.
2. People should move in the up wind direction or at right angle to the wind direction.
3. Don't panic, walk, don't run and keep a handkerchief on the mouth. Keep breathing as normal as possible.
4. Before going to attend the leakage, wear self-contained breathing apparatus or a canister gas mask, whichever is suitable.
5. At least two persons should go to attend leakage.
6. Identify the leak with the help of ammonia solution, if available,
7. If the leakage is from the profess system, stop the supply of chlorine to the process.
8. If the leakage is from the pipe line close the valves at both end of the leakage and the header valve.
9. Make an attempt to put suitable clamps etc.
10. If the leakage is from the tonner, bring the leaking point in the upper most position, so that the leakage is not in the liquid phase but in the gaseous phase.
11. Stop the leakage by using an emergency kit.
12. Utilize the remaining chlorine from the tonner in process.
13. If above is not possible, neutralize the chlorine in caustic soda, soda ash or hydrated lime solution ensuring that the unabsorbed chlorine gas is not coming out.
14. If the leakage develops during transportation, the vehicle should be properly removed to an isolated remote place.
15. The immediately contact the filler or the consignor as the case may be.

b. Neutralization Procedure

1. If all efforts to control the leak fails and the leakage continues, neutralize the chlorine by passing it into a solution of caustic soda, soda ash or hydrated lime through a suitable pipeline with a perforated distributor. Caustic Soda is recommended as it absorbs chlorine more readily.

2. Never emerge the leakage container in the tank containing alkaline solution or water.

c. Protective Equipment

1. Protection from chlorine gas must be provided first of all to the respiratory system, followed closely by protection for the eyes. A self-contained breathing apparatus or airline respiratory with full-face mask or canister gas mask should be used depending upon the concentration of chlorine in the atmosphere.

2. Protection for rest of the body (by wearing impervious clothing) becomes necessary if the chlorine gas concentration is high and the exposure poured is extended.

a. Emergency Equipments

1. Ammonia Torch
2. Chlorine emergency kit

b. Symptoms

c. Exposure to chlorine causes irritation to the mucous membrane of eyes, nose and throat and later on to the chest.
d. Cough develops, which may lead to vomiting.
e. If duration and concentration is high, it may cause restlessness, throat irritation, sneezing and copious salivation.
f. In extreme cases lung tissues may be attacked resulting in pulmonary edema, fall at blood pressure and cardiac arrest in a few minutes.

⇒ **First aid**

1. Remove victim to a well ventilated area.
2. Loosen the clothes and remove the shoes.
3. Keep him warm using blankets.
4. Place the patient on his back with the head and back elevated.
5. Rest is a must.
6. Cough syrup and common throat iozonges can be given for soothing the throat irritation.
7. Milk, buttermilk, lime juice, fresh water may be given.
8. If breathlessness persists administer medical oxygen under low pressure using a pulmotor or similar type of vital equipment.
9. Bronchi dilators can be given under medical advice.

7.10 Off-Site Emergency Preparedness Plan

The task of preparing the Off-Site Emergency Plan lies with the district collector. However, the off-site plan shall be prepared with the help of the local district authorities. The proposed plan shall be based on the following guidelines.

The off-site plan in detail will be based on those events, which are most likely to occur, but other less likely events, which have severe consequence, will also be considered. Incidents, which have very severe consequences yet have a small probability of occurrence, shall also be considered during the preparation of the plan. However, the key feature of a good off-site emergency plan is flexibility in its application to emergencies other than those specifically included in the formation of the plan.

The roles of the various parties who will be involved in the implementation of an off-site plan are described below. Depending on local arrangements, the responsibility for the off-site plan shall be either rest with the works management or, with the local authority. Either way, the plan shall identify an emergency coordinating officer, who would take the overall command of the off-site activities. As with the on-site plan, an emergency control center shall be setup within which the emergency coordinating officer can operate.

An early decision will be required in many cases on the advice to be given to people living "within range" of the accident - in particular whether they shall be evacuated or told to go indoors. In the latter case, the decision can regularly be reviewed in the event of an escalation of the incident. Consideration of evacuation may include the following factors:

a. In the case of a major fire but without explosion risk (e.g. LPG storage tank), only houses close to the fire are likely to need evacuation, although a severe smoke hazard may require this to be reviewed periodically;

b. If a fire is escalating and in turn threatening a store of hazardous material, it might be necessary to evacuate people nearby, but only if there is time; if insufficient time exists, people shall be advised to stay indoors and shield them from the fire. This latter case particularly applies if the installation at risk could produce a fireball with vary severe thermal radiation effects (e.g. LPG storage);

c. For release or potential release of toxic materials, limited evacuation may be appropriate downwind if there is time. The decision would depend partly on the type of housing "at risk". Conventional housing of solid construction with windows closed offers substantial protection from the effects of a toxic cloud, while shanty house, which can exist close to factories, offer little or no protection.

The major difference between releases of toxic and flammable materials is that toxic clouds are generally hazardous down to much lower concentrations and therefore hazardous over greater distances. Also, a toxic cloud drifting at, say 300 m per minute covers a large area of land very quickly. Any consideration of evacuation shall take this into account. Although the plan will have sufficient flexibility built in to cover the consequences of the range of accidents identified for the on-site plan, it will cover in some detail the handling of the emergency to a particular distance from each major hazard works.

7.10.1 Aspects Proposed to be Considered in the Off-Site Emergency Plan

The main aspects, which shall be included in the emergency plan are:

- **Organization**

Details of command structure, warning systems, implementation procedures, emergency control centers.

Names and appointments of incident controller, site main controller, their deputies and other key personnel.

- **Communications**

Identification of personnel involved, communication center, call signs, network, lists of telephone numbers.

- **Specialized knowledge**

Details of specialist bodies, firms and people upon whom it may be necessary to call e.g. those with specialized chemical knowledge, laboratories.

- **Voluntary Organizations**

Details of organizers, telephone numbers, resources etc.

- **Chemical Information**

Details of the hazardous substances stored or procedure on each site and a summary of the risk associated with them.

- **Meteorological Information**

Arrangements for obtaining details of weather conditions prevailing at the time and weather forecasts.

- **Humanitarian Arrangements**

Transport, evacuation centers, emergency feeding treatment of injured, first aid, ambulances, temporary mortuaries.

- **Public Information**

Arrangements for a] dealing with the media/ press office; b] informing relatives, etc.

- **Assessment**

Arrangements for: (a) collecting information on the causes of the emergency; (b) reviewing the efficiency and effectiveness of all aspects of the emergency plan.

7.10.2 Role of the Emergency Co-ordinating Officer

The various emergency services shall be co-ordinate by an emergency co-ordinating officer (ECO), who will be designated by the district collector. The ECO shall liaise closely with the site main controller. Again depending on local arrangements, for very severe incidents with major or prolonged off-site consequences, the external control shall be passed to a senior local authority administrator or even an administrator appointed by the central or state government.

7.10.3 Role of the Local Authority

The duty to prepare the off-site plan lies with the local authorities. The emergency-planning officer (EPO) appointed shall carry out his duty in preparing for a whole range of different emergencies within the local authority area. The EPO shall liaise with the works, to obtain the information to provide the basis for the plan. This liaison shall ensure that the plan is continually kept up to date.

It will be the responsibility of the EPO to ensure that all those organizations, which will be involved off site handling the emergency, know of their role and are able to accept it by having for example, sufficient staff and appropriate equipment to cover their particular responsibilities. Rehearsals for off-site plans shall be organized by the EPO.

7.10.4 Role of Police

Formal duties of the police during an emergency include protecting life and property and controlling traffic movements.

Their functions shall include controlling bystanders evacuating the public, identifying the dead and dealing with casualties, and informing relatives of death or injury.

7.10.5 Role of Fire Authorities

The control of a fire shall be normally the responsibility of the senior fire brigade officer who would take over the handling of the fire from the site incident controller on arrival at the site. The senior fire brigade officer shall also have a similar responsibility for other events, such as explosions and toxic release. Fire authorities in the region shall be apprised about the location of all stores of flammable materials, water and foam supply points and fire-fighting equipment. They shall be involved in on-site emergency rehearsals both as participants and, on occasion, as observers of exercises involving only site personnel.

7.10.6 Role of Health Authorities

Health authorities, including doctors, surgeons, hospitals, ambulances, and so on, shall have a vital part to play following a major accident, and they shall form an integral part of the emergency plan.

For major fires, injuries shall be the result of the effects of thermal radiation to a varying degree, and the knowledge and experience to handle this in all but extreme cases may be generally available in most hospitals. For major toxic releases, the effects vary according to the chemical in question, and the health authorities shall be apprised about the likely toxic releases from the plant which will unable then in dealing with the aftermath of a toxic release with treatment appropriate to such casualties.

Major off-site incidents are likely to require medical equipment and facilities additional to those available locally, and a medical "mutual aid " scheme shall exist to enable the assistance of neighboring authorities to be obtained in the event of an emergency.

7.10.7 Role of Government Safety Authority

This will be the factory inspectorate available in the region. Inspectors are likely to want to satisfy themselves that the organization responsible for producing the off-site plan has made adequate arrangements for handling emergencies of all types including major emergencies. They may wish to see well-documented procedures

and evidence of exercise undertaken to test the plan.

In the event of an accident, local arrangements regarding the role of the factory inspector will apply. These may vary from keeping a watching brief to a close involvement in advising on operations in case involvement in advising on operations. In cases where toxic gases may have been released, the factory inspectorate may be the only external agency with equipment and resources to carry out tests.

The action plan for handling of Off-site emergencies has been tentatively prepared by PSP. The same action plan will be finalized & implemented during emergency in future. The action plan is given in **Table-7.17.**

TABLE-7.17
OFF-SITE ACTION PLAN

Sr. No.	Action required to be taken to mitigate disaster by aid giving agency	Responsible agencies for taking action	Equipments/material facilities required at site to mitigate emergency
A1	Arrangements for evacuation/rescue of persons from zone of influence to predetermined camps	Police Department	Self Breathing apparatus with pare cylinder Chemical gas mask with spare canister Vehicle with PA system Transportation for evacuation of people
2	Caution to public by announcement		
3	Traffic and Mob control by cordoning of the area		
4	Law & order		
5	Request to railway authority for keeping Rudrapur railway gate open & to stop the up & down trains at the nearest railway station		
B1	Control of fire	District Fire Brigade	Self breathing apparatus with spare cylinders Foam/water fire tenders Gas mask with spare canisters Lime Neck to toe complete asbestos suit, PVC hand gloves, gumboots, safety goggles Mobile scrubbing system along with suction arrangement.
2	Containment of spilled chlorine and its neutralization		
3	Scrubbing of the flashed of gas cloud with water curtain		
4	To rescue trapped persons		
5	If fire is big due to LPG, keep surrounding area cool by spraying water		
6	Communication to UKEB to continue or cut off electric supply		
7	Communication to water supply department for supplying water		
C1	Medical facilities for affected parsons (first aid and treatment)	Hospital and public health	Ambulance with onboard resuscitation unit first aid, antidotes for toxicity, stretchers
D1	Identification of concentration of gas in zone of influence	Pollution control board	Gas detector
2	Communication to PHED for decontamination of affected water		
E1	Removal of debris and damaged	Municipal	Provide bulldozers

Sr. No.	Action required to be taken to mitigate disaster by aid giving agency	Responsible agencies for taking action	Equipments/material facilities required at site to mitigate emergency
	structures	corporation	Provide cranes
F1	Monitor the incoming and outgoing transports	Transport department	Provide traffic police at site Provide emergency shifting vehicles at site Provide stock of fuel for vehicles
02	Arrange emergency shifting of affected persons and non affected person to specified area		
03	Arrange diesel/petrol for needed vehicles		
G1	Give all information related to meteorological for safe handling of affected area for living beings	Meteorological Department	Provide wind direction and velocity instruments with temperature measure Mobile van for meteorological parameter measurements
02	Forecast if any important weather change		
H1	Representative of all department are in local crisis group therefore it is expected to render services available with them since it is a group of experts and authority, the mitigating measures can be implemented in speed up way. The representative from locals are also there so communication with local people is easy and fast		Must have all resources at hand, specially disaster management plan and is implementation method. All relevant information related to hazardous chemical industry are generally available with crisis group News paper editor is a part of the group so right and timely media released can be done
02	The district emergency or disaster control officer is the president and he is used to mock drill etc. so action can be taken in right direction in time		
I1	Collector is the President of District Crisis Group therefore all district infrastructure facilities are diverted to affected zone	District Crisis group	All necessary facilities available at district can be made available at affected zone Control of law and order situation
02	All other functions as mentioned in local crisis group		

7.11 Occupational Health (Impacts and Mitigation Measures)

Occupational health needs attention both during construction and erection and operation and maintenance phases. However, the occupational risks varies both in magnitude and variety.

7.11.1 Assessment of Risks

Risks has been assessed separately for construction and operation phase. Details are given below:

- **Construction**

The occupational health problems envisaged at this stage can mainly be due to noise during construction.

To overcome these hazards, in addition to arrangements to reduce it within TLV's, people protective equipments shall also be supplied to workers.

- **Operation**

Occupational risks assessed for operation phase are listed in **Table-7.18**.

TABLE-7.18
OCCUPATIONAL RISKS

Operation Area	Occupational Risks	Control Measures
Material handling	Dust	Suction hood shall be provided and connected to bag filters. This will ensure dust free work zone environment.
Zinc & Lead melting & casting section	Heat stress, noise, dust & metal fumes	Suction hood shall be installed above the furnaces and proper ventilation shall be maintained. Automatic temperature controller will be installed in furnaces to avoid excessive heat. Industrial fans will be used in the furnace area to lower the ambient temperature and improve the working conditions for operators. Properly designed equipment will maintain the noise level in the work zone. Building enclosure will further reduce the noise in surrounding. Well designed hygiene ventilation system will be provided comprising of hygiene suction hood, ducting, hygiene fan with bag filter to cover the secondary emission. After treatment in bag filters, emission will be made through stacks of adequate height. This will ensure dust & fumes free work zone environment.

Operation Area	Occupational Risks	Control Measures
DG set	Sox, NOx, PM and noise	LSHS/HFO or HSD shall be used as fuel having sulphur content less than 1%. Acoustic enclosures shall be provided for noise attenuations. Stacks of adequate height shall be provided for proper dispersion of gases.

7.11.2 Personal Protective Equipments

Apart from taking engineering or administrative controls or best work practices, personnel protective equipment (PPEs) should be used in conjunction with these controls to protect individuals, exposed to health and safety hazards, from the risk of injury by creating a barrier against workplace hazards.

PPE include devices for head protection, eye and face protection, protective clothing, hand protection, foot protection, hearing and respiratory protection. Hazard awareness and training shall be provided to all those working in the plant to make them aware of what hazards exist in their workplace.

The personal protective equipments will be given to all the workers based on their specific work requirements. PPEs includes

- Industrial Safety Helmet;
- Crash Helmets;
- Face shield with replacement acrylic vision;
- Zero power plain goggles with cut type filters on both ends;
- Zero power goggles with cut type filters on both sides and blue color glasses;
- Welders equipment for eye and face protection;
- Cylindrical type earplug;
- Ear muffs;
- Canister Gas mask;
- Self contained breathing apparatus;
- Leather apron;
- Aluminized fiber glass fix proximity suit with hood and gloves;
- Safety belt/line man's safety belt;
- Leather hand gloves;
- Asbestos hand gloves;
- Acid/Alkali proof rubberized hand gloves;
- Canvas cum leather hand gloves with leather palm;
- Electrically tested electrical resistance hand gloves; and
- Industrial safety shoes with steel toe.

7.11.3 Occupational health facility

The proposed plant is small in scale of operation (employing 250 no of manpower) and good occupational health medical facilities are available in Rudrapur City and nearby area.

Nursing staff with other basic necessary facilities will be provided in the plant area for first- aid treatment round the clock for attending emergency arising out of accidents, if any.

Occupational health check ups and other for any emergency treatment, there will be a tie up with the near by hospitals. Occupational health survey shall be carried out at regular interval and their recommendations shall be implemented in time bound manner.

In order to increase health awareness, periodical in-house and external trainings will be arranged through external and internal faculty.

7.11.4 Occupational Health Monitoring Plan

Initial and periodical medical examination shall be done for all the workers as per their specific exposure.

Medical examinations will be carried out as per the tentative plan given in **Table-7.19**. The list of materials to be kept in centralized place is given in **Table-7.20.**

TABLE-7.19
OCCUPATIONAL HEALTH MONITORING PLAN

S.No.	Dept	OH Risk	Test	Frequency
1	Compressor House/DG house	Noise	Hearing Tests	Once in a Year
2	Drivers / Crane Operators / Lifter Operators	No Risk (Only preventive check)	Ophthalmologic	Below 45 Years (Once in a Year) More than 45 years old (Twice in a Year)
3	Lead melting & casting section	Lead fumes	Blood lead level	Once in three months
4	All Employees	General and Occupational Health Check	Periodical Medical Examination	Twice in a Year for (Process) and Once in a Year (For Non Process

TABLE-7.20
LIST OF MATERIALS TO BE KEPT IN CENTRALIZED PLACE

Sr. No.	Materials		Number
I.	Safety belts		10
II.	Hand gloves (rubber & leather)		50
III.	Rubber tubes		6
IV.	Safety goggles		12
V.	Stretcher	Vertical type	1
		Ordinary type	2

Sr. No.	Materials	Number
VI.	Manila rope (1/2" & ¾")	20m each
VII.	Hanging ladder way	20m, 1 sets
VIII.	Submersible pump (complete set)	1 set
IX.	Pipe fitting & valve (1", 2"' 3" & 4")	Sufficient numbers
X.	Iron pans, pick axe, spades	10 no.s each
XI.	Screw props	2
XII.	Wire rope slings & clamps (1/2", 2")	2 sets
XIII.	Hose pipe (1/2" & 1")	50m each
XIV.	Hose fittings and clamps of all size	Lot
XV.	Chain pulley block of 1, 2 & 5 tone capacity. One each	
XVI.	Eye bolts	6
XVII.	Tripod	2
XVIII.	Loose bars (3', 5' & 8')	1no.s each
XIX.	Carry strip roll	1
XX.	Helmets	15
XXI.	cable roll	1
XXII.	Telephone instrument	1
XXIII.	First aid box	1
XXIV.	Hand shovels	10

7.11.5 Safety Plan

Safety of both men and materials during construction and operation phases is of concern. Safety plan has been prepared and implemented in the existing silver plant. The same will be continued after the expansion of the Plant. The preparedness of an industry for the occurrence of possible disasters is known as emergency plan. The disaster in the plant is possible due to leakage of hazardous chemicals like chlorine, collapse of structures and fire/explosion etc.

Keeping in view the safety requirement during construction, operation and maintenance phases, PSP has already formulated the safety policy and the same will be further strengthening for the expansion project. The safety policy is based on the following regulations:

- To allocate sufficient resources to maintain safe and healthy conditions of work;
- To take steps to ensure that all known safety factors are taken into account in the design, construction, operation and maintenance of plants, machinery and equipment;
- To ensure that adequate safety instructions are given to all employees;
- To provide wherever necessary protective equipment, safety appliances and clothing and to ensure their proper use;
- To inform employees about materials, equipment or processes used in their work which are known to be potentially hazardous to health or safety;
- To keep all operations and methods of work under regular review for making necessary changes from the point of view of safety in the light of experience and up to date knowledge;

- To provide appropriate facilities for first aid and prompt treatment of injuries and illness at work;

- To provide appropriate instruction, training, retraining and supervision to employees in health and safety, first aid and to ensure that adequate publicity is given to these matters;

- To ensure proper implementation of fire prevention methods and an appropriate fire fighting service together with training facilities for personnel involved in this service;

- To organize collection, analysis and presentation of data on accident, sickness and incident involving people injury or injury to health with a view to taking corrective, remedial and preventive action;

- To promote through the established machinery, joint consultation in health and safety matters to ensure effective participation by all employees;

- To publish/notify regulations, instructions and notices in the common language of employees;

- To prepare separate safety rules for each types of occupation/processes involved in a project; and

- To ensure regular safety inspection by a competent person at suitable intervals of all buildings, equipments, work places and operations.

In operation, the safety guidelines shall be framed in consultation with CIFB and were tested under their guidance. The same shall be implemented.

7.11.6 Safety Organization

- **Construction and Erection Phase**

A qualified and experienced safety officer shall be appointed. The responsibilities of the safety officers include identification of the hazardous conditions and unsafe acts of workers and advice on corrective actions, conduct safety audit, organize training programs and provide professional expert advice on various issues related to occupational safety and health. He is also responsible to ensure compliance of Safety Rules/ Statutory Provisions. In addition to employment of safety officer by HZL, every contractor, who employs more than 200 workers, shall also employ one safety officer to ensure safety of the worker, in accordance with the conditions of contract.

- **Operation and Maintenance Phase**

When the construction is completed the posting of safety officers shall be in accordance with the requirement of Factories Act and their duties and responsibilities shall be as defined there of.

7.11.7 Safety Circle/ Safety Steward System

In order to fully develop the capabilities of the employees in identification of hazardous processes and improving safety and health, safety circles would be constituted in each area of work. The circle would consist of 5-6 employees from that area. The circle normally shall meet for about an hour every week.

7.11.8 Safety Training

A training center shall be set up at the plant. Safety training shall be provided by the Safety Officers with the assistance of faculty members called from Corporate Center, Professional Safety Institutions/ Universities and Internal experienced Faculty. In addition to regular employees, limited contractor labors shall also be provided safety training. To create safety awareness safety films shall be shown to workers and leaflets/ stickers will be distributed etc. Some precautions and remedial measures proposed to be adopted to prevent fires are:

- Compartmentation of cable galleries, use of proper sealing techniques of cable passages and crevices in all directions would help in localizing and identifying the area of occurrence of fire as well as ensure effective automatic and manual fire fighting operations;
- Spread of fire in horizontal direction would be checked by providing fire stops for cable shafts;
- Reliable and dependable type of fire detection system with proper zoning and interlocks for alarms are effective protection methods for conveyor galleries;
- Housekeeping of high standard helps in eliminating the causes of fire and regular fire watching system strengthens fire prevention and fire fighting; and
- Proper fire watching by all concerned would be ensured.

Training of Persons

All the rescue and fire fighting teams must be properly trained to carry out their duties in an emergency. Practice drills shall be carried out once in every six months to ensure that persons are fully conversant with their duties and can carry them out efficiently when the need arises. A record of all such drills and meetings will be maintained.

7.11.9 Health & Safety Monitoring Plan

The health of all employees shall be monitored once in a year for early detection of any ailment/ abnormality due to exposure to heat and hazardous chemicals.

7.12 Risk Assessment in Melting & Casting Section & Actions:

One of the operational hazard in melting casting of zinc is the difference between outflow and inflow of molten metal which is handled by providing the

Thermocouple for monitoring and maintaining the temperature of Induction furnace in the range of 515 -530 degree C. Another risk is removing of hot Zinc dross (Zinc Oxide formation) formation over surface of molten metal in induction furnace and handling the same. Zinc dross is removed by trained personnel with proper PPE's and Zinc dross is handled by dross handling plant having bag filter for dust collection, dust so collected is sent back to sister plant for recycling. While these operations are performed required PPE's including dust masks are provided to all the persons working in that area.

Also Efficiency of Bag Filter will be monitored at regular interval. Monitoring of work place environment will be carried out. If concentration of PM exceeds the PEL appropriate control measures will be taken to ensure the PM emissions are maintained within the limits.

8.0 PROJECT BENEFITS

The proposed zinc and lead melting and casting plant will result in improvement of infrastructure as well as upliftment of social structure in the area. The people residing in the nearby areas will be benefited directly and indirectly as well. It is anticipated that the proposed plant will provide benefits for the locals in two phases i.e. during construction phase as well as during operational phase of the plant.

8.1 Construction Phase

8.1.1 Employment

The major benefit due to the proposed project will be in the sphere of generating temporary employment for substantial number of personnel. The construction phase of the plant is expected to span over 9 months. Approximately, an indirect employment for about 500 people will be created by the proposed project during the construction phase. These construction workers will be taken from the study area to the extent possible. Hence, the proposed project will benefit locals to a great extent.

8.1.2 Community Services

HZL will employ local people to the extent possible. In addition, HZL will provide necessary infrastructure like water supply, sewerage, medical facility, etc. for catering to the needs of the project personnel and their families, which will also be beneficial to the locals residing in the area.

8.1.3 Transportation

Construction phase of zinc and lead melting and casting plant and other facilities will involve movement of material of great magnitude. The material to be transported includes earthwork, concrete, steel, equipment and other materials. The proposed project will result in improving the infrastructure facilities of the area.

8.2 Operational Phase

8.2.1 Population

During the operational phase, about 250 people will be employed. Considering a family size of 5 persons, there is a likelihood of benefit to about 1250 persons. Considering that most of the skilled personnel proposed to be employed for the proposed project would be from outside the study area and unskilled/ semiskilled personnel will be from within the study area. The proposed project would add to the population in the study area, which would result in better scope for indirect employment.

8.2.2 Education

Skilled/unskilled people and limited skilled people (depending on availability) will be hired from local population. Especially skilled people expected to come to the study area from outside are expected to be highly educated. In addition, some secondary developments like opening of new schools may take place in view of

the increased family population due to the proposed employment. These factors will be beneficial to locals residing in the study area.

8.2.3 Employment

The manpower requirement for the operational phase of the plant will be about 250 people. In addition, there will be an indirect employment for skilled/ semi skilled people with implementation of this project.

All attempts will be made to employ locally available skilled personnel from the study area. In case of non-availability of skilled persons, people will be hired from out side the study area. Requirement of un-skilled / semi-skilled people will be mostly met from the local population.

8.2.4 Transportation

The major raw material will be transported by road to plant site. There will also be small increase in the vehicular traffic due to passenger transport. This increase in traffic will be less and necessary road network is already available.

8.2.5 Other Benefits

As part of the Corporate Social Responsibility, HZL will develop education, health, infrastructure development, bioinvestment, livelihood, social mobilization, women empowerment, sports and vocational training facilities in neighboring villages.

8.2.6 Corporate Social Responsibility

Hindustan Zinc Limited is an outstanding example of successful Indian Corporate having an exemplary record in asset optimization, effective marketing, people management and caring for the environment. The Company has made remarkable progress in the areas of production, productivity and all other parameters of performance and in line with the same has created substantial emphasis towards structured **community initiatives** in line with the overall CSR philosophy. The significant strides of achievement that we have been able to accomplish in various corporate social responsibility initiatives have been detailed in this document for consideration. The company has exemplary track record in Health, Safety and Environment areas by constantly upgrading its performance on safety indices and delivering better than the statutory environmental related performance.

Corporate Social Responsibility is an integral part of its business which is accorded as much importance as a business project. HZL has undertaken several social projects for sustainable socio-economic development for weaker section of society in the operational villages in the vicinity of its smelters and mines. Apart from the regular welfare initiatives for the employees such as better health, education, infrastructure, recreational facilities etc, HZL's achievements in the field of rural development stand out as a benchmark to emulate and have qualitatively improved the life of the community in the neighborhood.

HZL's sharp focus on CSR and long term objective are evident from the fact that the company has a full-fledged CSR team of 150 functionaries including qualified

professionals and subject matter specialists. The team is rendering the services for the upliftment of under privileged rural masses in 180 operational villages.

Hindustan Zinc believes in sustainable development and is committed to raise the quality of life and social well-being of communities. Broadly, the following are the focus areas of the company:

- Social Investment: Health, Education & Livelihood
- Bio-Investment: Water Harvesting, Agriculture and Social forestry
- Environment conservation

➢ **Vision**

Facilitate Sustainable Development Initiatives to raise the Quality of Life and Social Well-being of the communities in the neighborhood**.**

➢ **Mission**

Sustain community level ownership of the development actions and results.

➢ **Objective**

- To establish & strengthen mutual co-existence and cohesiveness with stakeholders; and

- Encourage community participation by establishing and strengthening village institutions.

The company's CSR strategy is to identify the poverty stricken villages and convert them into "Model One" in a phased manner. All the development initiatives are undertaken on partnership basis in a form of collaborative projects. These Model villages have all the basic amenities and are self sustaining in every respect. Under Integrated Village Development Programme HZL has planned to transform 101 poverty stricken villages into model village.

HZL's community development initiatives are making significant impact in the lives of people in the areas where we work and many of such people are from the weaker sections of the society. In furtherance of our believes and philosophy to make due contribution to the community, we have become a member of the **U.N. Global Compact** and we plan to further the cause of society as a part of this Global Compact membership. With a clear belief to run community initiatives like any other business project, the Company has acquired **SA 8000** certification.

A successful example of Public Private Partnership (PPP) both for high impact & key signature social projects such as Health & Nutrition, Women Empowerment, Promotion of Education, Sustainable Livelihood, Agriculture & Horticulture, Animal Husbandry, Watershed Development, Infrastructure Development, Social Mobilization, Model Village Development, etc.

The progress and performance of all social development projects are discussed periodically with all the stakeholders. All the social projects are being evaluated

and audited by reputed external agencies to assess the performance and get the feedback for applying timely corrective measures. HZL plays a pro-active role as enabler and development partners in implementation of all social development projects.

HZL's Mining units at remote locations have helped doing economic and social development of the area apart from creation of infrastructural facilities benefiting the entire nearby population. These establishments have provided opportunities for the people to get gainful employment, directly and indirectly, and also created facilities for quality education of the children and the health care for the family of the employees as well as local community. With exclusive manpower in CSR, the company has been successful in positively impacting the lives of more than 500,000 people living in the vicinity of company's business operations.

Several sustainable development projects are being implemented in the operational villages and these have now become Self –sustainable and Replicable "Role Model" and are successfully being implemented in other nearby villages. The projects have brought about a qualitative change in the lives of community residing in the operational villages. More importantly the projects have enabled the BPL families to improve their quality of life through various development interventions.

Hindustan Zinc is continuously advancing on its path to transform the lives of all needy and poor people residing in the vicinity of its operations to make our society a better place to live in.

- ***CSR Budget***

The CSR details proposed are given in **Table-8.1**.

TABLE-8.1
CSR BUDGET DETAILS

Sr. No.	Focus area	Phase-1			Phase-2	
		2012-13	2013-14	2014-15	2015-16	2016-17
1	Health	32.5	36	38	33.5	34
2	Education	22	16	18	25	23.5
3	Agriculture	25	24	26	27	26.5
4	Livestock Management	18	27	29	21	19.5
5	Watershed, RWH and Irrigation	28	33	33	31	29.5
6	Non-farm Livelihood(Rural youths training, income generation trainings of SHG members)	22	22	18.5	17	20
7	Water, Hygiene and Sanitation	41	30	28	38	39.5
8	Rural Infrastructure	39.5	41	38.5	39	38
9	Social Mobilization (Awareness generation programmes, Capacity building programmes, etc.)	9	9	7	6	7.5
10	Environment & Social Forestry	13	12	14	12.5	12
	Total	250	250	250	250	250

9.0 ADMINISTRATIVE ASPECTS

9.1 Corporate Philosophy of HZL

HZL has a corporate philosophy of sustainable development and its action are driven by EHS policy. In order to properly manage its activities for environmental protection, an 'Environment Management Division' was set up. The EMD at various levels and locations has experts in the fields of Environmental Engineering, Environmental Science, Environment Management, Wastewater Treatment and Horticulture. EMD involves in implementation of all necessary measures to protect environment in of its various units in India. Each unit has separate well-equipped environmental cell, which regularly monitors various environmental parameters in and around the units. The EHS policy is given below:

Hindustan Zinc Limited

ENVIRONMENT, OCCUPATIONAL HEALTH, SAFETY, SECURITY AND COMMUNITY POLICY

HZL believes in sustainable development in harmony with nature and accordingly, is committed to the effective management of health, security and safety of all its employees, protecting its surrounding environment and making a contribution to the development of the local community.

This commitment encompasses efficient use of natural resources, protection of assets and provision of a safe workplace with support systems for zero harm to the environment.

Accordingly, HZL will strive to:

- Maintain management systems for health, safety, security, environment and the community that are in compliance with law and consistent with world-class standards like ISO 14001, OHSAS 18001.
- Develop a working culture conducive to continuous improvements in performance without compromising with safety, security and health of its employees and its commitment to develop in harmony with nature.
- Develop employees through training and leadership.
- Conserve natural resources through efficient use.
- Work with communities to contribute to their development.
- Institute and update systems to report progress with high standards of reporting integrity.

Date : 4th November, 2008
Place : Udaipur

Akhilesh Joshi
Chief Operating Officer
& Whole-time Director

EHS at HZL

- EHS is driven by its Policy at Company level as well as unit level
- EHS performance is reported weekly and reviewed monthly by Business Management Group headed by COO
- EHS System is in place
  - Management information system (MIS)
  - EHS Business Plan
  - Integrated Management System (ISO 9001, ISO 14001 & OHSAS 18001)
- Modern Environment Laboratory, well equipped and versatile
- Micro meteorological observatory, online stack and ambient monitoring
- Qualified/ Specialized EHS team which works closely with operation team
- Focused R&D being done in association with premier research institutes with the objectives of environment improvements
- Training on environmental awareness
- Elaborate MIS on key performance indicators is in place
- External EHS audits by reputed agencies
- CDM credit earned for Waste Heat Recovery
- Winner of several Environment and Safety Awards

1 1

9.2 Infrastructure for Environmental Protection

The plant will have environment cell to supervise and implement the environmental related issues. This will be supported by a equipped laboratory to carry out the analysis. The Organizational Structure of Environment Management is presented in **Figure-9.1**.

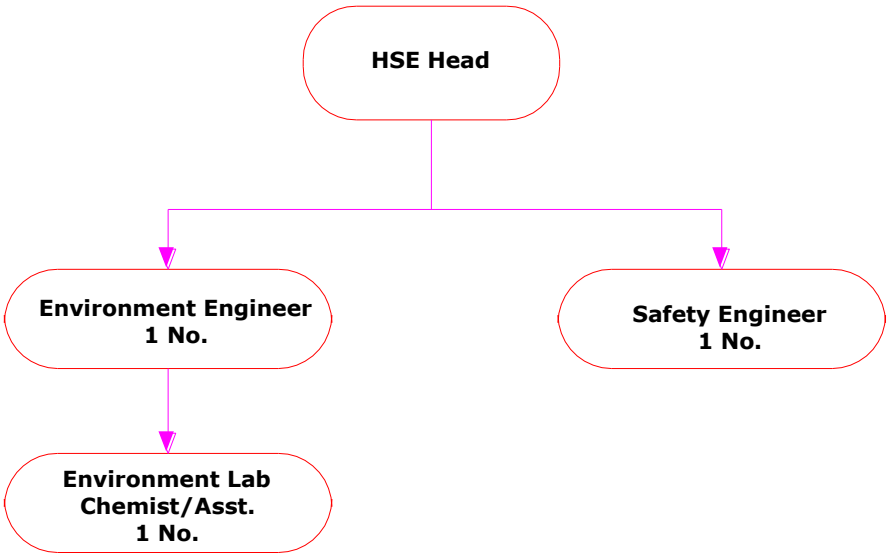


FIGURE-9.1
ORGANIZATIONAL STRUCTURE OF ENVIRONMENT MANAGEMENT

10.0 SUMMARY AND CONCLUSIONS

This chapter presents the justification for implementation of the project, Summary of anticipated impacts and mitigation measures and conclusions.

10.1 Justification for Implementation of the Project

The proposed project of zinc and lead melting and casting plant will have marginal impacts on the local environment. However, with the implementation of the proposed pollution control and environment management measures, the minor impacts anticipated due to construction and operation of the proposed plant will be mitigated.

The proposed project will provide employment to about 500 persons during construction phase and about 250 persons during operational phase. Apart from the employment and business opportunities for the local people, they will also be benefited in the areas such as education, health care, infrastructure facilities, livestock management, non farm livelihood, social mobilisation etc.

Thus, this project will lead to overall development of the region in particular and the state in general. This project will also generate indirect employment to a considerable number of families, who will render their services for the employees of the project.

Thus, in view of considerable benefits from the project without any major adverse environmental impact, the proposed project is most advantageous to the region as well as to the nation.

10.2 Summary of Anticipated Environmental Impacts and Mitigation Measures

The summary of anticipated adverse environmental impacts due to the proposed project and mitigation measures is given in **Tabe-10.1**.

TABLE-10.1
ANTICIPATED ADVERSE ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Discipline	Potential Negative Impacts	Probable Source	Mitigative Measures	Remarks
Constructional Impact				
Water Quality	Increase in suspended solids due to soil run-off during heavy precipitation	Loose soil at construction site	During monsoon season run off from construction site will be routed to a temporary sedimentation tank for settlement of suspended solids.	_
Air Quality	Increase in dust and NOx concentration	Levelling activity and heavy vehicular movement	Sprinkling of water in the construction area and unpaved roads will be done. Proper periodic maintenance	The impact will be low, as the main approach road will be tarred.

Discipline	Potential Negative Impacts	Probable Source	Mitigative Measures	Remarks
			of vehicles will be done.	
Noise	Increase in noise level	Construction equipment	Equipment will be kept in good condition to keep the noise level within 85 dB (A). Workers, who are working in the high noisy areas, will be provided with protective equipment.	Workers will be provided necessary protective equipment *e.g.* ear plugs, earmuffs.
Terrestrial Ecology	Clearing of land	Land acquisition and soil enabling activities	Landscaping and extensive plantation development and plantation in the open area will be carried out.	Extensive plantation in the surrounding areas including plant site will be done. The plantation will be developed in plant area.
Operational Impact				
Water Quality	Deterioration of surface water quality	Discharge from various plant units and other auxiliary units	Adequate treatment facilities will be provided so that the treated effluents conform to the regulatory standards. Treated water will be reused/ recycled for secondary purposes. Zero discharge shall be maintained except in monsoons, when natural storm water shall be allowed to flow outside ensuring its quality.	The reuse of treated wastewater will help in conserving the fresh water resources.
Air Quality	Increase in PM, SO_2, and NOx levels in ambient air.	Stack emissions and fugitive emissions.	Bag filters having 99.9 % efficiency will be provided to control Particulate Matter emission to less than 50 mg/Nm^3. Stacks will be provided for the proper dispersion of gaseous pollutants. • Two stacks of 30 m height in the zinc section for bag filter discharge • One stack of 40 m height in the lead section for bag filter and combustion off	The resultant air quality will conform to the stipulated standards.

Discipline	Potential Negative Impacts	Probable Source	Mitigative Measures	Remarks
			gases discharge; • One stack of 20m (1 DG set-500 KVA) and one of 50m (3 DG sets-5.5 MW) for DG set emissions; and • One stack of 40 m (Process stack) and one stack of 30 m (Hygiene stack) height in the silver plant for bag filter discharge • Provision of FGD system in case of using HFO as a fuel Motorable roads in the plant area will be paved to reduce dust emission. Afforestation programs will be undertaken at the periphery plant area.	
Noise Levels	Increase in noise levels in the plant area.	Equipment in main plant and auxiliaries.	Equipment will be designed to conform to noise levels prescribed by regulatory agencies. Provision of green belt and plantation would further help in attenuating noise.	Employees working in high noise areas would be provided earplugs/ earmuffs as protective device.
Demography and Socio-Economics	Strain on existing amenities like housing, water sources and sanitation, medical and infrastructure facilities.	Influx of people of proposed melting and casting facilities for zinc and lead employees as well as contractor's employees/ labourers.	Locals will be given preference in employment. No significant impact is envisaged as sufficient additional facilities are proposed by the project proponents.	Overall socio-economic status of the area is expected to improve considerably.
Storm Water Control	Impact on water resources	Rain water	Separate storm drains will be provided. The run-off water thus will be used in plantation development during rainy season. Surplus water will be disposed off to nearby nallah.	Separate storm water drains will ensure discharge of uncontaminated run-off water during rainy season. The collected run-off water from the

Discipline	Potential Negative Impacts	Probable Source	Mitigative Measures	Remarks
				drains will be used for rainwater harvesting within the plant premises.
Fire & Safety	Accidents and disasters related to fire & safety	Chemical and fuel storages	Disaster Management Plan (DMP) has been prepared	On-site and Off-site Emergency plan will be implemented during any disaster.

10.3 Conclusions

The proposed project will have certain level of marginal impacts on the local environment. However, development of this project has certain beneficial impact/effects in terms of providing the employment opportunities that the same will create during the course of its setting up as well as during operational phase of the project.

Thus, it can be concluded that with the judicious and proper implementation of the pollution control and mitigation measures, the proposed project will be beneficial to the society will contribute to the economic development of the region in particular and country in general.

11.0 DISCLOSURE OF CONSULTANTS

11.1 Introduction

Studies were carried out by several institutions of different disciplines during the preparation of the EIA/EMP report based on the Expert Appraisal Committee (EAC) prescribed Terms of Reference. The list of consultants involved in different studies are given below.

Sr. No.	Study	Consultants
1	Environmental Impact Assessment study including Environment Management Plan	Vimta Labs Ltd, Hyderabad, India
2	Remote Sensing and Land use/Land cover Studies	Hydro-Geosurvey Consultants Pvt Ltd, Rajasthan, India
3	Hydrology and Hydrogeology Study	Hydro-Geosurvey Consultants Pvt Ltd, Rajasthan, India

The profile of the Consultants is given below:

11.2 Vimta Labs Limited - Environment Consultant

Vimta Labs Limited is a leading multi-disciplinary testing and research laboratory in India. VIMTA provides contract research and testing services in the areas of environmental assessment, analytical testing, clinical research, pre-clinical (animal) studies, clinical reference lab services, advanced molecular biology services and research & development studies.

The **Environment Division** has been in the forefront of its vision to provide better environment through guiding and assisting the industry for sustainable development. A stalwart in the mission to protect and preserve the natural resources on earth for future generations, it offers extensive research and consultancy services in the field of environment. With its rich experience, multi-disciplinary expertise and with the support of its state-of the-art analytical equipment, the services offered by the division are wide ranging and encompasses entire gamut of environment management and monitoring services. With its emphasis on quality services over the years, it has evolved itself into a single reference point in India for comprehensive environmental services.

11.2.1 The Quality Policy

- VIMTA is committed to good professional practices and quality of operations in its testing, validation and research services;
- VIMTA shall ensure customer satisfaction by maintaining independence, impartiality and integrity in its operations;
- VIMTA shall provide the services in accordance with national and international norms;

- VIMTA shall implement quality systems as per ISO/IEC 17025 and applicable Good Laboratory Practices (GLPs) & Good Clinical Practices (GCPs), to generate technically valid results/data; and

- VIMTA shall ensure that all its personnel familiarize with the policies and procedures of the quality system and implement the same in their work.

11.2.2 Major Milestones and Accreditations

- 1984 - Registered with an initial investment of Rs.200,000=00
- 1985 - Recognized by ISI (now known as Bureau of Indian Standards)
- 1987 - Qualified by the criteria of Ministry of Environment and Forests, India and was notified as one of the first 14 Standard Environmental Laboratories published in the Gazette of India
- 1988 - Licensed for carrying out tests on Drugs and Pharmaceuticals
- 1991 - Accredited by NCTCF, DST, Government of India (the forerunner of NABL)
- 1995 - Accredited by NABL, India under its revised scheme, certified by Standards Australia, Quality Assurance Services as per ISO/IEC Guide 25 and ISO 9002
- 1996 - GLP Compliance
- 1998 - Accreditation by GOSSTANDART and joint venture for certification of Food Exports with ROSTEST, Russia
- 1998 - World Bank Recognition
- 2002 - ANVISA Brazil Certification
- 2003 - USFDA accepts Vimta Bioequivalence study report. Showcased Vimta at AAPS (USA) and ICSE-CPHI (Germany)
- 2003 – Recognized by Saudi Arabian Standards Organization
- 2004- Enters Gulf market - Executes a contract for environmental consultancy in Kuwait
- 2006 –Expands its overseas activities. Undertakes environmental assignment in Saudi Arabia
- 2006 – Undertakes environmental impact assignment in Tanzania, Africa
- 2008 – Has been Pre-Qualified by World Health Organization (WHO)
- *2009 – Undertaken Environmental impact assignment in Cameroon, Africa*
- *2010 – Accredited by QCI/NABET, Government of India for EIA report preparation*

11.2.3 Services Offered

Spread over 70,000 sq.ft lush green garden premises at Cherlapally, Hyderabad (India), the scientifically designed and meticulously groomed infrastructural facility of the Central Laboratory of **VIMTA** has the most sophisticated instruments backed by an excellent team of professionals.

Over 150,000 sq. ft. of world class research laboratory is also under operation at Biotech Park-Genome Valley, Hyderabad (India). Having all the facilities under

one roof is perhaps the only one of its kind in South Asia in the contract testing and research sector.

VIMTA Central Laboratory, Cherlapally, Hyderabad

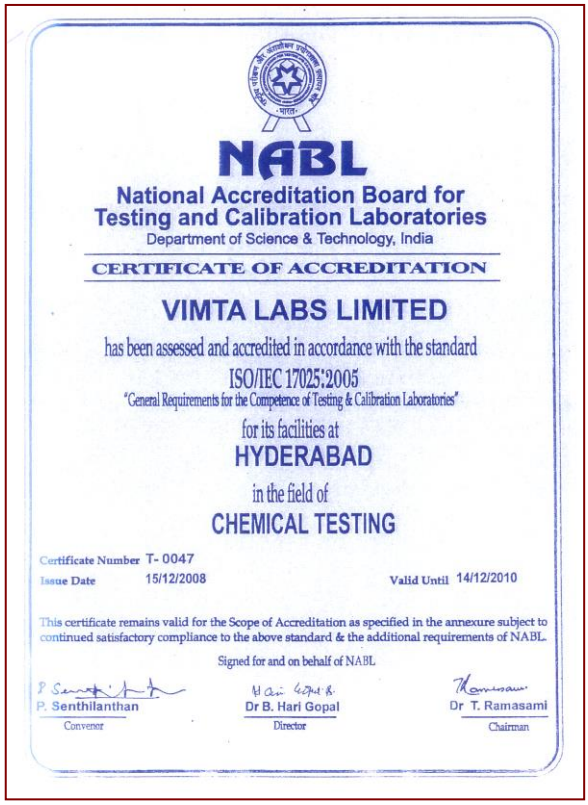
VIMTA Life Sciences, Genome Valley, Hyderabad

Vimta offers services under the following specializations:

- Environment;
- Analytical;
- Clinical Reference Lab;
- Clinical Research;
- Preclinical;
- Molecular Biology; and
- Research and Development.

The environment division of VIMTA Labs Limited (VLL) has its presence all over India and other countries including a strong association with international consultants like Japan Bank for International Cooperation (JBIC), Kennametal Inc. - USA, Rudal Blanchard – UK, E&E Solutions – Japan, NAPESCO & Kuwait National Petroleum Corporation – Kuwait, Marafiq and Haif Consultants – Saudi Arabia and others. Vimta Labs Limited has the following credentials:

- Recognition by BIS, India;
- Recognition by Ministry of Environment and Forests, Govt. of India and various State Pollution Control Boards (wherever applicable) ;
- Recognition by Department of Science & Technology, Govt. of India (NABL) ;
- Recognition by Ministry of Defence, Govt. of India;
- Recognition by APEDA, Ministry of Commerce, Govt. of India;
- Recognition by Saudi Arabia Standard Organization (SASO), Saudi Arabia;
- Recognition from NEMC, Tanzania;
- Accreditation by NCTCF;
- Certification from Standard Australia;
- Recognition from ANVISA Brazil;
- Recognition from USFDA;
- Quality Assurance Services as per ISO/IEC 17025;
- Quality Assurance Services as per ICH Guidelines; and
- Recognition by World Health Organization (WHO).



NABL

National Accreditation Board for Testing and Calibration Laboratories

Department of Science & Technology, India

CERTIFICATE OF ACCREDITATION

VIMTA LABS LIMITED

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2005

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

HYDERABAD

in the field of

CHEMICAL TESTING

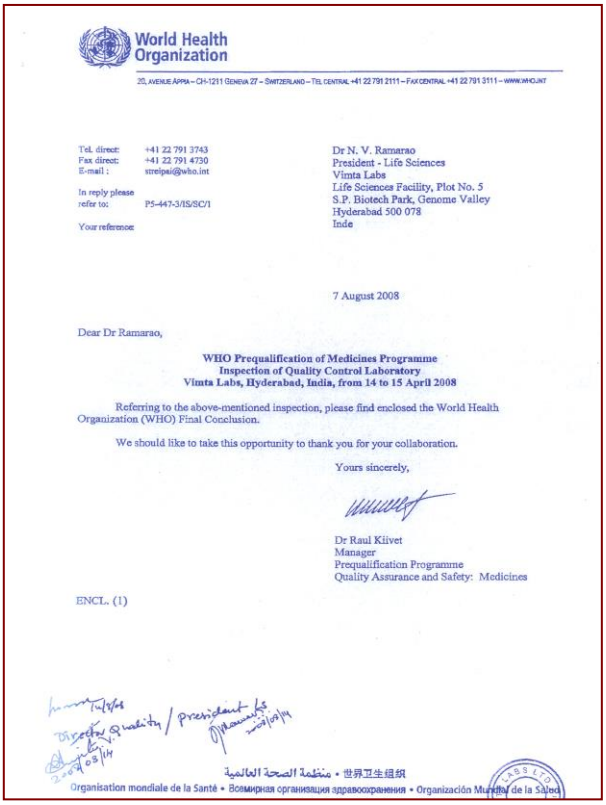
Certificate Number T- 0047

Issue Date 15/12/2008 Valid Until 14/12/2010

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the additional requirements of NABL.

Signed for and on behalf of NABL

P. Senthilanthan, Convener — Dr B. Hari Gopal, Director — Dr T. Ramasami, Chairman



World Health Organization

20, AVENUE APPIA – CH-1211 GENEVA 27 – SWITZERLAND – TEL CENTRAL +41 22 791 2111 – FAX CENTRAL +41 22 791 3111 – WWW.WHO.INT

Tel. direct: +41 22 791 3743
Fax direct: +41 22 791 4730
E-mail : strelpai@who.int

In reply please refer to: PS-447-3/IS/SC/1

Your reference

Dr N. V. Ramarao
President - Life Sciences
Vimta Labs
Life Sciences Facility, Plot No. 5
S.P. Biotech Park, Genome Valley
Hyderabad 500 078
Inde

7 August 2008

Dear Dr Ramarao,

WHO Prequalification of Medicines Programme
Inspection of Quality Control Laboratory
Vimta Labs, Hyderabad, India, from 14 to 15 April 2008

Referring to the above-mentioned inspection, please find enclosed the World Health Organization (WHO) Final Conclusion.

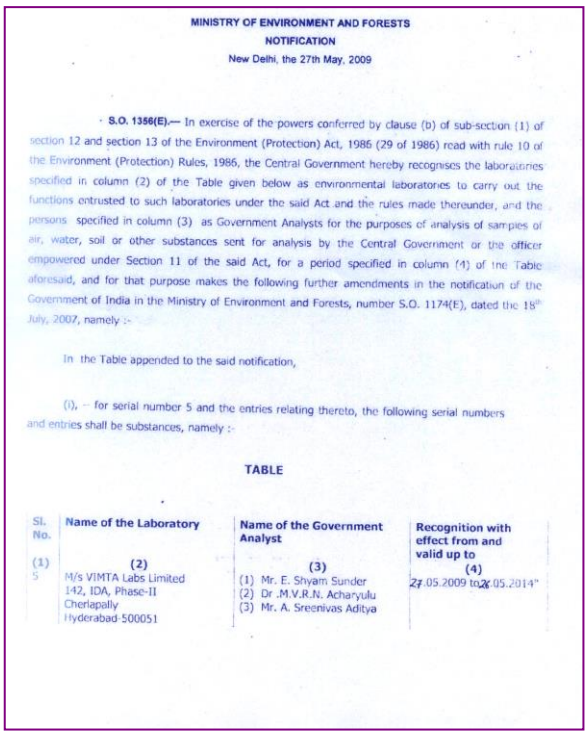
We should like to take this opportunity to thank you for your collaboration.

Yours sincerely,

Dr Raul Kiivet
Manager
Prequalification Programme
Quality Assurance and Safety: Medicines

ENCL. (1)

Organisation mondiale de la Santé • Всемирная организация здравоохранения • Organización Mundial de la Salud



MINISTRY OF ENVIRONMENT AND FORESTS

NOTIFICATION

New Delhi, the 27th May, 2009

S.O. 1358(E).— In exercise of the powers conferred by clause (b) of sub-section (1) of section 12 and section 13 of the Environment (Protection) Act, 1986 (29 of 1986) read with rule 10 of the Environment (Protection) Rules, 1986, the Central Government hereby recognises the laboratories specified in column (2) of the Table given below as environmental laboratories to carry out the functions entrusted to such laboratories under the said Act and the rules made thereunder, and the persons specified in column (3) as Government Analysts for the purposes of analysis of samples of air, water, soil or other substances sent for analysis by the Central Government or the officer empowered under Section 11 of the said Act, for a period specified in column (4) of the Table aforesaid, and for that purpose makes the following further amendments in the notification of the Government of India in the Ministry of Environment and Forests, number S.O. 1174(E), dated the 18th July, 2007, namely :-

In the Table appended to the said notification,

(i), – for serial number 5 and the entries relating thereto, the following serial numbers and entries shall be substances, namely :-

TABLE

Sl. No.	Name of the Laboratory	Name of the Government Analyst	Recognition with effect from and valid up to
(1)	(2)	(3)	(4)
5	M/s VIMTA Labs Limited 142, IDA, Phase-II Cherlapally Hyderabad-500051	(1) Mr. E. Shyam Sunder (2) Dr .M.V.R.N. Acharyulu (3) Mr. A. Sreenivas Aditya	27.05.2009 to 26.05.2014"

NABET

National Accreditation Board for Education and Training

July 26, 2010

Mr. M. Janardhan,
Vice President
Vimta Labs Limited,
142, IDA, Phase – II,
Cherlapally, Hyderabad – 500 051

Dear Sir,

QCI – NABET Scheme for Accreditation of EIA Consultant Organization

This is with reference to your application for QCI – NABET Accreditation as EIA Consultant Organization.

We are pleased to inform you that based on Document & Office Assessments Vimta Labs, Hyderabad are hereby accredited as an EIA Consultants as per the scope given in Annexure I (A & B). Please confirm the correctness of spellings of the names of the experts mentioned in Annexure I B. The detailed terms and conditions are mentioned in Annexure II. You are also advised to check the QCI website for the Minutes of the Accreditation Committee Meeting held on June 24, 2010 for observations related to your application or any decisions with respect to Scheme/ assessment process and take necessary action for compliance.

The accreditation of your organization will be for three year period starting May 18, 2010. The annual renewal of the accreditation will be confirmed after surveillance assessment every year. Surveillance assessments will be conducted to ensure compliance with NABET Scheme and the details mentioned in your Quality Manual.

May we request for an early payment of the annual fees and your confirmation of acceptance of the terms and conditions attached. This will enable us to issue you the requisite accreditation certificate which will be valid for one year duration.

We thank you for your esteemed support in making this scheme successful and for your participation in this national cause.

Thanks and best regards,

Yours sincerely,

Vipin Sahni
Director

RECEIVED 30 JUL 2010 VIMTA LABS LTD. HYD.

QUALITY COUNCIL OF INDIA

Page 1 of 7

Institution of Engineers Building, 2nd Floor, Bahadur Shah Zafar Marg, New Delhi - 110 002, India
Tel : +91-11-2337 9321, 2337 8057 Fax : +91-11-2337 9621 email : nabet@qcin.org Website : www.qcin.org

11.2.4 Services of Environment Division

Environment essentially being a multi-disciplinary science, the range of services offered by the division are also comprehensive and caters to the needs of industry, pollution control agencies, regulatory authorities and in a larger pursuit of a green globe. The services under environment include:

- Site selection and liability studies;
- Environmental impact assessments;
- Environment management plans;
- Carrying capacity based regional studies;
- Environmental audits;
- Solid and hazardous waste management;
- Risk assessment (MCA,HAZON,HAZOP) & disaster management plans;
- Occupational health and safety, industrial hygiene;
- Environmental monitoring for air, meteorology, water, soil, noise, ecology and socio-economics;
- Industrial emission source monitoring;
- Offshore sampling and analysis of marine water and sediments;
- Marine ecological studies;
- Marine impact assessment;
- Rehabilitation and resettlement studies;
- Forestry and ecological studies;
- Geological and hydro-geological studies;
- Land use /land cover studies based on remote sensing;
- Socio-economic studies;
- Due diligence studies;
- Industrial epidemiological studies;
- Wasteland management studies; and
- Study on bio-indicators.

The services under Environmental Chemistry include:

- Analysis of water, wastewater, soil, solid waste, hazardous waste as per international codes;
- Source emissions and work zone air/noise quality monitoring;
- Analysis of SVOCs, VOCs, PAH, BTEX, AOX, PCB's, TCLP metals, TOC etc.;
- Categorization of hazardous waste; and
- Pesticide residue analysis.

11.2.5 Facilities of Environment Division

Vimta-Environment Division is located in scientifically designed Central Laboratory with the state-of the-art modern facilities to offer vide range of services in indoor and outdoor monitoring and analytical characterization in the field of Environment. Further, it is ably supported by highly skilled and experienced team of professionals in the fields of science, engineering, ecology, meteorology, social planning, geology & hydro-geology and environmental planning.

Besides the regular monitoring equipment such as Respirable Dust Samplers (RDS), automatic weather monitoring stations, stack monitoring kits, personal samplers, noise meters, portable water kits etc, the other major specialized equipment include:

- Monostatic Sodar–Designed by National Physical Laboratory, GOI;
- Integrated Noise Level Meters–Quest, U.S.A;
- Flue Gas Analyzers–Testo, Germany;
- 113-A Gravimetric Dust Sampler-Casella, London;
- ICP AES– Varian, USA;
- Gas Liquid Chromatographs with FID, ECD & pFPD–Varian, USA;
- Gas Chromatograph with Mass Detector–Varian, USA;
- Atomic Absorption Spectrometer [AAS]–Varian, USA;
- PAS-AFC-123 instrument;
- High Performance Liquid Chromatograph (HPLC);
- Laser Particle Size Analyzer;
- Bomb Calorimeter;
- Polarographs;
- X-ray Fluorescent Spectrometer;
- Flame Photometer;
- Carbon Sulphur Analyzer;
- Computerized Fatigue Testing Machine;
- Electronic Universal Testing Machine;
- Fourier Transmission Infrared Spectroscope; and
- Water Flow Current Meter – make Lawrence & Mayo.

HIGH RESOLUTION GAS CHROMATOGRAPHS

11.2.6 Quality Systems

The basic fact that environment division and its supporting site laboratories are accredited by NABL (IS0-17025) and Ministry of Environment and Forests, India and by other international bodies stand testimony to its emphasis on Quality Systems.

11.2.7 Achievements

Being the first laboratory to be recognized under Environment Protection (EP) Act by Government of India (GOI), environment division with its best mind power and industrial knowledge competency that allows it to compare with the best in the business.

- The environment division till date has executed about 600 environmental impact assessment and environment management studies with risk assessment and disaster management plans for various spectrum of industries and obtained statutory approvals;

- Supported by the strong modern laboratory and experienced hands, environment division is well equipped in conducting due diligence, phase-I and phase-II studies;

- Undertaken specialized studies such as regional environmental impact assessment on carrying capacity principle; upper air meteorological studies using monostatic SODAR for major industrial complexes;

- Associated with prestigious studies such as environmental pollution monitoring around Taj Trapezium (India), pre and post satellite launch studies for Indian Space Research Organisation (ISRO) and monitoring for offshore oil & gas exploration for deep-sea water and sediment sampling;

- The services offered include vide spectrum of industries covering power, chemical, cement, mining, steel & alloys, metallurgical, aluminium refining & smelting, dye & intermediates, bulk drugs, pesticides, agro-chemicals, petro-chemicals, refineries, pulp & paper, oil & gas exploration & production, asbestos, infrastructure such as highways, seaports and airports, river valley, foundries etc;

- Undertaken environmental consultancy for pipeline layout and up gradation of API oil-water separators of various crude oil depots and petrol filling stations of Kuwait National Petroleum Corporation, Kuwait;

- Undertaken performance evaluation and capacity expansion of sewage treatment plant and industrial wastewater treatment Plant for Marafiq, Saudi Arabia; and

- Undertaken environmental impact assessment studies for pulp and paper mill expansion of Mufindi Paper Mills, Tanzania, Africa.

The details of the persons involved in the preparation of present EIA/EMP report is presented below:

DETAILS OF PERSONNEL INVOLVED IN CURRENT EIA/EMP STUDY – VIMTA LABS LTD

Sr. No.	Name	Qualification	Position	Contribution	Experience
1	Mr. M.Janardhan	M.Tech (Env. Engg)	Vice President (Environment)	Co-ordination	About 20 years of experience in the field of environmental management and environmental engineering
2	Mr. E.Shyam Sundar	M.Sc., M.Phil (Chem) PGDES	Assoc. Vice President (Env. Projects)	Co-ordination	About 18 years of experience in the field of environmental chemistry and monitoring
3	Mr Anand Harapanhalli	B.E (Env)	Manager	Expert	About 20 years of experience in the field of environmental management and environmental engineering
3	Dr.M.V.R.N.Acharyulu	M.Sc., Ph.D (Ecology)	Deputy Manager	Expert	About 19 years of experience in the field of Terrestrial, Aquatic and Marine Ecology
4	Mr. K.V.Kishore Babu	M.Tech (Env)	Deputy Manager	Expert	About 8 years of experience in the field of environmental management and environmental engineering
5	Mr. G.V.Raghava Rao	M.Tech (Env)	Group Leader	Expert	About 11 years of experience in the field of environmental management and environmental engineering
6	Dr. C. Mary Sukanya	M.Sc (Tech), Ph.D (Envi Science & Tech)	Env. Scientist	Project Co-ordinator	About 7 years of experience in the field of Environmental Management and Environmental Chemistry
7	Mr. P. Muni Nagendra Prasad	M.Sc. (Env)	Scientist	Expert	About 3 years of experience in the field of environmental sampling and analysis
8	Mr. P. Niranjan Babu	B.Com	Asst Manager	Secretarial Support	About 18 years of experience in the field of environmental monitoring
9	Mr. P. Krishna	I.T.I (Civil)	Sr. Draftsman	Cartography	About 10 years experience in the field of environmental management and civil drawings
10	Mr. J. Rama Krishna	I.T.I (Civil)	Draftsman	Cartography	About 9 years experience in the field of environmental management and civil drawings
11	Mr. B. Raju	I.T.I (Civil)	Draftsman	Cartography	About 2 years experience in the field of environmental management and civil drawings

11.2.8 Hydrology & Hydrogeology and Landuse Experts

Agency	**Hydro-Geosurvey Consultants Pvt. Ltd, Rajasthan, India**
Team	**Mr. Rajneesh V. Khilnani & Dr. V.B.Khilnani**
Experience	Almost 20 years of field experience in the following spheres:- • Detailed hydro-geological and geo-electrical resistivity surveys for locating sites for construction of well/tube wells and its development and rehabilitation • Ground water management, conservation and its artificial recharge by rain water harvesting • Conducting long duration pump tests for ascertaining different aquifer parameters • Sea water intrusion studies in coastal areas • Comprehensive hydro-geological assessment studies to determined surplus exploitable ground water potential and impact of mining on water regime • Landuse and landcover studies. Some of the important hydro-geological investigations carried out in foreign countries • Hydro-geological investigation of plants and mine areas, near Al-taween, JK Cement (Fujairah) FZC, Emirate of Fujairah, UAE in 2008 • Interpreted hydrological data and resistibility soundings for water supply of a cement plant in South Vietnam, Vietnam Cement Corporation, BinLang, South Vietnam in 2004 • Interpreted the hydro-geological data & assisted in preparation of resort on ground water resources of Republic of Chad of Western Africa, for an NRI, based in Western Germany for agricultural development of Chad in 1997