ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REPORT

FOR

Installation of Air Separation Unit

by

M/S Multan Chemicals Limited

Located at

Plot No. 57C, Allama
Iqbal Industrial City (AIIC),
Sahianwala, Faisalabad, Punjab



Proponent:

Mr. Tariq Mahmood Khan Babar

Prepared by:

Zoom Consultancy & Services Lahore

77 UG Eden Height Gulberg, Lahore

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LIST OF ABBREVIATIONS

Abbreviation	Description
AIIC	Allama Iqbal Industrial City
ASU	Air Separation Unit
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
DG	Diesel Generator
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMMP	Environmental Management and Monitoring Program
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
FIEDMC	Faisalabad Industrial Estate Development and Management Company
GHG	Greenhouse Gas
HSE	Health, Safety and Environment
HSD	High-Speed Diesel
KLD	Kiloliters per Day
KL	Kiloliters
LAR	Liquid Argon
LIN	Liquid Nitrogen
LOX	Liquid Oxygen
MCL	Multan Chemicals Limited
MSDS	Material Safety Data Sheet
NOC	No Objection Certificate
NO_2	Nitrogen Dioxide
NOx	Oxides of Nitrogen
O_2	Oxygen
O_3	Ozone
PEQS	Punjab Environmental Quality Standards
$PM_{2.5}$	Particulate Matter with Aerodynamic Diameter of 2.5 Micrometres or Less
PM_{10}	Particulate Matter with Aerodynamic Diameter of 10 Micrometres or Less
PPE	Personal Protective Equipment
RWH	Rainwater Harvesting
SCBA	Self-Contained Breathing Apparatus
SDS	Safety Data Sheet
SO_2	Sulphur Dioxide
TDS	Total Dissolved Solids
TPD	Tons per Day
TSS	Total Suspended Solids
VFD	Variable Frequency Drive

Executive Summary

1. Project Title and Location

Environmental Impact Assessment (EIA) Report for the Proposed 240 TPD Cryogenic Air Separation Unit for Production of Oxygen, Nitrogen and Argon by Multan Chemicals Limited at Plot No. 57C, Allama Iqbal Industrial City (AIIC), Sahianwala, Faisalabad, Punjab.

Multan Chemicals Limited (MCL) proposes to establish a Cryogenic Air Separation Unit (ASU) for the production of liquid and gaseous industrial/medical gases at Plot No. 57C, Allama Iqbal Industrial City (AIIC), Sahianwala Interchange, Faisalabad, Punjab. The project site is located within the designated industrial area developed by Faisalabad Industrial Estate Development and Management Company (FIEDMC). The plot has been provisionally allotted to MCL for establishment of an air-separation unit for production of oxygen, nitrogen, argon, and related by-products.

The total plot area is **12.65 acres**, equivalent to approximately **51,194 m²** or **455,360 ft²**. The site is accessible through the internal AIIC road network and is connected to the M-4 Motorway through Sahianwala Interchange.

The project-site coordinates, are presented below:

Reference point	Easting	Northing
P-1 / North-West corner	1,077,631.106	11,498,082.661
P-2 / South-West corner	1,077,651.412	11,497,715.674
P-3 / North-East corner	1,078,900.707	11,498,152.717
P-4 / South-East corner	1,078,855.769	11,497,782.130
Approximate site centroid	1,078,259.749	11,497,933.296

The approximate geographic reference of the site centroid as **31°26′15″ N latitude and 73°08′20″ E longitude**.

2. Proponent Details

The proponent of the project is Mr. Tariq Mahmood Khan Babar, an established Pakistani manufacturer and supplier of industrial and medical gases. MCL has existing air-separation and gas-filling operations in Multan and Faisalabad and supplies oxygen, nitrogen, argon, and related gases to healthcare facilities and industrial customers through its filling stations and distributor network.

Particular	Details
Project	Multan Chemicals Limited (MCL)
Chief Executive Officer	Mr. Tariq Mahmood Khan Babar
Registered / corporate address	4-C-II, Industrial Estate, Multan, Pakistan
Project location	Plot No. 57C, Allama Iqbal Industrial City, Sahianwala, Faisalabad
Contact number	+92 305 555 0120
Office telephone	041-8900111
Email	tbkhan@mcl-gases.com

3. EIA Report Preparation

This Environmental Impact Assessment has been prepared for Multan Chemicals Limited to identify, evaluate, and manage the potential environmental, occupational-health, safety, and community impacts associated with the construction, installation, commissioning, and operation of the proposed ASU.

Name of Concultancy: Zoom Consultancy & Services Lahore

Office address: 77 UG Eden Height Gulberg, Lahore

The report has been structured to support the project's application for environmental approval and includes the project description, baseline environmental conditions, stakeholder consultation, impact assessment, mitigation measures, Environmental Management Plan (EMP), environmental monitoring plan, and occupational health and safety provisions.

4. Project Proposal

The proposed facility is a **240 TPD Cryogenic Air Separation Unit** designed to produce high-purity oxygen, nitrogen, and argon from atmospheric air. The project is intended to meet demand from medical, healthcare, welding, fabrication, steel, chemical, food-processing, construction, and other industrial sectors.

The project cost is reported as approximately **PKR 3.4 billion**. The plant is expected to operate continuously, subject to planned maintenance shutdowns. The proposed project will create direct and indirect employment during construction and operational phases.

Project component	Description
Project type	Cryogenic air separation and industrial/medical gas production facility
Installed production capacity	240 TPD ASU
Main products	Oxygen, nitrogen, and argon in liquid and gaseous form
Annual full-capacity	Annual full-capacity production of 62,700 tons of oxygen, 6,300 tons of nitrogen, 2,700 tons of argon and 900 tons of ultra-pure Oxygen; total 72,600 tons per annum.
Product storage	Vacuum-insulated cryogenic tanks, cylinder filling system, and ISO/tanker dispatch arrangements
Land requirement	12.65 acres / 51,194 m²
Main raw material	Ambient atmospheric air
Operational inputs	Electricity, cooling water, molecular sieves/activated alumina, lubricants, maintenance materials, and limited diesel for standby generator operation
Proposed continuous power demand	Approximately 7.3 MW, subject to final vendor electrical-load schedule
Proposed standby power	1,000 kVA DG set for essential systems, subject to final design
On-Site Solar Power Generation	5 MW Solar PV System integrated for green energy generation, carbon footprint reduction, and operational cost optimization.
Fresh-water requirement	Approximately 35 KLD, comprising cooling-system make-up and domestic use, subject to final water balance
Construction employment	Approximately 150–180 workers
Operational employment	Technical, administrative, safety, maintenance, logistics, and support personnel

The proposed technology is based on **cryogenic fractional distillation**. Ambient air will be drawn through inlet filters and compressed through a main air compressor. The compressed air will be cooled and purified using purification systems containing activated alumina and molecular sieves to remove moisture, carbon dioxide, hydrocarbons, and other trace impurities. The purified air will then be cooled to cryogenic temperature in a main heat exchanger and separated in a double-column distillation system.

Nitrogen, having the lower boiling point, will be recovered from the upper portion of the distillation process, while oxygen will be recovered from the lower section. Argon will be recovered through a dedicated argon-

recovery arrangement. The final products will be transferred to cryogenic storage tanks and dispatched through bulk tankers, ISO containers, or high-pressure cylinders. A booster turbo-expander will provide refrigeration and improve energy efficiency.

The project is an air-separation facility and does not involve a conventional chemical reaction or routine process combustion. Consequently, the principal operational environmental concerns relate to electricity consumption, noise and vibration from compressors, cooling-water management, standby DG emissions, wastewater and stormwater control, solid and hazardous waste handling, transport movements, and safety risks associated with cryogenic fluids and oxygen-enriched or oxygen-deficient atmospheres.

5. Major Environmental Impacts

The potential impacts of the project have been identified for construction and operation phases. With the proposed controls, most impacts are expected to be localized, manageable, and reversible.

Activity / aspect	Potential impact
Site preparation and civil works	Dust emissions, vehicle exhaust, noise, soil disturbance, construction waste, stormwater runoff, and temporary traffic increase
Construction workforce	Occupational injuries, sanitation concerns, safety risks, and generation of domestic solid waste
Heavy vehicle movement	Traffic congestion, road-safety risks, dust, vehicle emissions, and nuisance to nearby industrial users
Main air compressor and auxiliaries	Elevated noise and vibration, particularly at compressor house and plant boundary
Electricity-intensive ASU operation	High indirect greenhouse-gas emissions associated with grid electricity consumption
Cooling-water system	Fresh-water consumption, drift, chemical dosing, cooling-tower blowdown, and potential uncontrolled discharge if not properly managed
Standby DG set	Intermittent exhaust emissions, including particulate matter, sulphur dioxide, nitrogen oxides, carbon monoxide, and noise during emergency operation
Domestic sewage	Wastewater from washrooms, kitchen, and office facilities
Maintenance activities	Used lubricating oil, oil filters, oily rags, spent filters, packaging waste, metal scrap, and potential soil contamination from accidental leaks or spills
Molecular sieve / adsorbent replacement	Periodic generation of spent adsorbent material requiring characterization and controlled disposal or return to supplier
LOX, LIN, LAR and gaseous oxygen handling	Cryogenic burns, oxygen enrichment and increased fire intensity, oxygen-deficient atmospheres due to nitrogen release, pressure-release hazards, and loss of containment
Tanker and cylinder dispatch	Traffic accidents, product release, fire escalation in oxygen-enriched areas, and public/driver safety risks
Land and landscape	Reduction in open plot area and potential visual impacts, offset through planned plantation and green-belt development

The key operational environmental issue is anticipated to be compressor-related noise. The project indicate that the main air compressor may generate high noise levels at source; therefore, enclosure design, silencers, vibration isolation, routine maintenance, and monitoring at the plant boundary are essential.

The main safety hazards relate to cryogenic products. Liquid oxygen can increase combustion intensity in oxygen-enriched environments, while liquid nitrogen can displace atmospheric oxygen and create an oxygen-deficient atmosphere. Liquid products can also cause cold burns and damage materials on direct contact. Therefore, product storage, transfer, filling, tanker loading, and maintenance activities will require detailed operating procedures, controlled access, oxygen monitoring, emergency isolation, adequate ventilation, trained personnel, and fire-prevention systems.

6. Recommended Mitigation Measures

Multan Chemicals Limited shall implement the following mitigation and management measures during construction and operation of the project:

- Obtain environmental approval from the Punjab Environmental Protection Agency before commencement of construction and comply with all approval conditions.
- Finalize and implement a site-specific Environmental Management Plan, Occupational Health and Safety Plan, Emergency Response Plan, Waste Management Plan, Traffic Management Plan, and contractor environmental and safety requirements.
- Undertake construction activities during approved daytime hours, maintain equipment properly, and provide noise-control measures for high-noise construction machinery.
- Control construction dust through water sprinkling, covering of spoil and material trucks, speed limits on unpaved surfaces, wheel-washing where required, prompt removal of debris, and appropriate storage of loose materials.
- Provide covered waste-storage areas; segregate excavated material, recyclable material, domestic waste, scrap, hazardous waste, and construction waste; and dispose of all waste through approved channels.
- Install acoustic enclosures, silencers, anti-vibration mounts, and suitable building insulation for the main air compressor, blow-off points, pumps, and other significant noise sources. Conduct preventive maintenance and require hearing protection in designated high-noise zones.
- Adopt energy-efficiency measures, including appropriately sized high-efficiency motors, variable-frequency drives, booster turbo-expander energy recovery, preventive maintenance, power-consumption tracking, efficient lighting, and implementation of a formal energy-management programme.
- Maintain a closed-loop cooling-water system with high-efficiency drift eliminators. Use non-chromate water-treatment chemicals, maintain cooling-water chemistry, control drift and blowdown, and ensure that blowdown is treated or discharged only through the approved final disposal arrangement.

- Prepare a final water balance showing circulating cooling-water flow, make-up water, domestic consumption, wastewater generation, cooling-tower blow down, reuse quantity, and disposal route. The selected domestic sewage-treatment arrangement must be finalized before submission and reflected consistently in the EIA.
- Install and maintain an appropriate wastewater-treatment and disposal system for domestic wastewater and any cooling-tower blowdown, with reuse for plantation only where treatment quality and the approved system allow.
- Install rainwater-harvesting and stormwater-management infrastructure, including properly designed recharge/collection structures, oil-and-grit separation for contaminated runoff, and separate drains for clean stormwater and wastewater.
- Develop and maintain a green belt around the site boundary and open areas. The proposes approximately 15% of the plot area, equivalent to 7,679 m², for green-belt development with suitable native or adapted tree species.
- Store used oil, oil filters, oily rags, chemical containers, and other hazardous wastes in labelled, covered, leak-proof containers placed on an impervious floor with secondary containment. Maintain waste manifests and hand over hazardous waste only to an authorized contractor/facility.
- Design and operate cryogenic tanks, pipelines, pumps, vaporizers, filling systems, and pressure-relief arrangements in accordance with applicable statutory requirements, approved engineering standards, manufacturer recommendations, and relevant fire-safety requirements.
- Establish strict oxygen-service cleanliness procedures. Oil, grease, combustible materials, smoking, welding, and ignition sources shall be prohibited in designated oxygen storage and handling areas unless controlled under an approved permit-to-work system.
- Install fixed oxygen-enrichment and oxygen-deficiency monitors at the cold box, storage area, filling area, enclosed workspaces, and other risk-prone locations. Set audible and visual alarms at appropriate oxygen concentration thresholds and ensure calibration and functional testing.
- Provide adequate ventilation, emergency shut-off valves, pressure-relief systems, earthing, lightning protection, wind indicators, fire hydrants, fire extinguishers, emergency showers, eyewash stations, first-aid facilities, and appropriate personal protective equipment.
- Provide specialized training to employees, contractors, drivers, and visitors on cryogenic safety, oxygen-enrichment hazards, oxygen-deficiency hazards, fire prevention, use of PPE, emergency response, spill/leak isolation, and safe tanker/cylinder handling.
- Implement a vehicle and tanker safety programme covering approved routes, fitness certification, driver competency, defensive driving, vehicle inspections, emergency information, communication arrangements, GPS tracking where adopted, and control of heavy-vehicle movement during peak traffic periods.

- Establish an EHS management structure, including an EHS Manager, Environmental Officer, Safety Officer, plant management, and contractor representatives. The EHS team shall maintain compliance records, monitoring results, training records, inspection checklists, incident reports, waste manifests, and corrective-action records.

7. Proposed Environmental Monitoring

A structured environmental monitoring programme shall be implemented during construction, commissioning, and operation. Monitoring shall be conducted by competent personnel and, where required, through an EPA Punjab–approved laboratory. The final monitoring programme shall be aligned with the environmental approval conditions, applicable Punjab Environmental Quality Standards, the confirmed process design, and the approved wastewater-disposal route.

Environmental component	Parameters	Proposed locations	Frequency	Responsibility
Ambient air quality	$PM_{2.5}$, PM_{10}, SO_2, NO_2, CO and other parameters required by approval conditions	Upwind and downwind site boundary; sensitive/representative receptor if identified	Quarterly during operation; as required during construction	Environmental Officer / approved laboratory
DG-stack emissions	Relevant combustion-emission parameters, when DG is operated regularly or as required by EPA	DG exhaust stack	As required by approval conditions and operating hours	Environmental Officer / approved laboratory
Noise	Equivalent continuous noise level, Leq dB(A)	Four site boundaries, compressor house, DG area, filling area, and nearest representative receptor	Monthly internal monitoring; quarterly third-party monitoring or as required by EPA	Environmental Officer / approved laboratory
Cooling-water system	Make-up-water use, circulation rate, chemical dosing, conductivity, pH, drift-control performance, blowdown volume	Cooling tower and associated utility system	Daily operational log; monthly review	Utilities Engineer / Environmental Officer
Wastewater	Flow, pH, BOD_5, COD, TSS, TDS, oil and grease, temperature, and other parameters specified for the approved disposal route	Treatment-system outlet and/or approved discharge point	Monthly operational checks; quarterly laboratory testing,	Environmental Officer / approved laboratory

			subject to approval conditions	
Drinking water	Applicable drinking-water-quality parameters	Office, canteen, and drinking-water points	Quarterly or as required	Environmental Officer / approved laboratory
Groundwater / recharge system	Groundwater level, recharge performance, and relevant quality parameters where borewell/recharge structures are used	Borewell and/or piezometer	Half-yearly or as required by NOC/approval	Environmental Officer
Solid and hazardous waste	Quantity generated, storage condition, manifests, disposal certificates, used oil, filters, rags, spent adsorbent, scrap, and municipal waste	Waste-storage area and maintenance workshop	Monthly inspection and inventory; disposal record per consignment	Environmental Officer
Oxygen atmosphere monitoring	Oxygen concentration in air; alarm status and calibration	Cold box, tank farm, filling area, enclosed or confined spaces, and identified risk zones	Continuous online monitoring; routine functional verification and calibration	Safety Officer / Plant Manager
Energy performance	Electricity consumption, specific energy consumption, DG fuel use, solar generation if installed, and energy-saving performance	Main electrical panel, compressor system, utility systems	Daily meter readings; monthly review; annual audit	Plant Manager / Energy focal person
Green belt	Number of plants, survival rate, irrigation, replacement planting, pest/disease condition, and treated-water use if applicable	Green-belt and landscaped areas	Monthly during establishment; quarterly thereafter	Environmental Officer
Occupational health and safety	PPE compliance, permit-to-work records, incidents, near misses, emergency-equipment inspections, fire-system testing, oxygen-	Entire facility	Daily inspections; monthly EHS review; quarterly emergency drills	Safety Officer / EHS Manager

	monitor calibration, and training			
Traffic and transport	Vehicle inspection, driver training, route compliance, tanker incidents, complaints, and emergency readiness	Gate, dispatch area, and tanker fleet	Daily dispatch checks; monthly review	Logistics Manager / Safety Officer

The EHS Cell shall prepare monthly internal compliance records and submit monitoring reports to the relevant regulatory authority in accordance with the conditions of environmental approval. Any non-compliance, incident, significant spill, fire, release, or environmental complaint shall be investigated promptly, documented, and addressed through corrective and preventive action.

Subject to implementation of the proposed mitigation measures, environmental monitoring programme, safety controls, waste-management procedures, green-belt development, and emergency-response arrangements, the proposed project is expected to be environmentally manageable at the selected industrial site. The EIA shall include verified project specifications, baseline monitoring reports, site layout, drainage plan, utility balance, hazardous-waste-disposal arrangements, emergency-response plan, stakeholder-consultation record, and all required NOCs/approvals as annexures.

CHAPTER 1

INTRODUCTION

1.1 General Introduction

Multan Chemicals Limited (MCL) proposes to establish and operate a **240 Tons Per Day (TPD) Cryogenic Air Separation Unit (ASU)** for the production of oxygen, nitrogen, and argon at Plot No. 57C, Allama Iqbal Industrial City (AIIC), Sahianwala, Faisalabad, Punjab.

The proposed facility will produce industrial and medical gases by separating atmospheric air through a cryogenic air-separation process. The plant will use atmospheric air as its principal feedstock. Air will be filtered, compressed, cooled, purified, liquefied at cryogenic temperatures, and separated through fractional distillation into high-purity oxygen, nitrogen, and argon. The principal products will be stored in cryogenic storage tanks and dispatched through bulk tankers, ISO containers, cylinder-filling arrangements, and, where commercially feasible, pipeline supply to industrial customers.

The project is intended to enhance the availability of medical and industrial gases for hospitals, healthcare facilities, steel and metal-fabrication units, welding operations, glass and chemical industries, food-processing facilities, pharmaceutical units, construction activities, and other industrial consumers. The project will also support regional industrial development by providing a reliable supply of oxygen, nitrogen, and argon from a centrally located industrial site in Faisalabad.

The proposed project site is located within Allama Iqbal Industrial City, a planned industrial area and Special Economic Zone developed by Faisalabad Industrial Estate Development and Management Company (FIEDMC). The site is designated for industrial use and has been provisionally allotted to Multan Chemicals Limited for establishment of an air-separation unit for the manufacture of oxygen, nitrogen, argon, and associated by-products.

This Environmental Impact Assessment (EIA) has been prepared to identify, evaluate, and manage the potential environmental, occupational-health, safety, and socioeconomic impacts associated with the construction, installation, commissioning, operation, maintenance, and eventual decommissioning of the proposed facility.

1.2 Project Proponent

The project proponent is Mr. Tariq Mahmood Khan Babar, a Pakistani company engaged in the production, supply, distribution, and marketing of industrial and medical gases. MCL has experience in air-separation and gas-filling operations and maintains a network for supply of oxygen, nitrogen, argon, and related products to industrial and healthcare users.

According to the available company information, MCL has existing production facilities in Multan and Faisalabad and a distribution network comprising company-operated filling stations and distribution partners. The proposed ASU is planned as an expansion of the company's capacity to meet increasing demand for industrial and medical gases in Punjab and other regions of Pakistan.

Table 1.1: Proponent Information

Particular	Details
Proponent	Mr. Tariq Mahmood Khan Babar
Corporate / registered office	4-C-II, Industrial Estate, Multan, Pakistan
Project site	Plot No. 57C, Allama Iqbal Industrial City, Sahianwala, Faisalabad
Telephone	041-8900111
Mobile contact	+92 305 555 0120
Email	tbkhan@mcl-gases.com
Nature of business	Manufacture and supply of industrial and medical gases
Proposed activity	Cryogenic Air Separation Unit for oxygen, nitrogen, and argon production

1.3 Background and Need for Project

Oxygen, nitrogen, and argon are essential gases used in Pakistan's healthcare, industrial, manufacturing, construction, energy, food-processing, and engineering sectors. Medical oxygen is required for patient treatment, emergency care, surgical facilities, intensive-care units, ambulances, and hospital medical-gas systems. Industrial oxygen is widely used in cutting, welding, fabrication, steel processing, metal treatment, glass manufacture, chemical oxidation, wastewater treatment, and various combustion-support applications.

Nitrogen is used for inerting, blanketing, purging, pressure testing, food preservation, freezing, packaging, laboratory applications, and process safety. Argon is used primarily as an inert shielding gas in welding, metal fabrication, metallurgy, laboratories, and specialized industrial operations.

Multan Chemicals Limited proposes the new ASU to increase its production capacity and improve the reliability of regional supply. The company intends to expand its ability to serve industrial, healthcare, and institutional customers. The proposed facility is expected to support supply to Central Punjab, South Punjab, and other regions through bulk distribution and cylinder-filling arrangements.

The project is expected to offer the following benefits:

- Increased local and regional availability of high-purity oxygen, nitrogen, and argon.
- Improved reliability of supply for healthcare facilities and industrial users.
- Reduced dependence on long-distance transportation of liquid gases from distant production facilities.
- Support for manufacturing, fabrication, construction, chemical, food-processing, pharmaceutical, and healthcare sectors.
- Employment opportunities during construction, commissioning, operation, logistics, maintenance, administration, and support services.
- Local procurement and indirect economic activity.
- Development of industrial infrastructure within AIIC.
- Potential reduction in supply-chain delays during periods of increased medical or industrial demand.

1.4 Project Location

The proposed project will be established at **Plot No. 57C, Allama Iqbal Industrial City (AIIC), Sahianwala, Faisalabad, Punjab**. AIIC is a planned industrial development and Special Economic Zone under the administration of FIEDMC.

The project site is accessible through AIIC's internal road network and is linked with the Sahianwala Interchange and M-4 Motorway. The proposed location is suitable for an industrial gas facility because it is situated in an approved industrial area and provides access to regional road networks for transportation of cryogenic products and gas cylinders.

The FIEDMC provisional allotment letter confirms allotment of an industrial plot measuring approximately 12.65 acres to Multan Chemicals Limited for establishment of an air separation unit for manufacturing oxygen, nitrogen, argon, and related by-products.

Table 1.2: Site Particulars

Parameter	Details
Plot number	57C
Industrial estate	Allama Iqbal Industrial City (AIIC)
Location	Sahianwala, Faisalabad, Punjab
Land-use status	Industrial / SEZ industrial plot
Plot area	12.65 acres
Plot area in square metres	Approximately 51,194 m²
Plot area in square feet	Approximately 455,360 ft²
Plot shape	Slightly trapezoidal
Accessibility	AIIC internal road network, Sahianwala Interchange, and M-4 Motorway
Current status	Vacant / under development, subject to confirmation at the time of field survey
Project cost	Approximately PKR 3.4 billion

Table 1.3: Project Site Coordinates

Point	Location	Easting	Northing
P-1	North-West corner	1,077,631.106	11,498,082.661
P-2	South-West corner	1,077,651.412	11,497,715.674
P-3	North-East corner	1,078,900.707	11,498,152.717
P-4	South-East corner	1,078,855.769	11,497,782.130
Site centroid	Approximate plant centre	1,078,259.749	11,497,933.296

The project provide an approximate geographic reference for the site centroid of **31°26′15″ North latitude and 73°08′20″ East longitude**.

1.5 Project Overview

The project involves installation of a cryogenic ASU with a planned capacity of 240 TPD. The facility will separate atmospheric air into oxygen, nitrogen, and argon. The project will include process equipment, utility systems, cryogenic storage tanks, product pumps, vaporizers, filling facilities, dispatch area, electrical systems, cooling-water system, workshop, administrative facilities, drainage, firefighting equipment, safety systems, internal roads, green belt, and rainwater-management infrastructure.

The principal project components are expected to include:

- Ambient air-intake and filtration system.

- Main air compressor and associated compressor auxiliaries.
- Air pre-cooling and after-cooling system.
- Air purification system using activated alumina and molecular sieve adsorbers.
- Main cryogenic heat exchanger.
- High-pressure and low-pressure distillation columns within the cold box.
- Argon recovery and purification system.
- Booster turbo-expander for refrigeration and energy recovery.
- Liquid oxygen, liquid nitrogen, and liquid argon storage tanks.
- Cryogenic liquid pumps, vaporizers, piping, manifolds, and filling systems.
- Cylinder-filling and tanker-loading facilities.
- Main electrical system, transformer, control room, instrumentation, and automation system.
- Standby diesel generator for essential safety and emergency loads.
- Closed-loop cooling-water system.
- Domestic wastewater-management facilities.
- Stormwater drainage and rainwater-harvesting infrastructure.
- Firewater storage, fire hydrants, fire pumps, extinguishers, and emergency equipment.
- Waste-storage area for general, recyclable, and hazardous waste.
- Workshop, mechanical store, electrical store, office, guard room, and staff facilities.
- Green belt and plantation area.

Table 1.4: Key Project Information

Particular	Proposed information
Project title	Proposed 240 TPD Cryogenic Air Separation Unit for Oxygen, Nitrogen and Argon Production
Proponent	Mr. Tariq Mahmood Khan Babar
Project site	Plot No. 57C, AIIC, Sahianwala, Faisalabad
Total land area	12.65 acres / approximately 51,194 m²
Total estimated project cost	Approximately PKR 3.4 billion
Technology	Cryogenic air separation through fractional distillation
Main feedstock	Atmospheric air
Main products	Oxygen, nitrogen, and argon
Plant capacity	240 TPD
Operating pattern	Continuous operation, subject to planned maintenance shutdowns

Proposed power requirement	Approximately 7.3 MW continuous demand
Proposed backup power	Approximately 1,000 kVA DG set for essential systems
Proposed water requirement	Approximately 35 KLD fresh-water demand
On-Site Solar Power Generation	5 MW Solar PV System integrated for green energy generation, carbon footprint reduction, and operational cost optimization.
Cooling system	Closed-loop cooling-water system
Construction period	Approximately 12–14 months
Construction workforce	Approximately 150–180 workers
Operational workforce	Technical, operational, safety, maintenance, administrative, logistics, and support staff

1.6 Production Capacity and Products

The proposed ASU has been described as a 240 TPD facility. The project indicate that the facility will produce oxygen as the principal product, with nitrogen and argon as co-products.

The business plan indicates full-capacity annual production of approximately 62,700 tonnes of oxygen, 6,300 tonnes of nitrogen, 2,700 tonnes of argon, and 900 tonnes of ultra-pure oxygen, with a combined annual output of approximately 72,600 tonnes.

Table 1.5: Proposed Products and Annual Production

Product	Proposed annual production at full capacity	Typical form of supply
Oxygen	62,700 tonnes/year	Liquid oxygen and gaseous oxygen
Nitrogen	6,300 tonnes/year	Liquid nitrogen and gaseous nitrogen
Argon	2,700 tonnes/year	Liquid argon and gaseous argon
Ultra-Pure Oxygen	900 tonnes/year	High-purity liquid/gaseous oxygen
Total output	72,600 tonnes/year	Liquid and gaseous industrial/medical gases

The following information before submission:

- Whether **240 TPD** represents total combined product output or oxygen-only capacity.

- The guaranteed daily capacity of liquid oxygen, gaseous oxygen, Ultra-Pure Oxygen, liquid nitrogen, gaseous nitrogen, and argon.
- Product purity specifications.
- Storage-tank capacities and number of tanks.
- Number and capacity of filling pumps, vaporizers, cylinders, tankers, and ISO containers.
- Annual operating days and expected annual production.
- Market distribution areas and expected daily tanker/cylinder movements.

1.7 Process Description

The proposed project will use low-temperature cryogenic air-separation technology. This is a physical separation process in which atmospheric air is separated into its main components based on different boiling points.

The general process is described below.

1.7.1 Air Intake and Filtration

Ambient air will be drawn into the plant through an air-intake system equipped with suitable filters. The filters will remove dust, suspended particles, and other solid contaminants before compression.

1.7.2 Air Compression

Filtered ambient air will be compressed using a main air compressor. Compression increases the pressure of the air stream and generates heat; therefore, after-cooling and inter-cooling arrangements will be provided to reduce the air temperature before further processing.

1.7.3 Air Pre-Cooling and Purification

The compressed air will pass through a pre-cooling arrangement and then through adsorption-based purification equipment. Activated alumina and molecular sieves will remove moisture, carbon dioxide, and trace hydrocarbons. Removal of these impurities is necessary to avoid freezing, blockage, contamination, and operational problems in downstream cryogenic equipment.

1.7.4 Cryogenic Cooling

Purified air will enter the main cryogenic heat exchanger, where it will be cooled to very low temperature through heat exchange with returning cold product streams. The air will be cooled sufficiently to enable liquefaction and separation.

1.7.5 Fractional Distillation

The cryogenically cooled air will enter a distillation-column arrangement, generally comprising high-pressure and low-pressure columns. Separation occurs because the main components of air have different boiling points:

- Nitrogen has a lower boiling point and concentrates toward the upper part of the column.
- Oxygen has a higher boiling point and concentrates toward the lower part of the column.
- Argon is recovered from an intermediate argon-rich stream through a dedicated recovery and purification system.

1.7.6 Refrigeration and Energy Recovery

A booster turbo-expander will provide additional refrigeration required for cryogenic separation. The turbo-expander also contributes to energy efficiency by recovering energy from the expanding process stream.

1.7.7 Product Storage, Filling and Dispatch

Liquid oxygen, liquid nitrogen, and liquid argon will be transferred to vacuum-insulated cryogenic storage tanks. From these tanks, products will be filled into bulk tankers, ISO containers, and/or high-pressure cylinders. Gaseous products may also be supplied through vaporizers, manifolds, or pipelines to customers where appropriate.

The proposed process is based on physical separation of air and is not a conventional chemical-reaction process. However, the plant will require robust management of high-energy electrical equipment, compressor noise, cooling water, cryogenic liquids, high-pressure systems, oxygen-enriched atmospheres, nitrogen-related oxygen-deficiency hazards, waste, traffic, and emergency preparedness.

1.8 Resource Requirements

1.8.1 Land Requirement

The project will be developed on a 12.65-acre plot. The land will accommodate the core ASU equipment, product-storage tanks, filling and dispatch facilities, utility systems, offices, workshops, internal roads, firefighting facilities, drainage infrastructure, rainwater-harvesting structures, and green-belt area.

The portion of the plot will be reserved for process equipment, storage/filling facilities, administration and safety infrastructure, roads, open space, and green-belt development. The final layout shall confirm land-use allocation, building coverage, setbacks, storage separation distances, emergency access routes, and green-belt area.

1.8.2 Electricity Requirement

The ASU will be electricity intensive because power is required for air compression, refrigeration, cooling-water pumps, process-control systems, lighting, filling equipment, and other auxiliaries.

The project information refers to approximately 5.2 MW of continuous power requirement, with a dedicated 11 kV feeder and approximately 6 MVA transformer arrangement. Another section refers to a higher connected load. A diesel generator is proposed for essential safety, emergency, and critical loads during grid interruption. Diesel use is expected to be limited to emergency or standby operation, subject to final operating arrangements.

1.8.3 Water Requirement

Water will be required mainly for cooling-system make-up, domestic use, equipment cleaning where necessary, firefighting-system testing, and green-belt irrigation. The freshwater requirement of approximately 35 KLD, comprising approximately 28 KLD for cooling-tower make-up and 7 KLD for domestic uses. The ASU will use a closed-loop cooling-water system, while the internal circulating-water flow is substantially higher than make-up demand.

The detailed water balance clearly identifying:

- Source of water.
- Freshwater requirement.
- Circulating cooling-water flow.
- Cooling-tower make-up.
- Blowdown quantity.
- Domestic water consumption.
- Domestic sewage generation.
- Treated-water reuse.
- Rainwater-harvesting/recharge quantity.
- Firewater requirement.
- Final wastewater-disposal arrangement.

1.8.4 Fuel Requirement

The ASU does not require furnace oil, coal, or process fuel for gas separation. Limited high-speed diesel may be required for the standby DG set during power interruption, periodic testing, or emergency operation.

1.8.5 Human Resource Requirement

The project will require technical and support personnel during construction and operation. Approximately 150–180 construction workers and operational employment in engineering, production, quality control, maintenance, HSE, administration, security, logistics, cylinder handling, and related support functions.

MCL shall provide safe worker accommodation arrangements where applicable, potable water, sanitation facilities, first aid, PPE, training, emergency communication, grievance mechanisms, and compliance with applicable labour and occupational health and safety requirements.

1.9 Environmental and Safety Considerations

The proposed ASU is expected to have limited direct process emissions because the process separates ambient air and does not involve routine process combustion or a conventional chemical reaction. However, environmental and safety impacts can arise during project construction and operation.

The principal environmental and occupational health and safety issues expected to require management include:

- Fugitive dust, vehicle emissions, noise, vibration, construction waste, and worker safety during construction.
- Operational noise and vibration from main air compressors, booster compressors, pumps, cooling towers, blow-off points, DG set, and filling operations.
- High electricity consumption and associated indirect greenhouse-gas emissions.
- Freshwater consumption for cooling-system make-up and domestic use.
- Cooling-tower drift, chemical dosing, blowdown, and wastewater management.
- Domestic sewage management.
- Stormwater management and prevention of runoff contamination.
- Used oil, oil filters, oily rags, contaminated absorbents, spent filters, spent adsorbent, scrap, packaging waste, and general solid waste.
- High-pressure equipment, pressurized pipelines, and pressure-relief systems.
- Cryogenic burns and frostbite due to exposure to liquid oxygen, liquid nitrogen, and liquid argon.
- Oxygen-enriched atmospheres that can intensify combustion and fire.
- Oxygen-deficient atmospheres due to nitrogen release in confined or poorly ventilated areas.
- Product leakage, tanker incidents, cylinder-handling hazards, and transport safety.
- Fire protection, emergency access, emergency isolation, alarm systems, evacuation arrangements, and coordination with relevant emergency-response agencies.

- Need for a green belt, water conservation, rainwater harvesting, environmental monitoring, and stakeholder communication.

The EIA evaluates these impacts and prescribes mitigation measures, monitoring requirements, institutional responsibilities, and emergency-response arrangements to ensure that the project is developed and operated in an environmentally sound and safe manner.

1.10 Regulatory Requirement for EIA

The proposed project is being processed as an EIA-level project under the applicable environmental-approval framework in Punjab. The facility under **Schedule II, Category B, Serial No. 2 Chemical Manufacturing Units**, requiring preparation of an Environmental Impact Assessment and environmental approval before commencement of construction activities.

The project shall comply with all applicable environmental, occupational health and safety, fire-safety, building, labour, industrial-estate, utility, storage, transport, waste-management, and emergency-response requirements. The final EIA shall include an updated and verified legal and administrative framework, including relevant provisions of:

- Punjab environmental legislation and applicable IEE/EIA review regulations.
- Applicable Punjab Environmental Quality Standards.
- FIEDMC / AIIC land-use, building-control, utility, drainage, and environmental requirements.
- Applicable requirements for storage, filling, transport, and handling of compressed and cryogenic gases.
- Applicable fire-safety and civil-defence requirements.
- Applicable labour, occupational health, and worker-safety requirements.
- Requirements relating to hazardous waste, used oil, wastewater, stormwater, and solid-waste management.
- Relevant approvals, no-objection certificates, licences, and third-party inspection/certification requirements.

No construction activity shall commence until environmental approval and other applicable statutory approvals have been obtained.

1.11 Objectives of the EIA Study

The key objectives of this Environmental Impact Assessment are:

1. To describe the proposed 239 TPD Cryogenic Air Separation Unit, including its location, process, capacity, utility requirements, storage facilities, support infrastructure, and operational activities.
2. To establish the existing physical, biological, socioeconomic, land-use, transport, and environmental conditions within the defined study area.
3. To identify and evaluate potential positive and negative impacts during pre-construction, construction, commissioning, operation, maintenance, emergency conditions, and decommissioning.
4. To assess potential impacts on air quality, noise, water resources, wastewater, soil, drainage, ecology, occupational health, community safety, traffic, waste management, energy consumption, and greenhouse-gas emissions.
5. To identify safety risks associated with high-pressure equipment, cryogenic liquids, oxygen enrichment, oxygen deficiency, fire, leakage, tanker operations, and cylinder filling.
6. To evaluate feasible alternatives related to project site, technology, design, water management, waste management, energy conservation, transport, and environmental safeguards.
7. To undertake stakeholder consultation and incorporate relevant issues, concerns, and suggestions into project design and environmental-management measures.
8. To develop a practical Environmental and Social Management Plan, environmental monitoring plan, occupational health and safety plan, waste-management plan, traffic-management plan, and emergency-response plan.
9. To define institutional responsibilities, training requirements, reporting arrangements, monitoring frequencies, corrective-action procedures, and environmental-management budget.
10. To support Multan Chemicals Limited in obtaining environmental approval and implementing the project in compliance with applicable legal and regulatory requirements.

1.12 Scope of the EIA

The EIA covers the proposed project and associated activities throughout its life cycle. The assessment includes the project footprint, immediate surrounding industrial area, nearby receptors, access roads, relevant product-dispatch routes, and a wider study area for assessment of environmental and socioeconomic context.

The proposed study area comprises:

- **Project footprint:** Plot No. 57C, AIIC, covering 12.65 acres.
- **Immediate influence area:** Project boundary and adjacent industrial plots.
- **Core study area:** Approximately 1 km radius around the project site.
- **General study area:** Approximately 5 km radius around the project site.

- **Transport assessment area:** AIIC internal roads, access roads, Sahianwala Interchange, M-4 connection, and routes to be used for tanker and cylinder dispatch.

The EIA scope includes baseline data collection, stakeholder consultation, alternatives assessment, impact assessment, mitigation planning, environmental monitoring, health and safety assessment, emergency preparedness, and institutional arrangements. The baseline studies and stakeholder consultations are to cover physical, biological, and socioeconomic conditions within the broader project influence area.

1.13 EIA Methodology

The EIA has been prepared using a structured assessment approach comprising the following activities:

1. Review of available project, including project description, business plan, site layout, provisional allotment documents, process information, machinery list, resource requirements, and proposed environmental-management measures.
2. Confirmation of project location, plot dimensions, site coordinates, surrounding land use, access roads, drainage features, industrial infrastructure, and nearby receptors.
3. Collection and review of baseline information relating to climate, topography, geology, soil, groundwater, surface drainage, ambient air quality, noise, ecology, land use, traffic, infrastructure, and socioeconomic conditions.
4. Identification of potential construction, operational, maintenance, transport, and emergency impacts.
5. Assessment of impacts according to their nature, extent, duration, reversibility, probability, receptor sensitivity, and significance.
6. Consideration of site, technology, design, environmental-management, and economic alternatives.
7. Consultation with relevant stakeholders, including the proponent, FIEDMC/AIIC management, nearby industrial units, workers, community representatives, relevant government departments, and other interested parties.
8. Development of mitigation measures following the hierarchy of avoidance, minimization, control, restoration, and monitoring.
9. Preparation of an Environmental and Social Management Plan, Environmental Monitoring Plan, occupational health and safety measures, waste-management procedures, traffic-management measures, and emergency-response arrangements.
10. Identification of approvals, permits, licences, monitoring records, training requirements, inspection systems, and institutional responsibilities necessary for compliance.

1.14 EIA Report Structure

The EIA report is organized in the following chapters:

Chapter	Title	Main contents
Executive Summary	Project overview	Summary of project, impacts, mitigation, monitoring, and key commitments
Chapter 1	Introduction	Project background, proponent details, location, rationale, objectives, scope, and methodology
Chapter 2	Screening, Scoping and Analysis of Alternatives	EIA requirement, study boundaries, consultation issues, significant impacts, and alternatives
Chapter 3	Project Description	Detailed process, machinery, layout, utilities, materials, water balance, wastes, storage, transport, and implementation schedule
Chapter 4	Description of Existing Environment	Physical, biological, socioeconomic, land-use, traffic, environmental-quality, and receptor baseline
Chapter 5	Stakeholder Consultation and Public Participation	Consultation methodology, stakeholder concerns, public hearing, responses, and grievance mechanism
Chapter 6	Impact Assessment and Mitigation Measures	Construction, operation, transport, health and safety, cumulative, and emergency impacts with mitigation measures
Chapter 7	Environmental Monitoring Plan	Monitoring locations, parameters, frequency, standards, reporting, and corrective actions
Chapter 8	Conclusion and Commitments	Overall environmental acceptability, commitments, conditions, and recommendations
Annexures	Supporting documents	Maps, layout plans, laboratory reports, consultation evidence, approvals, certificates, calculations, and technical documents

1.15 Conclusion

Multan Chemicals Limited proposes to establish a 240 TPD Cryogenic Air Separation Unit at Plot No. 57C, Allama Iqbal Industrial City, Sahianwala, Faisalabad. The proposed facility will produce oxygen, nitrogen, and argon from atmospheric air through cryogenic fractional distillation and will support industrial and medical-gas supply requirements.

The project is planned within a designated industrial location and is expected to provide economic and supply-chain benefits. At the same time, the project requires detailed environmental and safety management because of compressor noise, electricity consumption, cooling-water demand, wastewater and stormwater management, waste generation, cryogenic-fluid handling, oxygen-enrichment hazards, oxygen-deficiency hazards, tanker movement, and emergency-response requirements.

This EIA has therefore been undertaken to ensure that all relevant impacts are assessed, that avoidance and mitigation measures are integrated into project design, and that the project is implemented only after obtaining environmental approval and other applicable statutory permissions.

CHAPTER 2

SCREENING, SCOPING AND ANALYSIS OF ALTERNATIVES

2.1 Introduction

This chapter presents the environmental screening, scoping, and alternatives assessment for the proposed **240 TPD Cryogenic Air Separation Unit (ASU) for production of oxygen, nitrogen, and argon** by Multan Chemicals Limited (MCL) at Plot No. 57C, Allama Iqbal Industrial City (AIIC), Sahianwala, Faisalabad.

The purpose of this chapter is to:

- Determine whether the proposed project requires an Initial Environmental Examination (IEE) or an Environmental Impact Assessment (EIA).
- Define the spatial and temporal boundaries of the environmental assessment.
- Identify the key environmental, occupational health and safety, and community concerns raised during initial consultation.
- Identify the significant impacts and environmental factors requiring detailed assessment.
- Review feasible site, technology/design, environmental-management, and economic alternatives.
- Explain the basis for selection of the proposed project site, cryogenic air-separation technology, and environmental-control measures.

The project involves installation and operation of a cryogenic air separation facility on a 12.65-acre industrial plot. Atmospheric air will be filtered, compressed, purified, cooled to cryogenic temperature, and separated through fractional distillation into oxygen, nitrogen, and argon. The project is proposed within AIIC, a designated industrial and Special Economic Zone developed by Faisalabad Industrial Estate Development and Management Company (FIEDMC).

2.2 Environmental Screening

2.2.1 Purpose of Screening

Environmental screening is the first step in the EIA process. It determines the level of environmental study required for a proposed project by considering its type, scale, location, resource requirements, potential emissions, waste streams, occupational hazards, transport requirements, and likely interaction with surrounding environmental and social receptors.

The proposed project is an industrial gas-production facility based on cryogenic air-separation technology. Although the process does not involve a conventional chemical reaction or routine process combustion, it includes high-capacity compressors, cryogenic storage systems, oxygen and nitrogen handling, standby power generation, cooling-water systems, industrial-gas filling and dispatch, and heavy-vehicle movement. Accordingly, the project has potentially significant environmental and safety considerations that require comprehensive assessment and management.

2.2.2 Project Category

The project comprises establishment of a **240 TPD Cryogenic Air Separation Unit** for the production of oxygen, nitrogen, and argon. The EIA categorizes the project under **Schedule II, Category B, Serial No. 2 Chemical Manufacturing Units**, for which preparation of a detailed Environmental Impact Assessment and obtaining environmental approval prior to commencement of construction are stated as mandatory.

The project is therefore being assessed as an **EIA-level project**, rather than an IEE-level project, due to the following considerations:

- The proposed facility is a substantial industrial installation with a reported project cost of approximately PKR 3.4 billion.
- The project will be established on 12.65 acres of land within AIIC.
- The ASU has a planned production capacity of 240 TPD and will produce oxygen, nitrogen, and argon through energy-intensive cryogenic processing.
- The project requires high-capacity air compression, refrigeration, cooling-water circulation, electrical infrastructure, storage vessels, gas-filling arrangements, and cryogenic-product dispatch.
- Liquid oxygen, liquid nitrogen, liquid argon, gaseous oxygen, and high-pressure cylinders require specialized safety management because of their cryogenic, oxygen-enrichment, pressure, fire-escalation, and oxygen-deficiency hazards.
- The project may generate localized impacts related to construction dust, noise, vibration, wastewater, cooling-tower blowdown, standby generator emissions, solid waste, hazardous maintenance waste, rainwater runoff, traffic, and tanker dispatch.
- The project requires assessment of potential impacts on nearby industrial workers, visitors, road users, communities, infrastructure, groundwater resources, air quality, and the broader AIIC environment.
- The proposed activity requires a detailed Environmental Management Plan, monitoring programme, occupational health and safety system, emergency-response plan, and consultation process.

2.2.3 Screening Conclusion

Based on the nature, scale, location, and potential environmental and safety implications of the proposed activity, the project requires a **full Environmental Impact Assessment (EIA)** for submission to the Punjab Environmental Protection Agency prior to construction and commissioning.

The EIA shall address the complete project life cycle, including pre-construction planning, construction, installation, commissioning, normal operation, maintenance, emergency conditions, transport and dispatch activities, and eventual decommissioning.

Table 2.1: Environmental Screening Summary

Screening parameter	Project characteristic	Screening outcome
Project type	Cryogenic air separation and industrial/medical gas-production facility	Industrial project requiring formal environmental review
Production capacity	240 TPD ASU for oxygen, nitrogen, and argon	Large-scale industrial installation
Land requirement	12.65 acres / approximately 51,194 m²	Requires assessment of land use, drainage, green belt, traffic, and safety layout
Project location	Plot No. 57C, AIIC, Sahianwala, Faisalabad	Located in designated industrial area; site-specific and cumulative impacts still require assessment
Major equipment	Air compressor, purification unit, cold box, distillation columns, turbo-expander, cryogenic tanks, filling pumps, vaporizers, electrical system, DG set, cooling-water system	Potential noise, energy, water, safety, and maintenance-waste impacts
Main environmental aspects	Construction dust, noise, vibration, electricity demand, cooling-water use, wastewater, DG emissions, waste generation, stormwater, traffic, and green belt	Requires detailed impact identification and mitigation
Main safety aspects	Cryogenic burns, oxygen enrichment, oxygen deficiency, pressure release, fire escalation, tanker/cylinder safety	Detailed HSE and emergency-response assessment required
Regulatory classification in project draft	Schedule II, Category B, Serial No. 2 — Chemical Manufacturing Unit	Full EIA required
Screening decision	EIA	EIA to be submitted for environmental approval before construction

2.3 Scoping of Environmental Assessment

2.3.1 Purpose of Scoping

Scoping identifies the environmental and social issues that are likely to be material for decision-making and therefore require detailed assessment in the EIA. It ensures that the assessment concentrates on the project components, receptors, risks, and mitigation measures that may have meaningful environmental consequences.

For the proposed ASU, scoping was undertaken through review of available project documents, layout information, process description, utility requirements, proposed environmental-management measures, site context, and initial stakeholder concerns. The primary environmental focus areas as compressor noise, electricity consumption, cooling-water management, maintenance waste, cryogenic-product storage and filling, oxygen-enrichment hazards, oxygen-deficiency hazards, emergency preparedness, and traffic associated with product dispatch.

2.3.2 Spatial Boundaries

The spatial boundaries of the EIA have been defined according to the type of impact being evaluated. Different environmental aspects have different zones of influence; therefore, one uniform boundary is not appropriate for all topics.

Table 2.2: Spatial Boundaries of Environmental Assessment

Assessment area	Proposed spatial boundary	Environmental issues covered
Project footprint	Entire Plot No. 57C, covering 12.65 acres / approximately 51,194 m²	Plant layout, buildings, compressor area, cold box, storage tanks, filling sheds, utilities, workshop, waste-storage area, drainage, rainwater harvesting, green belt, internal roads, firefighting system, and emergency access
Immediate influence area	Project boundary and adjacent industrial plots within approximately 500 m	Construction dust, construction noise, operational noise, local traffic, stormwater drainage, visual effects, occupational and community safety interface
Core study area	Approximately 1 km radius around the project site	Ambient air quality, noise, land use, local drainage, ecological features, nearby industrial units, roads, labour facilities, and nearby settlements/receptors
General study area	Approximately 5 km radius around the project site	Broader land use, socioeconomic setting, transport routes, groundwater and drainage context, sensitive receptors, cumulative industrial-development context, and emergency-response linkages
Transport corridor	Internal AIIC roads, access routes to Sahianwala Interchange, M-4 Motorway connections, and product-dispatch routes to be finalized by MCL	Tanker and cylinder-truck movements, traffic safety, road-condition impacts, emissions, accident risk, and emergency response

The project define a **1 km core zone** and **5 km buffer zone** for the EIA study. The project plot is situated inside AIIC, where surrounding land use is predominantly industrial or designated for industrial development. The FIEDMC provisional allotment letter confirms that Plot No. 57C, measuring approximately 12.65 acres, has been allotted to MCL for establishment of an air separation unit for production of oxygen, nitrogen, argon, and by-products.

2.3.3 Temporal Boundaries

The temporal boundary of the assessment covers the complete project cycle. The duration of the construction phase is stated as approximately 12–14 months, whereas commercial operations will be continuous, subject to planned maintenance shutdowns. The EIA shall harmonize the final construction schedule, commissioning schedule, and operational design life using the approved project implementation plan.

Table 2.3: Temporal Boundaries of Environmental Assessment

Project phase	Indicative time period	Environmental matters assessed
Pre-construction	From environmental approval until commencement of civil works	Finalization of layout, permits, detailed design, utility approvals, contractor selection, environmental and safety plans, baseline confirmation, community communication, and procurement
Construction	Approximately 12–14 months, subject to final project schedule	Land preparation, excavation, foundations, structural works, equipment installation, dust, noise, construction traffic, waste, worker welfare, stormwater, occupational health and safety
Commissioning	Following mechanical completion and before full commercial operation	System testing, pressure testing, trial runs, equipment calibration, safety-system testing, noise verification, oxygen-monitor testing, emergency drills, and environmental compliance verification
Operational phase	Continuous operation, expected 24 hours/day with scheduled maintenance shutdowns	Electricity consumption, compressor noise, cooling-water use, DG operation, wastewater, waste management, cryogenic storage, cylinder filling, tanker movement, emergency readiness, monitoring and reporting
Maintenance and shutdowns	Periodic and planned throughout operation	Equipment inspection, adsorbent replacement, used oil and filter waste, confined-space hazards, repairs, cleaning, isolation, and temporary emissions/noise
Decommissioning or major modification	At end of plant life or during future expansion/modification	Equipment removal, disposal of refrigerants/chemicals if any, waste handling, contaminated-material assessment, land restoration, and separate environmental review for major changes

2.3.4 Consultation Issues and Concerns

Initial consultation and stakeholder interaction included focus group discussions and key informant interactions with stakeholders associated with AIIC, nearby communities, and relevant institutions. The principal concerns as employment opportunities, noise, water use, operational safety, and traffic movements.

The public hearing will be conducted in accordance with the applicable environmental-approval process and instructions of the Punjab Environmental Protection Agency. The consultation process shall continue throughout EIA review, construction, and operation, especially where concerns are received from adjacent industries, road users, workers, or neighbouring communities.

Table 2.4: Key Consultation Issues and Proposed EIA Response

Stakeholder concern	Main issue raised	EIA response and proposed commitment
Local employment	Nearby residents and workers may expect employment opportunities during construction and operation	Preference shall be given to suitably qualified local labour and technical personnel, subject to merit, skill requirements, and company recruitment procedures
Noise from compressors and machinery	Concern regarding high noise from main air compressor, auxiliary equipment, DG set, and construction activity	Acoustic enclosure, silencers, vibration isolators, preventive maintenance, PPE, boundary-wall monitoring, and compliance with applicable noise standards
Water consumption	Concern regarding demand on local water resources and potential wastewater discharge	Closed-loop cooling arrangement, water-conservation measures, rainwater harvesting, water metering, final water balance, controlled blowdown, and approved wastewater-treatment/disposal arrangement
Safety of oxygen and cryogenic products	Concern regarding oxygen leaks, fire escalation, cryogenic burns, high-pressure systems, and tanker safety	Approved design, emergency shut-off valves, oxygen monitoring, ventilation, firefighting system, safe separation distances, exclusion of oil/grease, training, drills, emergency-response plan, and coordination with relevant emergency services
Traffic and tanker movement	Concern regarding congestion, road accidents, access obstruction, and movement of cryogenic tankers/cylinders	Traffic-management plan, approved dispatch routes, vehicle fitness checks, trained drivers, controlled loading, speed limits, tanker emergency information, and scheduling of heavy-vehicle movement where feasible
Dust and construction disturbance	Concern regarding dust, construction noise, debris, and temporary road impacts	Water sprinkling, covered trucks, housekeeping, controlled storage of material, waste removal, speed control, designated routes, and restricted work hours where required

Waste handling	Concern about used oil, filters, oily rags, packaging waste, spent adsorbents, and domestic waste	Segregation, labelled storage, impermeable floor and secondary containment, waste inventory, recycling where practicable, and disposal through authorized channels
Green belt and visual environment	Expectation of plantation and better site appearance	Development of green belt and plantation in accordance with approved layout and estate requirements; survival monitoring and replacement planting
Community information	Need for a mechanism to communicate concerns and receive project information	Establishment of a grievance/contact mechanism during construction and operation; maintenance of complaint register and documented response procedure

2.3.5 Significant Impacts and Factors Requiring Assessment

The environmental scoping exercise has identified the following issues as significant or potentially significant. These topics require detailed assessment in subsequent chapters of the EIA and shall be addressed through the Environmental Management Plan, monitoring programme, and emergency-response arrangements.

Table 2.5: Significant Environmental and Social Issues

Environmental aspect	Potential impact or issue	Significance at scoping stage	Assessment requirement
Land use and site development	Conversion of vacant industrial plot into ASU, storage, filling, support buildings, roads, utilities, and green belt	Moderate	Confirm compatibility with AIIC land-use plan, approved layout, coverage, setbacks, drainage, emergency access, and green area
Construction dust	Fugitive particulate emissions from excavation, material handling, concrete works, vehicle movement, and construction activities	Moderate and temporary	Assess receptor locations, construction methods, control measures, monitoring, and contractor obligations

Construction noise and vibration	Noise from civil works, piling if required, equipment installation, generators, cranes, and transport	Moderate and temporary	Identify work schedule, sensitive receptors, equipment controls, PPE, and monitoring
Operational noise	Noise from main air compressor, booster compressor, pumps, cooling tower, blow-off/venting points, DG set, and filling operations	Potentially high without controls	Conduct noise assessment; incorporate acoustic design, silencers, vibration control, enclosures, and boundary monitoring
Ambient air quality	Dust during construction; vehicle emissions; intermittent DG emissions; possible venting during operational upsets	Low to moderate with controls	Establish baseline, assess DG stack and vehicle emissions, maintain equipment, and monitor as required
Electricity consumption and indirect GHG emissions	High electricity demand for compression and refrigeration	High resource-consumption aspect	Establish verified electrical load, energy baseline, specific energy consumption, efficiency measures, and renewable-energy potential
Water consumption	Cooling-water make-up, domestic use, equipment cleaning, firewater testing, and plantation demand	Moderate	Prepare final water balance, source approval, metering, water-conservation measures, rainwater harvesting, and reuse plan
Cooling-water blowdown and domestic sewage	Potential water contamination if discharged untreated or through an unapproved route	Moderate	Confirm final treatment and disposal route; characterize wastewater; ensure applicable effluent/discharge compliance
Stormwater management	Contamination of runoff from workshops, chemical/oil storage, tanker/filling areas, and construction surfaces	Moderate	Provide separate clean/contaminated drainage, oil-and-grit separation, rainwater harvesting, and controlled discharge

Solid waste	Construction debris, packaging, scrap metal, domestic waste, damaged insulation, and maintenance waste	Low to moderate	Implement waste segregation, storage, recycling, authorized disposal, and record keeping
Hazardous waste	Used oil, oily rags, oil filters, chemical containers, contaminated absorbents, and potentially spent adsorbent	Moderate	Develop hazardous-waste storage, manifest, contractor, spill-control, and disposal procedure
Cryogenic and compressed-gas hazards	Cryogenic burns, frostbite, pressure release, oxygen enrichment, oxygen deficiency, and equipment failure	High safety significance	Undertake detailed HAZID/HAZOP or equivalent review; prepare emergency plan, operating procedures, alarms, PPE, and training
Oxygen-enrichment/fire risk	Oxygen leaks may increase the intensity and rate of combustion in the presence of ignition sources or combustible/oily materials	High safety significance	Implement oxygen-service cleanliness, no-smoking policy, ignition-source control, leak detection, fire protection, hazardous-area management, and emergency isolation
Nitrogen-release/asphyxiation risk	Nitrogen can displace oxygen in enclosed or poorly ventilated areas	High safety significance	Provide ventilation, oxygen-deficiency monitoring, confined-space procedures, warning signs, SCBA, and rescue arrangements
Tanker and cylinder transport	Road safety, product release, tanker accident, cylinder handling, congestion, and emissions	Moderate to high	Prepare transport safety plan, driver training, vehicle checks, route management, GPS/communication, and emergency response
Occupational health and safety	Noise exposure, slips/trips/falls, electrical hazards, hot work, confined spaces, lifting,	High	Develop comprehensive HSE plan, permit-to-work system, PPE matrix, training, medical arrangements, incident investigation, and audits

	pressure systems, and chemical handling		
Ecology and green cover	Loss of vacant plot/open habitat, landscaping effects, plantation opportunities	Low to moderate	Verify ecology through field survey; retain/provide plantation and green belt
Socioeconomic effects	Temporary and permanent employment, local procurement, improved supply of medical and industrial gases	Beneficial	Assess local employment, skills development, contractor labour management, grievance mechanism, and community engagement
Cumulative impacts	Interaction with other industries and infrastructure within AIIC	Moderate	Review estate-wide drainage, traffic, ambient air, noise, utility demand, waste disposal, and emergency-response capacity

2.3.6 Issues Excluded from Detailed Assessment

The following issues are not expected to be significant at the scoping stage, subject to confirmation through baseline studies, final layout, and detailed engineering:

- Large-scale resettlement or displacement is not anticipated because the project is proposed on an allotted industrial plot within AIIC.
- Significant agricultural-land loss is not anticipated because the project site is within a designated industrial estate.
- Routine process emissions from chemical reaction are not anticipated because the facility separates atmospheric air through cryogenic distillation rather than manufacturing gases through a chemical-reaction process.
- Significant biodiversity impacts are not anticipated within the project footprint, subject to confirmation through ecological baseline survey and review of nearby sensitive habitats.
- Routine combustion emissions are expected to be limited primarily to emergency or standby DG operation, vehicles, and construction equipment, subject to final equipment specifications.

These issues shall nevertheless be reviewed during the EIA to verify that no site-specific concern has been overlooked.

2.4 Consideration of Alternatives

2.4.1 Introduction

Consideration of alternatives is an integral part of the EIA process. It examines whether reasonable alternatives could reduce environmental impacts while still meeting the project's technical, safety, operational, and economic objectives.

For the proposed project, the alternatives assessment considers:

- The **no-project alternative**.
- Alternative sites.
- Alternative design and technology options.
- Alternative environmental-management measures.
- Alternative economic and supply-chain options.

The proposed configuration has been selected because it is intended to provide reliable high-purity oxygen, nitrogen, and argon production at an industrially suitable location with access to roads, utilities, and industrial infrastructure. However, the selected alternative remains conditional on implementation of the mitigation measures, final engineering design, statutory approvals, and verified environmental safeguards identified in this EIA.

2.5 No-Project Alternative

Under the no-project alternative, MCL would not establish the proposed 240 TPD ASU at AIIC. The land would remain vacant or would be available for another permissible industrial or commercial activity.

The no-project alternative would avoid project-specific construction impacts, compressor noise, cooling-water demand, tanker dispatch, and cryogenic-product safety risks. However, it would also result in loss of the anticipated project benefits, including increased supply capacity of medical and industrial gases, potential employment, local industrial development, improved distribution capability, and reduced dependence on long-distance supply from existing plants or external suppliers.

Table 2.6: No-Project Alternative Assessment

Aspect	No-project alternative	Proposed project alternative
Land development	Plot remains undeveloped	Industrial plot is developed for ASU and associated facilities
Environmental impacts	Avoids project-specific construction and operational impacts	Impacts occur but can be controlled through design, EMP, monitoring, and safety systems
Gas supply	No additional oxygen, nitrogen, or argon production capacity from the site	Provides additional production capacity for medical and industrial users
Employment	No project-related construction or operational employment	Creates construction, technical, administrative, logistics, and support employment
Industrial-estate development	Does not contribute to proposed industrial activity at the allotted plot	Supports industrial development within AIIC
Transport and logistics	Continued reliance on existing supply arrangements and potentially longer transport routes	Potentially improves regional supply availability but introduces tanker-dispatch requirements
Overall outcome	Not preferred	Preferred, subject to EIA approval and implementation of all environmental and safety safeguards

The no-project alternative is not preferred because the project is intended to meet growing demand for industrial and medical gases and the selected industrial location is appropriate in principle for such a facility. The project shall proceed only after environmental approval and implementation of the mitigation measures specified in the EIA.

2.6 Site Alternatives

2.6.1 Sites Considered

The project proponent has selected Plot No. 57C, AIIC, Sahianwala, Faisalabad. The site is a 12.65-acre plot within a planned industrial and Special Economic Zone. The available documents confirm provisional allotment of the plot to MCL for establishment of an air-separation unit for manufacturing oxygen, nitrogen, argon, and related by-products.

For EIA purposes, the following broad site alternatives have been considered:

1. **Selected site: Plot No. 57C, AIIC, Sahianwala, Faisalabad.**
2. **Expansion at or near an existing MCL facility.**
3. **Alternative industrial estate or industrial plot in Faisalabad or another city.**
4. **Non-industrial or peri-urban site near residential or agricultural land.**

2.6.2 Site-Selection Criteria

The following criteria were used to assess site alternatives:

- Compatibility with approved land use and zoning.
- Availability of adequately sized industrial land.
- Access to reliable electricity and other utilities.
- Proximity to main roads and suitable tanker routes.
- Sufficient space for safe separation distances, emergency access, storage tanks, compressor area, filling facilities, firefighting infrastructure, drainage, and green belt.
- Distance and buffering from residential areas and sensitive receptors.
- Absence of resettlement or displacement requirements.
- Availability of estate-level infrastructure, including internal roads, drainage, sewerage, and emergency-response linkages.
- Potential for local employment and supply-chain benefits.
- Environmental sensitivity of the site and surrounding area.
- Economic viability, project implementation timeframe, and land-allotment status.

Table 2.7: Comparison of Site Alternatives

Site option	Advantages	Limitations / rejection criteria	Decision
Plot No. 57C, AIIC, Sahianwala, Faisalabad	Located in designated industrial/SEZ area; 12.65-acre plot; access through AIIC roads and M-4/Sahianwala interchange; planned industrial infrastructure; sufficient area for plant, storage, access, drainage, green belt, and safety layout; provisionally allotted to MCL for ASU	Requires detailed confirmation of final utility availability, wastewater route, drainage arrangement, safety distances, nearby receptors, and cumulative impacts	Selected, subject to environmental approval and final engineering safeguards

Expansion at existing MCL facility	May benefit from existing operational experience, staff, and some infrastructure	Potential land constraints, limited ability to provide required separation distances and expansion space, possible existing environmental load, constraints on heavy tanker movement, and possible proximity to developed areas	Not preferred for the proposed new large-capacity facility
Alternative industrial estate	May provide industrial zoning and infrastructure	Would require new land procurement, new utility arrangements, time for approvals, and may be less suitable in terms of transport access, market reach, or site dimensions	Not preferred compared with allotted AIIC plot
Peri-urban or non-industrial site	Potentially lower land cost in some areas	Land-use incompatibility, greater likelihood of community disturbance, agricultural-land conversion, higher exposure of residents, more difficult safety buffering, and more complex permitting	Rejected
Remote site away from markets	Potentially larger land availability	Increased transport distances, tanker emissions, higher logistics cost, delayed medical/industrial supply, and weaker utility or emergency infrastructure	Rejected

The selected site is preferred because it is located in a planned industrial zone, has been allotted specifically for an ASU, provides access to industrial infrastructure and regional transport routes, and offers adequate land area for plant development and environmental/safety controls..

2.6.3 Site-Related Environmental Commitments

Selection of Plot No. 57C is conditional upon the following commitments:

- Finalization of a layout that maintains applicable setbacks, tank separation distances, emergency access, firefighting access, drainage gradients, and green-belt area.
- Verification of the nearby land-use pattern and receptors through a current site survey and map.
- Confirmation of water supply, wastewater treatment/disposal route, stormwater discharge route, and utility approvals.
- Incorporation of a perimeter green belt and internal landscaping in accordance with approved design and estate requirements.
- Avoidance of uncontrolled discharge to open land, drains, or groundwater.
- Adoption of a formal transport-management plan for tanker and cylinder dispatch.

Preparation of a site-specific emergency-response plan coordinated with AIIC/FIEDMC and relevant emergency agencies.

2.7 Design and Technology Alternatives

2.7.1 Technology Options Considered

The core function of the project is production of high-purity oxygen, nitrogen, and argon. The project documents propose a cryogenic ASU using air compression, adsorption purification, cryogenic heat exchange, double-column fractional distillation, turbo-expander refrigeration, cryogenic storage, and product-filling/dispatch systems.

The following technology alternatives were considered:

1. **Cryogenic Air Separation Unit (selected technology).**
2. **Pressure Swing Adsorption (PSA) oxygen-generation plant.**
3. **Vacuum Pressure Swing Adsorption (VPSA) oxygen-generation plant.**
4. **Procurement and distribution-only model using externally supplied liquid gases.**
5. **Smaller decentralized gas-generation units at multiple locations.**

Table 2.8: Comparison of Technology Alternatives

Technology / design option	Description	Advantages	Limitations / rejection criteria	Decision
Cryogenic air separation	Air is compressed, purified, cooled to cryogenic temperature, and separated by fractional distillation; produces oxygen, nitrogen, and argon	Suitable for large-scale continuous production; capable of high-purity products; supports liquid-product storage and bulk distribution; enables recovery of nitrogen and argon; suitable for medical and industrial gas markets	High capital cost; high electricity demand; requires specialized cryogenic equipment, skilled operation, safety systems, and noise controls	Selected
PSA oxygen generation	Oxygen separated from compressed air using adsorbent beds at near-ambient temperature	Lower capital cost at small/moderate scale; relatively simple for on-site gaseous oxygen supply	Generally less suitable for large-scale liquid oxygen production; does not provide integrated high-volume nitrogen and argon recovery; may not meet overall project product and distribution objectives	Not selected
VPSA oxygen generation	Vacuum-assisted adsorption technology for oxygen production	Can be energy efficient for some gaseous oxygen applications; suitable for selected on-site users	Limited suitability for large liquid-product capacity and integrated oxygen/nitrogen/argon production; not aligned with proposed bulk cryogenic-storage and distribution model	Not selected
External procurement and distribution	Purchase liquid gases from third-party producers and distribute through storage/filling facilities	Avoids construction and operation of ASU; lower direct process impacts at project site	Continued dependence on external supply; transport dependency; reduced supply security; limited control over product availability and pricing; does not create local production capacity	Not selected
Multiple smaller decentralized units	Install several small plants near users or markets	May reduce long-distance delivery for some customers	Higher cumulative capital, land, staffing, compliance, and maintenance requirements; dispersed environmental and safety risks; less efficient for integrated co-product recovery	Not selected

2.7.2 Basis for Selection of Cryogenic Technology

Cryogenic air-separation technology has been selected because it is suitable for the proposed production scale and allows integrated recovery of oxygen, nitrogen, and argon in liquid and gaseous forms. It can support cryogenic storage, tanker dispatch, cylinder filling, and potential pipeline supply to industrial users. The process uses atmospheric air as the primary feedstock and does not rely on routine process combustion or chemical reactions to produce the gases.

The selected technology shall incorporate the following design controls:

- High-efficiency inlet air filters and suitable compressor controls.

- Acoustic enclosures, silencers, vibration isolation, and preventive maintenance for compressor-related noise control.
- Air purification through activated alumina/molecular-sieve adsorption to remove moisture, carbon dioxide, and hydrocarbons.
- Automated controls, instrumentation, alarms, and shutdown systems.
- Pressure-relief devices and safe venting arrangements.
- Properly designed cryogenic tanks, piping, filling pumps, vaporizers, and transfer systems.
- Oxygen-compatible materials and oxygen-service cleaning procedures.
- Fixed oxygen-deficiency and oxygen-enrichment monitoring in identified risk areas.
- Fire detection, firefighting system, emergency isolation, earthing, lightning protection, and controlled access.
- Closed-loop cooling-water system with drift control and managed blowdown.
- Energy-efficiency measures, including turbo-expander energy recovery, variable-frequency drives, energy metering, and consideration of solar power for suitable auxiliary loads.
- Adequate drainage, oil/chemical containment, rainwater harvesting, and waste-storage facilities.

2.7.3 Design Alternatives within the Selected Technology

The following internal design alternatives shall be considered and finalized during detailed engineering:

Design aspect	Preferred design approach	Selection rationale
Compressor arrangement	High-efficiency compressor with acoustic enclosure, silencers, anti-vibration mounts, and preventive-maintenance provisions	Reduces operational noise, vibration, energy losses, and worker exposure
Cooling-water system	Closed-loop cooling system with drift eliminators, metering, chemical-control programme, and controlled blowdown	Minimizes freshwater demand, reduces uncontrolled discharge, and supports water conservation
Product storage	Vacuum-insulated cryogenic storage tanks located within a controlled and adequately separated tank farm	Reduces boil-off, provides operational reliability, and improves safety management
Oxygen monitoring	Fixed oxygen sensors with alarms in storage, filling, cold-box, enclosed, and other identified risk areas	Enables early warning of oxygen enrichment or oxygen-deficiency conditions
Wastewater approach	Segregated domestic wastewater, cooling blowdown, clean stormwater, and potentially contaminated runoff systems	Prevents mixing of clean and contaminated flows; facilitates

		treatment, reuse, and compliant disposal
Drainage system	Separate stormwater and wastewater drains with oil-and-grit traps in risk areas	Reduces risk of contamination reaching estate drainage or soil
Fire and emergency systems	Hydrant network, firewater storage/pumps, extinguishers, emergency shut-offs, access routes, signage, emergency assembly areas, and trained response team	Controls consequences of fire, leaks, and operational emergencies
Green belt	Perimeter and internal plantation in accordance with final layout	Provides visual screening, dust interception, microclimate benefits, and improved site aesthetics
Energy management	VFDs, turbo-expander energy recovery, efficient motors, metering, LED lighting, preventive maintenance, and rooftop solar where feasible	Reduces electricity demand and indirect carbon footprint

2.8 Environmental Alternatives

2.8.1 Environmental-Management Options Considered

Environmental alternatives refer to the different methods available to avoid, minimize, control, monitor, or compensate for potential impacts. The preferred environmental alternative is the one that provides the highest practicable level of environmental protection while remaining technically workable and economically feasible.

Table 2.9: Environmental Alternatives and Selection Criteria

Environmental issue	Alternative options considered	Preferred option	Selection / rejection criteria
Construction dust	No dust control; occasional sprinkling; comprehensive dust-management plan	Comprehensive dust-management plan	Preferred due to reduced fugitive dust, improved worker/community protection, and better housekeeping
Compressor noise	No enclosure; partial enclosure; fully engineered acoustic enclosure with silencers and vibration control	Engineered acoustic enclosure with silencers and vibration isolation	Selected because source noise is a principal operational impact and must be controlled before reaching boundary receptors
Cooling-water management	Once-through cooling; open recirculation with limited controls; closed-loop cooling with drift eliminators and monitoring	Closed-loop cooling with drift control and controlled blowdown	Preferred due to lower freshwater demand, reduced wastewater, and better operational control
Wastewater disposal	Direct discharge; septic tank/soakage only; treatment and approved discharge/reuse arrangement	Finalized treatment and approved disposal/reuse system based on detailed design	Direct discharge is unacceptable; final system must comply with applicable standards and estate requirements

Stormwater	Combined drainage; separate drainage without pretreatment; segregated clean/contaminated drainage with oil-and-grit control	Segregated drainage with oil-and-grit control	Preferred to prevent contamination from workshop, storage, filling, or vehicle areas
Hazardous waste	Mixed storage with general waste; temporary unlabelled storage; segregated storage with containment and authorized disposal	Segregated hazardous-waste storage and authorized disposal	Preferred due to protection of soil, groundwater, workers, and regulatory compliance
Energy management	Conventional fixed-speed operation; energy-efficient equipment with VFDs and recovery systems	VFDs, turbo-expander recovery, metering, maintenance, efficient lighting, and solar for suitable loads	Preferred due to lower energy consumption and indirect GHG emissions
Rainwater management	Discharge all roof runoff; recharge only; collection/reuse plus recharge where feasible	Rainwater collection/reuse and recharge system with pretreatment	Preferred due to water conservation and reduced pressure on drainage infrastructure
Green belt	Minimal landscaping; plantation only at frontage; planned perimeter and internal green belt	Planned green belt as per approved layout	Preferred due to visual, dust, ecological, and microclimate benefits
Transport management	Unscheduled dispatch; basic gate control; planned dispatch with driver training and vehicle checks	Planned dispatch, trained drivers, inspections, route controls, and emergency readiness	Preferred due to reduced road-safety and congestion risks
Emergency preparedness	Reliance on external responders only; internal emergency procedures; integrated internal/external emergency response	Integrated emergency-response system	Preferred because cryogenic and oxygen-related events require immediate site-level response

2.8.2 Preferred Environmental Alternative

The preferred environmental alternative comprises:

- Development of the ASU at the selected industrial plot within AIIC.
- Use of cryogenic air-separation technology with energy-efficient and noise-control features.
- Closed-loop cooling-water management.
- Segregated drainage for clean stormwater, wastewater, and potentially contaminated runoff.
- A verified and approved wastewater treatment/disposal arrangement.
- Rainwater harvesting and water-conservation measures.
- Acoustic treatment for compressors and other significant noise sources.
- Dedicated hazardous-waste storage with impermeable flooring and secondary containment.
- Green-belt development and survival monitoring.
- Fixed oxygen monitoring, oxygen-service cleanliness, emergency shut-off systems, fire protection, and safety training.
- Environmental monitoring through internal records and third-party laboratory testing where required.

- A formal EHS management system with responsibilities, inspection schedules, corrective actions, reporting, and emergency drills.

2.9 Economic Alternatives

2.9.1 Economic Options Considered

The economic assessment considers alternatives that could meet the market demand for oxygen, nitrogen, and argon while balancing capital cost, operating cost, reliability, transport requirements, environmental implications, safety, and long-term viability.

The total estimated project cost of approximately **PKR 3.4 Billion**, including land, buildings, plant and machinery, equipment, contingency, and working capital. The largest project-cost component is plant and machinery, reflecting the specialized nature of cryogenic air-separation technology.

The following economic alternatives were considered:

Economic alternative	Potential advantages	Limitations	Decision
Proposed 240 TPD cryogenic ASU at AIIC	Large-scale production; integrated oxygen, nitrogen, and argon recovery; ability to serve medical and industrial markets; bulk storage and distribution; potential supply reliability; economies of scale; employment and industrial development	High capital cost; high electricity demand; requires specialized operation, maintenance, safety systems, environmental controls, and regulatory approvals	Selected
Expansion of existing facilities	May use existing workforce and operational experience	May be constrained by available land, infrastructure, layout, safety distances, surrounding development, and capacity limitations	Not preferred for the proposed scale
Third-party procurement and distribution	Lower direct capital investment and fewer process impacts at local site	Dependence on suppliers, exposure to price and supply disruption, transport dependency, reduced control over product availability, and limited local value addition	Not preferred
Smaller decentralized PSA/VPSA plants	Lower initial cost per individual site; may serve selected local customers	Multiple sites increase compliance, staffing, maintenance, land, safety, and cumulative impacts; limited co-product recovery and liquid-product capability	Not preferred
Maintain existing production and supply only	Avoids immediate project cost and new site impacts	Does not meet projected demand growth, limits market reach, and may perpetuate long-distance supply constraints	Not preferred

1. Establish the proposed new 240 TPD cryogenic ASU at AIIC.
2. Expand or upgrade existing MCL production facilities.
3. Procure oxygen, nitrogen, and argon from third-party manufacturers and operate only distribution/filling infrastructure.

4. Install several smaller PSA/VPSA plants closer to selected customers.
5. Continue existing supply arrangements without additional production capacity.

Table 2.10: Economic Alternatives Assessment

2.9.2 Economic Selection Criteria

The selected economic alternative was evaluated against the following criteria:

- Ability to meet projected demand for oxygen, nitrogen, and argon.
- Ability to supply both industrial and medical users.
- Production reliability and supply security.
- Product purity and quality-control capability.
- Capital investment and operating cost.
- Electricity requirement and energy-efficiency potential.
- Availability of land, utilities, and industrial infrastructure.
- Logistics and distribution efficiency.
- Transport distance and associated fuel use.
- Employment generation and local economic contribution.
- Environmental-management cost.
- Safety-system and emergency-response requirements.
- Long-term flexibility for growth, customer diversification, and product distribution.

The proposed cryogenic ASU at AIIC is considered the preferred alternative because it can provide large-scale integrated production of oxygen, nitrogen, and argon, while the selected location provides industrial zoning, land availability, access to road infrastructure, and an established allotment arrangement. The project's economic viability remains dependent on final confirmation of electricity supply, water supply, equipment procurement, demand projections, operating cost, environmental-control budget, and compliance with all statutory requirements.

2.10 Conclusion

The screening assessment confirms that the proposed 240 TPD Cryogenic Air Separation Unit requires a **full Environmental Impact Assessment** because of its industrial scale, energy requirements, equipment configuration, cryogenic storage and handling, compressor noise, water-management requirements, tanker movement, and potential occupational and community safety risks.

The scoping process identifies the principal issues requiring detailed assessment as construction dust and noise; operational noise and vibration; electricity demand and indirect greenhouse-gas emissions; water consumption; cooling-water blowdown; domestic wastewater; stormwater; hazardous and non-hazardous waste; traffic; occupational health and safety; cryogenic-fluid handling; oxygen enrichment; oxygen-deficiency risk; fire protection; emergency response; and stakeholder concerns related to employment, noise, water, safety, and traffic.

The alternatives assessment supports selection of Plot No. 57C within AIIC because it is a designated industrial location, has been provisionally allotted to MCL for the proposed ASU, provides a 12.65-acre area, and has access to industrial and transport infrastructure. The selected cryogenic technology is appropriate for large-scale, integrated production of oxygen, nitrogen, and argon in liquid and gaseous forms.

The project may proceed for detailed environmental review and regulatory approval, provided that the final EIA incorporates verified project specifications; final layout and safety distances; baseline monitoring data; approved wastewater and stormwater arrangements; noise-control design; waste-management procedures; rainwater-harvesting measures; green-belt plan; tanker-transport plan; emergency-response plan; consultation record; and a comprehensive Environmental and Social Management Plan.

CHAPTER 3

DESCRIPTION OF THE PROJECT

3.1 Introduction

This chapter describes the proposed **240 Tons Per Day (TPD) Cryogenic Air Separation Unit (ASU)** of Multan Chemicals Limited (MCL) to be established at Plot No. 57C, Allama Iqbal Industrial City (AIIC), Sahianwala, Faisalabad. The proposed facility will produce oxygen, nitrogen, and argon from atmospheric air by using cryogenic air-separation and fractional-distillation technology.

The facility will include air-intake and filtration equipment, compressors, cooling and purification systems, a cryogenic cold box and distillation columns, turbo-expanders, cryogenic storage tanks, liquid-gas pumps, vaporizers, cylinder-filling facilities, tanker-loading area, utility systems, workshop, administrative buildings, internal roads, drainage, fire-protection arrangements, and green-belt development.

3.2 Type and Category of Project

The proposed project is an **industrial and medical gas-production facility** based on cryogenic air-separation technology. It will separate atmospheric air into oxygen, nitrogen, and argon through compression, purification, cryogenic cooling, and fractional distillation.

The project is categorized in the available project draft as a **Schedule II, Category B project under Serial No. 2 Chemical Manufacturing Units**, and is therefore being processed through a full Environmental Impact Assessment (EIA) for obtaining environmental approval prior to construction. Although the facility is classified for regulatory purposes within the applicable industrial category, its core production process is physical separation of atmospheric air rather than a conventional chemical-reaction process.

3.3 Objectives of the Project

The main objective of the project is to establish a modern and reliable ASU for production and supply of oxygen, nitrogen, and argon to industrial, healthcare, and commercial users.

Specific objectives of the project are:

- To produce high-purity oxygen for medical and industrial applications.
- To produce nitrogen and argon as co-products for industrial, commercial, and specialized applications.

- To strengthen the availability and reliability of industrial and medical gas supply in Faisalabad, Central Punjab, South Punjab, and other market areas.
- To provide liquid-gas storage, cylinder filling, bulk tanker loading, and product-distribution facilities.
- To create employment opportunities during construction, operation, maintenance, administration, and logistics activities.
- To implement energy-efficient cryogenic air-separation technology, including turbo-expander energy recovery and variable-frequency drives where applicable.
- To operate the facility in compliance with applicable environmental, occupational health and safety, fire-safety, industrial-estate, and waste-management requirements.
- To implement an Environmental Management Plan, environmental monitoring programme, emergency-response plan, and tree-plantation/green-belt programme.



Figure 1: Google map of project site

3.4 Location and Site Layout

The project is proposed at **Plot No. 57C, Allama Iqbal Industrial City (AIIC), Sahianwala, Faisalabad, Punjab**. AIIC is a planned industrial area and Special Economic Zone managed by Faisalabad Industrial Estate Development and Management Company (FIEDMC). The plot has been provisionally allotted to Multan Chemicals Limited for establishment of an Air Separation Unit for production of oxygen, nitrogen, argon, and related by-products.

The total project area is **12.65 acres**, equivalent to approximately **51,194 m²** or **455,360 ft²**. The site is accessible through the AIIC internal road network and is linked with Sahianwala Interchange and the M-4 Motorway.

Table 3.1: Site Coordinates

Reference point	Easting	Northing
North-West corner	1,077,631.106	11,498,082.661
South-West corner	1,077,651.412	11,497,715.674
North-East corner	1,078,900.707	11,498,152.717
South-East corner	1,078,855.769	11,497,782.130
Approximate site centroid	1,078,259.749	11,497,933.296

The approximate geographic coordinates of the centroid as **31°26′15″ N and 73°08′20″ E**. The coordinate datum and UTM zone shall be verified from the approved land survey and shown on the final location map.

The indicative layout provides space for the ASU process area, compressors, cold box, gas storage tanks, filling sheds, utilities, workshop, electrical room, control room, office building, guard room, internal circulation roads, drainage facilities, firefighting infrastructure, and green belt. The final layout shall be approved by the relevant authorities and shall incorporate applicable safety distances, tank-farm setbacks, emergency access, drainage, firewater facilities, and green-belt development.

3.5 Site Alternatives

The selected location is Plot No. 57C in AIIC, Faisalabad. The site was preferred because it is located in a planned industrial zone, has been allotted for the proposed industrial activity, has access to internal industrial roads and the M-4 Motorway, and offers sufficient area for plant equipment, product-storage facilities, emergency access, fire-protection infrastructure, internal roads, utilities, rainwater management, and green-belt development.

Alternative locations considered at planning level included expansion at an existing MCL facility, another industrial plot in Faisalabad or a different industrial estate, and a non-industrial/peri-urban site.

Expansion at an existing facility was not preferred because large cryogenic storage and processing facilities require adequate area for safe plant layout, tank separation, vehicle circulation, firefighting systems, and future operational flexibility. A non-industrial or peri-urban location was rejected because it could create land-use incompatibility, greater disturbance to residential or agricultural receptors, more difficult transport management, and higher community-safety concerns. Other industrial locations were not preferred because the selected AIIC plot has industrial zoning, available road connectivity, provisional allotment for the proposed ASU, and suitable project area.

3.6 Design and Technology Alternatives

The main technology alternatives considered for production of oxygen were cryogenic air separation, Pressure Swing Adsorption (PSA), Vacuum Pressure Swing Adsorption (VPSA), and procurement/distribution of gases produced by third parties.

Cryogenic air separation has been selected because the proposed project requires large-scale production of oxygen along with integrated production of nitrogen and argon. The technology also supports liquid-product storage, bulk tanker supply, cylinder filling, and potential pipeline supply to industrial users. The process is suitable for continuous high-capacity operation and can produce gases at the required purity for industrial and medical applications.

PSA and VPSA technologies are generally more suitable for smaller-scale, primarily gaseous oxygen supply applications. These alternatives were not preferred because they would not provide the same integrated liquid oxygen, nitrogen, and argon recovery and bulk-distribution capability planned for the project.

Table 3.3: Technology Alternative Assessment

Alternative	Advantages	Limitations / selection criteria	Decision
Cryogenic Air Separation Unit	Large-scale production; oxygen, nitrogen and argon recovery; liquid storage; bulk supply; cylinder filling; high product purity	High capital cost, electricity demand, specialist operation and safety controls required	Selected
PSA oxygen plant	Lower capital requirement for small gaseous oxygen systems	Limited suitability for large-scale liquid product, nitrogen and argon recovery, and bulk cryogenic distribution	Not selected
VPSA oxygen plant	Suitable for selected gaseous oxygen applications	Limited liquid-product capability and does not meet integrated co-product requirement	Not selected
Third-party gas procurement and distribution	Lower direct production investment	Continued dependence on external supply, transport cost, product-availability risk, and limited local production	Not selected

The selected design will incorporate energy-efficient equipment, turbo-expander refrigeration/energy recovery, automated control systems, acoustic treatment for compressors, closed-loop cooling, cryogenic storage tanks, oxygen-deficiency/enrichment monitoring, firefighting systems, emergency isolation, suitable drainage, rainwater harvesting, and green-belt development.

3.7 Process, Raw Materials and Products

3.7.1 Process Description

The ASU will separate atmospheric air into oxygen, nitrogen, and argon through a cryogenic fractional-distillation process. Atmospheric air is the principal process feedstock. The process does not involve conventional chemical reactions, chemical synthesis, or routine process combustion.

The general production steps are as follows:

1. **Air intake and filtration:** Ambient air will be drawn through air-intake filters to remove dust and suspended particles.
2. **Air compression:** Filtered air will be compressed through a main air compressor. Compression increases pressure and temperature; therefore, inter-cooling or after-cooling will be provided.
3. **Pre-cooling and purification:** The cooled compressed air will pass through purification equipment containing activated alumina and molecular sieves. This system removes moisture, carbon dioxide, and hydrocarbons that could freeze or create safety/operational problems in the cryogenic system.
4. **Cryogenic heat exchange:** Purified air will pass through a high-efficiency cryogenic heat exchanger, where it will be cooled to near-liquefaction temperature.

5. **Fractional distillation:** The cooled and partially liquefied air will enter high-pressure and low-pressure distillation columns. Separation takes place due to differences in boiling points of oxygen, nitrogen, and argon.
6. **Argon recovery:** An argon-rich stream will be processed through the argon-recovery arrangement to produce argon at the required product specification.
7. **Refrigeration and energy recovery:** Booster turbo-expanders will provide refrigeration necessary for cryogenic separation and help improve energy efficiency.
8. **Storage, filling and dispatch:** The final products will be stored in vacuum-insulated cryogenic tanks. Products will be dispatched through bulk tankers, ISO containers, high-pressure cylinders, vaporizers, and distribution arrangements.

3.7.2 Raw Materials

The principal raw material is ambient atmospheric air. Atmospheric air is filtered and processed within the ASU to recover oxygen, nitrogen, and argon. Other operational inputs will include electricity, water, activated alumina, molecular sieves, lubricants, maintenance materials, water-treatment chemicals, cleaning materials, and limited diesel for standby generator operation.

Table 3.4: Main Raw Materials and Inputs

Material / input	Source	Indicative quantity / requirement	Storage and handling
Atmospheric air	Ambient environment	Process feedstock; quantity to be confirmed by vendor process design	Drawn through elevated air-intake filtration system
Electricity	Grid supply through AIIC/FESCO arrangement	Approximately 7.3 MW continuous demand, subject to final vendor load schedule	Electrical rooms, transformers, control panels and distribution system
Water	AIIC water supply and/or approved borewell source	Approximately 35 KLD fresh-water demand, subject to final water balance	Underground/overhead water tanks and utility piping
Activated alumina	Approved supplier	Periodic replacement/top-up; exact quantity to be confirmed	Stored in sealed bags/drums in covered store
Molecular sieves	Approved supplier	Periodic replacement; exact quantity to be confirmed	Stored in sealed bags/drums in covered store
Cooling-water chemicals	Approved supplier	As per cooling-water treatment programme	Stored in labelled containers with secondary containment
Lubricating oil and grease	Approved supplier	Required for machinery maintenance; quantity to be confirmed	Stored in designated oil/chemical store with spill containment
Diesel / HSD	Approved supplier	For standby DG testing and emergency operation only; exact capacity to be confirmed	Stored in approved tank/containers with bunding and fire safeguards

3.7.3 Products and By-Products

The proposed ASU will produce oxygen as the main product, with nitrogen and argon as co-products. The project documents refer to a 240 TPD ASU and provide annual product quantities at full capacity. The EIA shall reconcile whether 240 TPD represents oxygen-only capacity or combined ASU production capacity.

Table 3.5: Proposed Products

Product	Proposed production	Product form	Main uses
Oxygen	62,700 tonnes/year at full capacity	Liquid oxygen and gaseous oxygen	Medical use, hospitals, welding, cutting, fabrication, steel, glass, chemical and industrial processes
Nitrogen	6,300 tonnes/year at full capacity	Liquid nitrogen and gaseous nitrogen	Purging, inerting, food processing, freezing, blanketing, pressure testing and industrial uses
Argon	2,700 tonnes/year at full capacity	Liquid argon and gaseous argon	Welding, fabrication, metallurgy, laboratories and specialized industrial processes
Ultra-Pure Oxygen	900 tonnes/year at full capacity	High-purity liquid and gaseous oxygen	High-precision medical applications, specialized laboratories, electronics, and advanced industrial processes
Total estimated output	72,600 tonnes/year	Liquid and gaseous products	Industrial and medical gas supply

3.7.4 Collection, Storage and Transport

Ambient air will be collected through the inlet air-filtration and compressor system. It will not be transported to the plant or stored as a conventional raw material. Activated alumina, molecular sieves, lubricants, water-treatment chemicals, and maintenance materials will be procured from approved suppliers and stored in designated covered storage areas.

Liquid oxygen, nitrogen, and argon will be stored in vacuum-insulated cryogenic tanks. Gaseous products may be filled into cylinders through high-pressure filling systems. Product dispatch will be undertaken through approved cryogenic tankers, ISO containers, and gas-cylinder vehicles. All loading, unloading, filling, and transport operations will follow approved standard operating procedures, inspection requirements, driver training, and emergency-response measures.

3.8 Operational Equipment and Machinery

The main operational equipment and machinery proposed for the project are listed below.

Table 3.6: Major Plant and Machinery

Equipment / system	Main function
Inlet air filter	Removes dust and particulates from ambient air
Main air compressor	Compresses ambient air for processing
Air pre-cooling / after-cooling system	Reduces compressed-air temperature
Air purification system	Removes moisture, carbon dioxide and hydrocarbons
Molecular-sieve adsorbers	Purifies compressed air before cryogenic cooling
Cryogenic cold box	Contains the main heat exchanger and cryogenic separation equipment
High-pressure and low-pressure distillation columns	Separates oxygen, nitrogen and argon
Argon recovery system	Recovers and purifies argon
Booster turbo-expander	Provides refrigeration and supports energy recovery
Liquid oxygen filling pumps	Transfers LOX to storage, tankers or filling system
Liquid nitrogen filling pumps	Transfers LIN to storage, tankers or filling system
Liquid argon filling pumps	Transfers LAR to storage, tankers or filling system
Vacuum-insulated storage tanks	Stores liquid oxygen, nitrogen and argon
Ambient vaporizers	Converts liquid product into gaseous product where required
Cylinder-filling manifolds	Fills high-pressure gas cylinders
Instrumentation and control system	Monitors and controls plant operations
Electrical transformer and distribution panels	Supplies and distributes electrical power
Standby diesel generator	Provides emergency power for essential loads
Cooling-water system	Provides cooling for compression and utility operations
Firewater tanks, pumps and hydrant system	Provides fire protection and emergency response
Oxygen monitors and alarms	Detects oxygen enrichment or oxygen-deficiency conditions
Workshop and maintenance equipment	Supports routine inspection and maintenance

3.9 Land Use, Road Access and Vegetation

3.9.1 Land Use

The project site is located within AIIC, which is designated for industrial development. The plot has been allotted for establishment of an ASU. The site is reported to be vacant/under development and does not involve displacement of residential population or conversion of agricultural land.

The final layout will allocate land for the process area, compressor/cold-box area, cryogenic tank farm, filling and dispatch facilities, offices, stores, workshop, electrical and control rooms, utility areas, water tanks, firefighting infrastructure, internal roads, parking, drainage, rainwater-harvesting facilities, and green belt.

3.9.2 Road Access

The site will be accessed through the internal road network of Allama Iqbal Industrial City. AIIC is connected to the Sahianwala Interchange and M-4 Motorway, providing access for delivery of machinery, consumables, cryogenic tankers, cylinder vehicles, and employee transport.

Heavy-vehicle entry, loading, dispatch, parking, reversing, and emergency access shall be managed through an approved Traffic Management Plan. Tanker movements shall be scheduled to avoid peak traffic where practicable, and all drivers shall receive appropriate training on vehicle safety, product handling, emergency communication, and route compliance.

3.9.3 Vegetation and Tree Plantation

The plot is located in an industrial development area and is not expected to support significant natural vegetation. Any existing vegetation within the plot shall be documented during the detailed site survey before construction. Unnecessary removal of existing trees shall be avoided.

A green belt and plantation area will be developed within the site. The draft project information proposes plantation on approximately 15% of the total plot area, equivalent to about 7,679 m², with approximately 400 trees. Proposed species include Neem (*Azadirachta indica*), Shisham (*Dalbergia sissoo*), Bottle Brush (*Callistemon* spp.), and other locally suitable species. The final plantation plan shall be based on approved site layout, species availability, water availability, soil conditions, and survival monitoring.

3.10 Cost and Magnitude of Operation

The total estimated project cost is approximately **PKR 3.4 Billion**. The principal capital cost relates to land acquisition/allotment, civil construction, imported plant and machinery, installation, utilities, storage tanks, control systems, ancillary equipment, contingency, and working capital.

Table 3.7: Estimated Project Cost

Cost Component	Estimated Amount (PKR)
Land	193,200,000
Building / Civil Works	320,400,000
Plant and Machinery	2,642,200,000
Furniture and Fixtures	9,300,000
Equipment and Installations	3,900,000
Computer Equipment	2,300,000
Total Fixed Machinery / Development Cost	**3,171,300,000**
Contingency	164,000,000
Working Capital	64,700,000
Total Project Cost	**3,400,000,000**

The facility is proposed for continuous industrial operation. The process equipment will operate on a 24-hour basis, subject to maintenance shutdowns, equipment inspections, product demand, and utility availability.

3.11 Schedule of Implementation

The proposed project will be implemented in phases. The overall construction and installation duration is expected to be approximately 12–14 months, subject to final procurement, civil works, import of equipment, installation, utility connection, inspection, commissioning, and statutory approvals.

Table 3.8: Indicative Implementation Schedule

Phase	Key activity	Indicative period
Pre-construction	Environmental approval, detailed engineering, utility approvals, procurement planning, contractor appointment	Month 1–2
Civil works	Site preparation, foundations, buildings, internal roads, drains, utility trenches and water systems	Month 2–6
Equipment delivery and installation	Delivery, erection and installation of compressor, purification system, cold box, tanks, pumps, piping and electrical systems	Month 5–10

Environmental and safety systems	Installation of acoustic controls, drainage, wastewater facilities, fire system, emergency equipment, oxygen monitors, rainwater harvesting and green-belt preparation	Month 6–10
Testing and commissioning	Hydrostatic testing, electrical testing, calibration, trial operation, safety checks, monitoring and emergency drills	Month 10–12
Commercial operation	Commencement of regular operation after approvals and commissioning clearance	Month 12 onward

3.12 Water Usage and Source

Water will be required for cooling-system make-up, domestic use, equipment cleaning where necessary, green-belt irrigation, fire-system testing, and other utility requirements. The estimated freshwater requirement of approximately **35 KLD**, comprising approximately **28 KLD for cooling-tower make-up** and **7 KLD for domestic use**.

The source of water is proposed to be the AIIC water-supply network and an approved borewell, subject to availability, NOC, and final utility design. The cooling system will be based on a closed-loop arrangement to reduce freshwater demand and minimize wastewater generation.

The EIA shall attach a detailed water balance and confirm:

- Water source and approval/NOC.
- Total daily freshwater requirement.
- Cooling-water circulation rate.
- Cooling-tower make-up requirement.
- Domestic water requirement.
- Blowdown quantity.
- Domestic sewage quantity.
- Treated-water reuse quantity.
- Rainwater-harvesting/recharge quantity.
- Firewater-storage capacity.

3.13 Wastewater Generation and Disposal

The ASU process is based on separation of atmospheric air and is not expected to generate conventional process effluent. However, wastewater may be generated from domestic activities, cooling-tower blowdown, equipment cleaning, floor washing, and occasional maintenance activities.

The domestic sewage generation at approximately **5.6 KLD**. Cooling-tower blowdown quantity and final treatment/disposal route shall be confirmed through the detailed water balance and cooling-water design.

Domestic sewage shall be treated through an approved on-site treatment arrangement or disposed through the AIIC sewerage system, subject to availability and written approval. Cooling-tower blowdown shall be managed through a controlled treatment/discharge arrangement and shall not be discharged to open land, stormwater drains, or groundwater.

The wastewater-management system shall include:

- Separate drainage for domestic wastewater, cooling-tower blowdown, clean stormwater, and potentially contaminated runoff.
- Oil-and-grit traps for runoff from workshop, chemical-storage, tanker-handling, or maintenance areas.
- Monitoring of treated wastewater and blowdown quality as required by the environmental approval and applicable standards.
- Water reuse for landscaping or other non-potable uses only where the final treatment system and water quality permit such reuse.
- Record keeping of wastewater quantity, sampling, laboratory analysis, treatment-system operation, and disposal/reuse.

3.14 Air Emissions and Control Measures

The cryogenic air-separation process does not involve routine combustion or chemical reaction emissions. The principal sources of air emissions during operation are expected to be:

- Standby diesel-generator exhaust during emergency operation and periodic testing.
- Vehicle exhaust from tankers, cylinder trucks, employee vehicles, and maintenance vehicles.
- Minor fugitive emissions from maintenance activities.
- Dust during construction and material handling.
- Non-polluting air-gas releases or process vents during controlled operational conditions.

The DG set shall be provided with an adequately designed exhaust stack, proper maintenance, low-sulphur fuel where available, and periodic emission monitoring as required. Vehicle emissions shall be controlled through preventive maintenance, valid fitness certification, no-idling practices, and controlled vehicle movement.

Construction dust will be controlled through water sprinkling, covering of trucks, covered storage of fine materials, speed limits, housekeeping, use of paved/compacted access roads where practicable, and prompt removal of construction debris.

No uncontrolled release of oil mist, hydrocarbons, chemicals, or contaminated vapours shall be allowed from the process, workshop, storage, or waste-handling areas.

3.15 Solid and Hazardous Waste Management

Solid waste will be generated during both construction and operation. Construction waste may include excavated material, surplus soil, concrete debris, wood, steel scrap, packaging material, cable waste, and domestic waste from workers.

During operation, waste may include municipal waste, packaging waste, scrap metal, damaged insulation, spent filters, used oil, oil filters, oily rags, contaminated absorbent, empty chemical containers, spent activated alumina, and spent molecular sieves.

The draft project information indicates that spent molecular sieve/adsorbent may be generated periodically and should be returned to the supplier or disposed of through an approved waste-management route after characterization. Used oil and contaminated maintenance waste shall be treated as hazardous waste and shall be stored in labelled containers on an impervious floor with secondary containment.

The following waste-management practices shall be adopted:

- Waste segregation at source into general waste, recyclable waste, inert construction waste, scrap metal, hazardous waste, and electronic waste.
- Reuse or recycling of metal scrap, cardboard, plastic, and packaging material through authorized recyclers where feasible.
- Storage of hazardous waste in a covered, ventilated, labelled, and access-controlled area.
- Provision of spill kits, drip trays, bunding, and secondary containment in oil and chemical storage areas.
- Maintenance of waste inventory, disposal record, manifest, contractor details, and disposal certificates.
- Disposal of hazardous waste only through authorized waste-management contractors/facilities.
- Prohibition of open burning, open dumping, or discharge of oil/chemical waste on land or into drains.

3.16 Operational Hours

The ASU is proposed to operate continuously on a **24-hour-per-day basis**, with operation on all days of the week except during planned shutdowns, major maintenance, equipment inspection, or emergency conditions. The expected operation of approximately **330 days per year**, allowing time for annual maintenance and inspection.

Administrative, workshop, and routine dispatch activities may operate according to shift schedules. Product loading and dispatch shall be planned to manage traffic and ensure safe operation of tanker and cylinder-filling activities.

3.17 Energy Requirements and Sources

The main energy source for the ASU will be electricity. Electricity will be required for the main air compressor, booster compressor, refrigeration system, pumps, cooling-water system, lighting, filling equipment, instrumentation, control systems, offices, and other utility loads.

The continuous electricity demand of approximately 7.3 MW, with a proposed dedicated 11 kV feeder and approximately 8.5–9.0 MVA transformer arrangement. The final electrical design shall confirm the sanctioned load, connected load, maximum demand, transformer capacity, backup arrangement, and annual energy consumption.

A standby diesel generator of approximately 1,000 kVA is proposed for essential safety and critical loads during power interruption. The facility will install a **5 MW solar photovoltaic system** to meet auxiliary and operational power loads, enhance green energy integration, and reduce overall grid dependence, subject to final technical feasibility, layout optimization, and approved electrical design.

Energy-conservation measures will include:

- High-efficiency motors and electrical equipment.
- Variable-frequency drives for compressors, pumps, and cooling-tower fans where applicable.
- Booster turbo-expander energy recovery.
- Preventive maintenance of compressors and rotating machinery.
- Energy metering and monthly performance review.
- LED lighting and daylight controls.
- Solar power for suitable non-process loads.
- Annual energy audit and continual energy-efficiency improvement.

3.18 Fuel Storage and Handling

No furnace oil, coal, biomass, natural gas, or process fuel is required for the main air-separation process. Limited high-speed diesel may be stored and used for standby generator operation, emergency power supply, and periodic DG testing.

Any diesel storage shall be located in a designated area with the following controls:

- Approved storage tank or suitable containers.
- Impervious floor and secondary containment/bunding.
- Clearly displayed hazard signs and no-smoking instructions.
- Fire extinguishers and spill-control materials.
- Controlled access and inventory record.
- Safe fuel-transfer procedure and trained personnel.
- Periodic inspection for leakage, corrosion, or damage.
- Prohibition of discharge of fuel-contaminated water or spills to soil and drains.

The exact diesel-storage capacity and annual fuel requirement shall be confirmed in the final engineering documents.

3.19 Emergency Response and Safety Features

The proposed facility will handle high-pressure gases and cryogenic liquids. The principal hazards include cryogenic burns, frostbite, pressure release, gas leaks, oxygen-enriched atmospheres, increased fire intensity in the presence of oxygen, oxygen-deficient atmospheres due to nitrogen release, electrical hazards, fire, tanker incidents, and cylinder-handling risks.

The facility shall implement a detailed Occupational Health, Safety and Emergency Response Plan before commissioning. Key safety features will include:

- Proper design, inspection, testing, certification, and maintenance of cryogenic tanks, pipelines, valves, pumps, vaporizers, filling equipment, pressure-relief devices, and associated systems.
- Provision of emergency isolation valves and safe venting systems.
- Fixed oxygen-deficiency and oxygen-enrichment monitors with audible and visual alarms at identified risk locations.
- Adequate natural and/or mechanical ventilation in enclosed or confined areas.
- Strict prohibition of oil, grease, smoking, open flames, and uncontrolled ignition sources in oxygen-service and storage areas.
- Firewater storage, hydrant system, fire pumps, hose reels, portable fire extinguishers, alarms, emergency lighting, and clearly marked emergency exits.
- Earthing and lightning-protection system.
- Safety signage, restricted-access zones, barricading, wind direction indicators, emergency assembly points, and evacuation routes.

- Personal protective equipment including safety shoes, gloves suitable for cryogenic service, face shields, goggles, helmets, hearing protection, flame-resistant clothing where required, and self-contained breathing apparatus for emergency response.
- First-aid boxes, eyewash stations, safety showers, stretchers, and arrangements for medical emergency support.
- Permit-to-work system for hot work, confined-space entry, electrical isolation, line breaking, working at height, and maintenance.
- Training of employees, contractors, drivers, and visitors on oxygen safety, cryogenic handling, fire response, evacuation, first aid, spill/leak response, and emergency communication.
- Routine mock drills for oxygen leak, nitrogen release, fire, tanker incident, power failure, and evacuation.

The emergency-response plan shall be coordinated with AIIC/FIEDMC management, local fire services, emergency medical services, and relevant government authorities.

3.20 Restoration and Rehabilitation Plan

The project is proposed on a designated industrial plot and is expected to remain operational for the economic life of the ASU. In the event of permanent closure, major modification, relocation, or decommissioning, MCL shall prepare and implement a site-specific decommissioning, restoration, and rehabilitation plan.

The restoration plan shall include:

- Submission of a closure/decommissioning plan to relevant authorities before major closure activities.
- Safe depressurization, isolation, cleaning, and decommissioning of pipelines, storage tanks, compressors, cold-box equipment, filling systems, and utility systems.
- Removal of residual gases, lubricants, chemicals, adsorbents, wastes, and hazardous materials by qualified personnel.
- Characterization and safe disposal/recycling of equipment, metal scrap, insulation, electrical items, used oil, chemicals, and contaminated material.
- Assessment of soil and groundwater quality in potentially affected areas, including workshop, oil/chemical storage, DG area, tank farm, filling area, and waste-storage area.
- Remediation of any soil or groundwater contamination identified during closure.
- Removal of temporary structures and restoration of internal drainage where required.
- Retention, replacement, or enhancement of plantation and green-belt areas where practical.
- Submission of closure-compliance documentation to relevant authorities.

3.21 Green and Sustainable Features

The project incorporates several environmental and resource-conservation measures to reduce water consumption, energy use, emissions, waste generation, and visual impact.

3.21.1 Rainwater-Harvesting System

The project proposes installation of a rainwater-harvesting system to collect roof runoff and reduce pressure on freshwater resources and stormwater drainage. The four recharge trenches, each approximately 20 m long, 2 m wide, and 3 m deep, along with a 100 KL underground storage tank for collection and reuse of rainwater.

Rainwater from suitable roof and paved areas will be routed through silt traps and oil-and-grit separation arrangements before storage or recharge. The collected water may be used for green-belt irrigation, cleaning, or other non-potable purposes, subject to final design and water-quality requirements.

3.21.2 Renewable Energy / Solar System

A 5 MW solar photovoltaic system is proposed for auxiliary and operational loads. The project plan incorporates a 5 MW solar PV installation, subject to final structural assessment, space availability, electrical design, and regulatory approvals.

The solar system will significantly reduce dependence on grid electricity for plant operations and auxiliary loads, directly contributing to the reduction of indirect greenhouse-gas emissions and supporting green energy initiatives.

3.21.3 Tree Plantation and Green Belt

A green belt will be developed around the project boundary and within available open spaces. The approximately 15% of the total site area, or approximately 7,679 m², for plantation, with around 400 trees. Proposed species include Neem, Shisham, Bottle Brush, and other locally suitable species.

The plantation plan will include:

- Planting along the site boundary, road-facing areas, open spaces, and suitable buffer locations.
- Use of native or locally adapted species with appropriate survival potential.
- Drip irrigation or controlled irrigation using available treated/recovered water where permitted.
- Plantation during the suitable planting season.

- Routine watering, mulching, protection, replacement planting, pest management, and survival monitoring.
- Maintenance for at least three years or as required by the environmental approval.

3.22 Conclusion

The proposed project is a 240 TPD Cryogenic Air Separation Unit of Multan Chemicals Limited at Plot No. 57C, Allama Iqbal Industrial City, Sahianwala, Faisalabad. The project will produce oxygen, nitrogen, and argon through cryogenic air separation and fractional distillation.

The project is located within a designated industrial area and is expected to support industrial and healthcare gas supply. The key environmental and safety considerations include construction dust and noise, compressor noise and vibration, electricity demand, cooling-water management, wastewater and stormwater management, waste handling, cryogenic-product storage, oxygen-enrichment hazards, nitrogen-related oxygen-deficiency hazards, fire safety, tanker movement, and emergency preparedness.

The proposed environmental safeguards include closed-loop cooling, acoustic enclosures, emission control for standby generation, wastewater management, stormwater control, hazardous-waste management, rainwater harvesting, solar energy, green-belt development, oxygen monitoring, fire-protection facilities, trained staff, and a comprehensive emergency-response system. Final project specifications, layout drawings, water balance, wastewater-disposal arrangement, utility approvals, storage capacities, and safety distances shall be verified and incorporated in the final EIA before submission.

CHAPTER 4

DESCRIPTION OF EXISTING ENVIRONMENT

4.1 Introduction

This chapter presents the baseline environmental conditions of the area surrounding the proposed **240 TPD Cryogenic Air Separation Unit (ASU)** of Multan Chemicals Limited at Plot No. 57C, Allama Iqbal Industrial City (AIIC), Sahianwala, Faisalabad.

The baseline study provides a description of existing physical, ecological, and socioeconomic resources that may interact with the proposed project. The project footprint comprises approximately **12.65 acres (51,194 m²)** within a designated industrial area. For assessment purposes, the project site, its immediate surroundings, a core study area of approximately 1 km radius, and a broader study area of approximately 5 km radius have been considered.

The baseline information is based on available project documents, review of the AIIC/FIEDMC site context, field observations to be documented through site photographs, stakeholder interaction, and environmental monitoring data/laboratory reports to be attached as annexures in the EIA. The final report shall not replace actual laboratory certificates with narrative data; original reports from an EPA Punjab–approved laboratory must be included as annexures.

4.2 Study Area

The study area has been divided into the following environmental zones:

Study zone	Coverage	Main purpose
Project site	Plot No. 57C, AIIC; 12.65 acres / 51,194 m²	Assessment of existing site conditions, land use, vegetation, drainage, access, utilities, and development footprint
Immediate surroundings	Adjacent industrial plots and internal AIIC roads	Assessment of direct impacts from construction, traffic, noise, drainage, and safety arrangements
Core study area	Approximately 1 km radius around the project site	Assessment of land use, nearby industrial activities, roads, workers, settlements, drainage, ambient air and noise receptors
General study area	Approximately 5 km radius around the site	Assessment of regional land use, socioeconomic setting, transport connections, water resources, ecology, and cumulative industrial development

The project site lies inside AIIC, which is a planned industrial area/SEZ developed by FIEDMC. The plot is allotted for establishment of an air-separation facility for manufacturing oxygen, nitrogen, argon, and associated by-products.

4.3 Baseline Physical Environment

4.3.1 Existing Land Use

The proposed site is located within a designated industrial estate. The immediate land-use pattern is characterized by vacant industrial plots, developing industrial facilities, internal roads, utility corridors, drainage infrastructure, and supporting industrial services. The site is not located in a residential colony, agricultural field, protected forest, or designated conservation area.

The project plot is presently reported as vacant/under development. The land is proposed to be developed for ASU process facilities, cryogenic storage, filling facilities, utility systems, offices, workshop, internal roads, drainage, firefighting infrastructure, rainwater harvesting, and green belt.

Table 4.1: Existing and Proposed Land Use at Project Site

Land-use component	Existing condition	Proposed project use
Plot area	Vacant/under development industrial plot	Cryogenic ASU and associated infrastructure
Zoning	Designated industrial land within AIIC	Compatible industrial use
Process area	No permanent ASU equipment at present	Compressor, purification, cold box, distillation columns and process equipment
Storage area	No operational storage at present	LOX, LIN and LAR storage tanks and filling facilities
Internal movement area	Unpaved/partially developed plot areas, subject to field verification	Internal roads, tanker circulation, loading/unloading and emergency access
Office/support facilities	Not established or under development	Office, control room, guard room, workshop, stores and staff facilities
Green/open area	Vacant open plot area	Proposed green belt, plantation, landscaped/open area and rainwater-management features

4.3.2 Topography and Elevation

Faisalabad is located in the generally flat alluvial plains of central Punjab. The project site is reported to be flat and suitable for industrial development. The approximate site elevation is around **629 ft above mean sea level**, equivalent to approximately **192 m above mean sea level**; this value shall be confirmed through the final topographic survey.

The relatively level terrain is favourable for construction of industrial buildings, foundations, internal roads, drainage systems, storage areas, and firefighting access. Site grading shall nevertheless be designed to ensure that stormwater drains away from process buildings, electrical rooms, chemical/oil stores, tank-farm areas, and product-filling facilities.

4.3.3 Geology and Soil

The Faisalabad region is generally underlain by alluvial deposits consisting of varying layers of silt, clay, sand, and fine-grained sediments. The site soil as alluvial silt-clay loam. Such soils are common in the central Punjab plains and require confirmation through a project-specific geotechnical investigation before final structural design.

The proposed facility will include heavy equipment such as air compressors, cold box, distillation columns, cryogenic tanks, pumps, transformers, and other rotating/process equipment. Therefore, a detailed geo-technical investigation shall be completed before construction to establish soil-bearing capacity, foundation design parameters, groundwater depth, soil corrosivity, settlement potential, and appropriate foundation type.

Table 4.2: Indicative Physical Site Conditions

Environmental parameter	Baseline description	Requirement before final design
Terrain	Generally flat alluvial plain	Confirm finished levels and drainage gradient by topographic survey
Site elevation	Approximately 629 ft / 192 m AMSL, subject to verification	Confirm benchmark and reduced levels
Soil type	Reported alluvial silt-clay loam	Confirm by geo-technical boreholes and soil testing
Soil stability	Generally suitable for industrial development, subject to site investigation	Determine bearing capacity, settlement and foundation design
Seismic setting	Draft refers to Seismic Zone 2B	Confirm from applicable building code and structural design basis
Erosion potential	Low under normal conditions due to flat terrain; may increase during excavation and exposed-soil conditions	Provide temporary drainage, compaction, material storage and dust-control measures
Drainage condition	Industrial-estate stormwater and sewerage infrastructure identified near the site	Verify connection levels, capacity, discharge approvals and separation of wastewater/stormwater

4.3.4 Climate and Meteorology

Faisalabad has a semi-arid climate characterized by hot summers, cool winters, seasonal monsoon rainfall, and generally dry conditions for much of the year. The annual rainfall of approximately **375 mm**, with a substantial proportion occurring during the monsoon months of July and August. Summer temperatures are reported to range approximately from **26.9°C to 45.5°C**, while winter temperatures may range approximately from **4.1°C to 19.4°C**.

These climatic conditions are relevant to the project because high summer temperatures may increase cooling-water demand and influence worker heat-stress management, while monsoon rainfall may affect site drainage, construction scheduling, stormwater control, and rainwater-harvesting performance.

Table 4.3: Indicative Climate Profile of the Study Area

Parameter	Baseline condition
Climate type	Semi-arid
Summer period	Generally April to September
Winter period	Generally November to February
Reported summer temperature range	Approximately 26.9°C to 45.5°C
Reported winter temperature range	Approximately 4.1°C to 19.4°C
Average annual rainfall	Approximately 375 mm
Main rainfall season	July–August monsoon period
Site implication	High-temperature working conditions, dust potential during dry months, and stormwater-control requirement during monsoon

4.4 Ambient Air Quality

The existing ambient-air environment in Faisalabad is influenced by industrial activity, vehicular traffic, construction activity, road dust, agricultural residue burning during seasonal periods, domestic/commercial fuel use, and regional atmospheric conditions. In industrial and developing areas, particulate matter particularly $PM_{2.5}$ and PM_{10} is typically the key ambient-air-quality parameter of concern.

The information indicates PM_{10} concentrations in the range of approximately **110–145 µg/m³** at surveyed locations. It also notes that sulphur dioxide and nitrogen dioxide were within applicable ambient standards in the available assessment narrative.

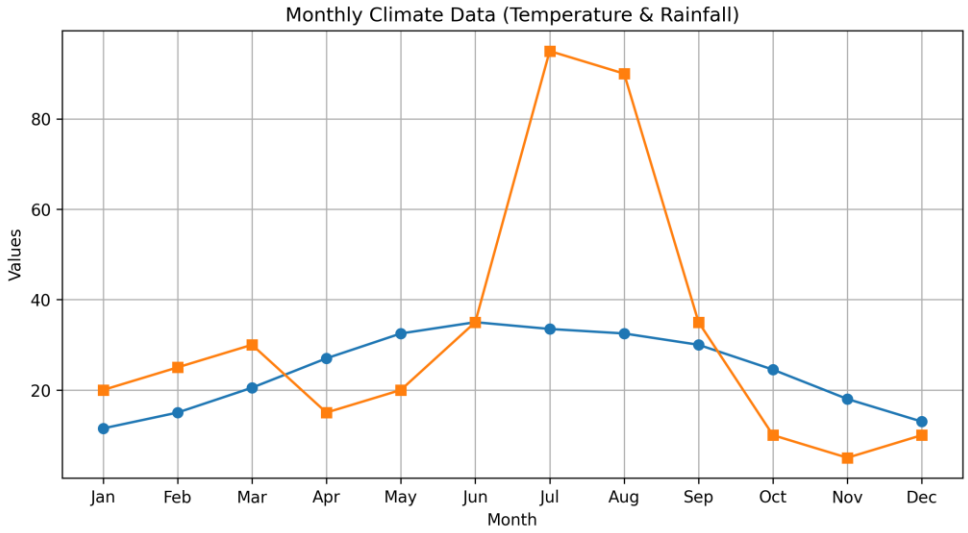


Table 4.4: Ambient Air Quality Monitoring Locations

Station	Location description	Purpose
AAQ-1	Upwind project-boundary location	Represents prevailing background air condition
AAQ-2	Downwind project-boundary location	Represents air quality potentially influenced by nearby industrial/road activities
AAQ-3	Near main access road/internal industrial road	Represents traffic and road-dust influence
AAQ-4	Nearest representative community/receptor location	Represents potential exposure at nearby settlement or worker-use area

Table 4.5: Baseline Ambient Air Quality Results

Parameter	Unit	AAQ-1 Upwind	AAQ-2 Downwind	AAQ-3 Roadside	AAQ-4 Receptor	Observed range	Applicable standard*
$PM_{2.5}$	µg/m³	31	36	42	34	31–42	35
PM_{10}	µg/m³	110	125	145	118	110–145	150
Sulphur dioxide, SO_2	µg/m³	18	21	24	19	18–24	120
Nitrogen dioxide, NO_2	µg/m³	31	35	39	33	31–39	80
Carbon monoxide, CO	mg/m³	1.2	1.4	1.8	1.3	1.2–1.8	5
Ozone, O_3	µg/m³	42	45	47	43	42–47	130

Applicable standards shall be checked and updated against the relevant PEQS / ambient-air-quality criteria before final EIA submission. The values in this table are a working baseline format and must be replaced or validated through annexed EPA Punjab–approved laboratory reports.

The baseline results indicate that PM_{10} remained within the stated standard at all locations, while $PM_{2.5}$ showed elevated values at the roadside and downwind locations. This is consistent with the dust-prone and industrial/traffic-influenced setting of Faisalabad. The project shall therefore implement dust control during construction and maintain strict vehicle-management, housekeeping, paved internal-road, and DG-maintenance measures during operation.

4.5 Ambient Noise Environment

The existing noise environment is influenced primarily by internal industrial-estate traffic, construction and development activities, nearby industrial operations, heavy vehicles, and general road traffic. The project site is within an industrial zone; therefore, baseline noise is expected to vary according to time of day, traffic volume, construction activity, and operation of nearby units.

Table 4.6: Baseline Noise Monitoring Results

Monitoring location	Day-time Leq dB(A)	Night-time Leq dB(A)	Applicable industrial limit, day	Applicable industrial limit, night
N-1: Northern project boundary	62	54	75	65
N-2: Southern project boundary	64	55	75	65
N-3: Eastern project boundary / access-road side	68	57	75	65
N-4: Western project boundary	63	54	75	65
N-5: Internal AIIC road / traffic-influenced location	70	59	75	65
N-6: Nearest representative receptor	58	50	75	65

The indicative results show that baseline noise is within the stated industrial-area limits, although the access-road location has comparatively higher daytime noise because of traffic and industrial-estate activity. During operation, compressor-related noise will be the most important project-specific source; therefore, acoustic enclosures, silencers, anti-vibration mounts, preventive maintenance, PPE, and boundary monitoring will be required.

4.6 Water Resources and Water Quality

4.6.1 Surface Water and Drainage

No natural perennial surface-water body is identified within the immediate project footprint. The site lies within a planned industrial estate where stormwater drainage and sewerage infrastructure are available or being developed. The available site drawing identifies nearby stormwater-drain and sewerage-manhole levels; the final project design shall verify available connection points, capacities, discharge permissions, and final drainage arrangement.

The project shall maintain separate systems for clean stormwater, domestic wastewater, cooling-tower blowdown, and potentially contaminated runoff from workshop, chemical/oil-storage, filling, loading, or maintenance areas. No untreated wastewater, oil-contaminated runoff, or chemical spill shall be discharged to open land, stormwater drains, or groundwater.

Since there is no confirmed natural surface-water body receiving project discharge, **surface-water-quality sampling is not applicable at this stage**. If the final disposal arrangement includes discharge to a drain, channel, watercourse, or estate system with a receiving water body, water sampling upstream and downstream of the relevant receiving point shall be undertaken.

4.6.2 Groundwater

The draft EIA notes that groundwater in the area may occur at a depth of approximately **20–30 m** or **60–70 ft**, with total dissolved solids reportedly ranging from approximately **800–1,500 mg/L**. Such groundwater may require treatment before drinking use. The final groundwater depth and quality shall be confirmed through site-specific borewell data and laboratory testing.

Groundwater protection is important because potential contamination could arise from improper handling of used oil, fuel, water-treatment chemicals, maintenance waste, or contaminated runoff. The project will therefore provide impervious storage surfaces, bunding, drip trays, spill kits, segregated drainage, and controlled disposal of hazardous waste.

Table 4.7: Baseline Groundwater / Source Water Quality

Parameter	Unit	Result	Typical benchmark / limit*	Interpretation
pH	-	7.4	6.5–8.5	Within typical acceptable range
Total Dissolved Solids	mg/L	1,240	1,000	Elevated; treatment may be required for potable use
Total Hardness	mg/L as $CaCO_3$	410	500	Within typical limit, but relatively hard
Chloride	mg/L	230	250	Within typical limit
Sulphate	mg/L	310	250	Elevated
Nitrate	mg/L	18	50	Within typical limit
Fluoride	mg/L	0.7	1.5	Within typical limit
Iron	mg/L	0.18	0.3	Within typical limit
Arsenic	mg/L	0.006	0.01	Within typical limit
Total coliform	MPN/100 mL	Absent	Absent	Compliant in sample

The baseline source-water results indicate that groundwater/source water may be suitable for industrial use after appropriate treatment or softening, but elevated TDS, hardness, and sulphate may require conditioning for cooling-water applications and treatment for potable supply. Drinking water for staff shall be provided through a tested and treated source.

Parameter	Concentration, mg/L
TDS	1,240
Total hardness	410
Chloride	230
Sulphate	310
Nitrate	18

4.7 Soil Quality and Geotechnical Investigation

The project site is located on generally flat industrial land that is expected to comprise alluvial soil. Soil quality is relevant for evaluating foundation suitability, soil contamination risk, stormwater infiltration, plantation potential, and proper management of oils, fuels, chemicals, and wastes.

The geo-technical report shall be based on boreholes/test pits at locations suitable for the proposed heavy equipment, tank farm, compressor foundation, cold box, main buildings, and utility structures.

Table 4.8: Indicative Baseline Soil Quality Results

Parameter	Unit	S-1 Process area	S-2 Proposed tank-farm area	S-3 Green-belt area	Interpretation
pH	-	7.8	7.7	7.6	Slightly alkaline, typical for Punjab alluvial soils
Electrical conductivity	dS/m	1.4	1.6	1.2	Low to moderate salinity
Organic matter	%	0.68	0.55	0.82	Low organic content, typical of disturbed/open industrial land
Oil and grease	mg/kg	<5	<5	<5	No significant hydrocarbon contamination detected
Lead	mg/kg	18	17	15	Within typical background range
Chromium	mg/kg	21	20	19	Within typical background range
Cadmium	mg/kg	<1	<1	<1	Below detection / low concentration
Texture	-	Silt-clay loam	Silt-clay loam	Silt-clay loam	Suitable for plantation with soil improvement and proper drainage

The data indicate that the site does not show evidence of significant oil-and-grease contamination before project development. The site shall be protected from future contamination through lined oil/chemical storage areas, bunding, spill-control arrangements, proper waste handling, and routine inspection.

4.8 Baseline Ecological Environment

4.8.1 General Ecological Setting

The project is located within a planned industrial estate and the immediate site is vacant industrial land. The area does not represent a natural forest, wetland, protected habitat, or designated wildlife reserve. There is no protected area is identified within approximately 10 km of the site and identifies Gatwala Wildlife Park at a greater distance. This should be verified using current official maps before final submission.

The ecological value of the immediate project site is expected to be low because of existing industrial development, road access, vacant plots, limited natural vegetation, and human disturbance. Nevertheless, site clearance shall be minimized, and any existing trees or vegetation shall be surveyed and documented before construction.

4.8.2 Flora

Existing vegetation at the site is expected to comprise sparse grasses, herbs, shrubs, roadside vegetation, and occasional planted trees associated with industrial-estate roads or adjoining plots. Representative flora that may occur in disturbed industrial/roadside environments of the Faisalabad area include:

- Neem (*Azadirachta indica*).
- Shisham (*Dalbergia sissoo*).
- Kikar / Babul (*Vachellia nilotica*).
- Ber (*Ziziphus mauritiana*).
- Eucalyptus (*Eucalyptus* spp.) where planted.
- Conocarpus (*Conocarpus* spp.) in landscaped areas.
- Bottle Brush (*Callistemon* spp.) in landscaped areas.
- Seasonal grasses, herbs, and ruderal vegetation.

No rare, threatened, endemic, or legally protected plant species are expected within the industrial plot, subject to detailed field verification.

4.8.3 Fauna

The fauna likely to occur in and around the project area is expected to be limited to species adapted to urban, industrial, roadside, and agricultural-edge environments. These may include common birds, rodents, reptiles, and domestic animals. The final field survey shall record species actually observed.

Representative fauna may include:

- House crow (*Corvus splendens*).
- House sparrow (*Passer domesticus*).
- Common myna (*Acridotheres tristis*).
- Rock pigeon (*Columba livia*).
- Cattle egret (*Bubulcus ibis*) in open/agricultural edge areas.
- Black kite (*Milvus migrans*) in open urban/industrial areas.
- House gecko (*Hemidactylus* spp.).
- Field rat (*Rattus* spp.).
- Indian hare (*Lepus nigricollis*) only where open land/vegetation is present.
- Domestic cattle, goats, dogs, and cats in peripheral areas.

No significant wildlife habitat is expected to be directly affected because the site is located inside AIIC and is designated for industrial use. However, lighting shall be directed downward, open waste shall not be left exposed, and plantation shall use locally suitable species.

Table 4.10: Baseline Ecological Receptors

Ecological feature	Existing condition	Potential sensitivity
Natural forest	Not identified within project plot	Low
Wetland / lake / river	Not identified within immediate project footprint	Low
Protected area	No protected area reported within the immediate study area; to be verified through official mapping	Low to moderate, subject to verification
Existing vegetation	Sparse grasses, shrubs and planted/roadside trees expected	Low
Common birds	Likely present in open land, roadside and industrial settings	Low
Common mammals/reptiles	Limited to disturbance-tolerant species	Low
Plantation potential	High within project boundary through planned green belt	Beneficial opportunity

4.8.4 Ecological Enhancement

The project provides an opportunity to improve local green cover through plantation and landscaping. The draft proposes development of approximately **7,679 m²**, or **15% of the total plot area**, as green belt with approximately 400 trees, subject to final layout and approval.

The plantation plan shall use locally adapted species, maintain plant survival records, replace dead saplings, avoid invasive species where possible, and use water-efficient irrigation methods. Green belt development will improve site aesthetics, reduce dust movement, provide shade, and contribute to local microclimatic improvement.

4.9 Baseline Socioeconomic Environment

The project is located within AIIC, where immediate surroundings are industrial in character. The nearest settlements and local communities are located outside the core industrial plot area. The EIA refers to Sahianwala village at an approximate distance of 1.2 km and a population of approximately 5,000; this information shall be verified through field survey, local-government data, and consultation records before final submission.

The socioeconomic setting includes industrial workers, skilled and unskilled labour, transport workers, small businesses, contractors, local residents, and communities engaged in agriculture, services, trade, manufacturing, and employment associated with industrial estates.

The project is expected to create employment opportunities during construction and operation. The company's business-plan information indicates projected direct employment increasing from 122 personnel in Year 1 to 159 personnel in Year 5. The employment projection shows a majority male workforce, with female employment projected to increase from 10 persons in Year 1 to 12 persons in Year 5.

4.10 Conclusion

The proposed project is located on a 12.65-acre industrial plot within AIIC, Faisalabad. The baseline environment is characterized by planned industrial land use, relatively flat alluvial terrain, semi-arid climate, developing industrial infrastructure, road connectivity, low ecological sensitivity within the immediate project footprint, and a socioeconomic setting influenced by industrial, transport, service, and construction activities.

The main baseline environmental concerns relevant to the project are particulate matter in the regional/industrial air environment, noise from industrial-estate traffic and future compressor operation, groundwater quality and protection, drainage and wastewater management, construction disturbance, cryogenic-gas safety, tanker traffic, and need for green-belt development.

The site is considered suitable for the proposed ASU because it is within a designated industrial estate and is not reported to conflict with residential, agricultural, protected-area, or sensitive ecological land use. The EIA shall include verified laboratory reports, geo-technical investigation, field photographs, location maps, land-use map, ecological survey, socioeconomic survey, and all relevant approvals to substantiate the baseline assessment.

CHAPTER 5

IMPACT ASSESSMENT METHODOLOGY AND CHARACTERISTICS OF IMPACTS

5.1 Introduction

This chapter explains the methodology adopted to identify, predict, evaluate, and classify potential environmental, occupational health and safety, and socioeconomic impacts associated with the proposed **240 TPD Cryogenic Air Separation Unit (ASU)** of Multan Chemicals Limited at Plot No. 57C, Allama Iqbal Industrial City (AIIC), Sahianwala, Faisalabad.

The assessment covers the complete project cycle, including pre-construction, construction, installation, commissioning, operation, maintenance, product storage, cylinder filling, tanker dispatch, emergency conditions, and eventual decommissioning. The impact assessment considers potential effects on land use, soil, air quality, noise, water resources, drainage, wastewater, waste, ecology, traffic, worker health and safety, community safety, and socioeconomic conditions.

The proposed project involves physical separation of atmospheric air into oxygen, nitrogen, and argon. The main environmental and safety issues are therefore related to construction activities, compressor noise, electricity consumption, cooling-water use, wastewater and stormwater management, DG emissions, maintenance waste, transport movement, cryogenic liquids, high-pressure systems, oxygen enrichment, oxygen deficiency, and emergency preparedness.

5.2 Objectives of Impact Assessment

The impact assessment has been carried out to:

- Identify project activities that may interact with environmental and social receptors.
- Establish the nature, magnitude, extent, duration, reversibility, probability, and significance of potential impacts.
- Distinguish between adverse, beneficial, direct, indirect, short-term, long-term, temporary, permanent, reversible, and irreversible impacts.
- Identify impacts that require mitigation measures, monitoring, management controls, and emergency-response arrangements.
- Assess impacts during normal operations as well as accidental or emergency conditions.
- Recommend measures to avoid, minimize, control, or compensate for potentially adverse impacts.

- Provide the basis for the Environmental and Social Management Plan, Environmental Monitoring Plan, Occupational Health and Safety Plan, Waste Management Plan, Traffic Management Plan, and Emergency Response Plan.

5.3 Impact Assessment Approach

The assessment follows a structured approach in which each project activity is linked with the environmental or social receptor that may be affected. The significance of an impact is assessed by considering the sensitivity of the receptor and the characteristics of the impact.

The impact assessment process includes the following steps:

1. Review of project information, process description, site layout, utility requirements, machinery list, product storage, transport arrangements, and proposed environmental safeguards.
2. Review of baseline environmental conditions, including land use, nearby industrial activities, air quality, noise, water resources, drainage, soil, ecology, traffic, local settlements, and socioeconomic conditions.
3. Identification of project activities during construction, operation, maintenance, transport, emergency conditions, and closure.
4. Identification of potential interactions between project activities and environmental/social receptors.
5. Evaluation of potential impacts using checklists, interaction matrices, network analysis, maps/overlays, field observations, and professional judgement.
6. Assessment of impact characteristics, including nature, magnitude, extent, timing, duration, reversibility, probability, and risk.
7. Identification of mitigation measures following the hierarchy of avoidance, minimization, control, restoration, and monitoring.
8. Reassessment of residual impacts after implementation of the proposed mitigation measures.

The impact assessment will be updated if the final process design, plant layout, tank capacities, water balance, wastewater-disposal arrangement, traffic plan, safety-distance layout, or project schedule changes materially.

5.4 Methodologies for Impact Identification

A combination of methods has been used to identify and assess the likely impacts of the project. Use of more than one method improves the reliability of the assessment and ensures that direct, indirect, cumulative, and accidental impacts are not overlooked.

5.4.1 Checklist Method

A structured environmental checklist has been used to identify the interaction of project activities with key environmental and social components. The checklist covers physical, ecological, socioeconomic, occupational health and safety, and emergency-response issues.

Table 5.1: Environmental Impact Identification Checklist

Environmental component	Key issue considered	Construction phase	Operation phase	Maintenance/emergency phase
Land use	Industrial land development and site utilization	Applicable	Applicable	Applicable
Soil	Excavation, erosion, spills, waste disposal and contamination	Applicable	Applicable	Applicable
Air quality	Dust, vehicle exhaust, DG emissions and controlled venting	Applicable	Applicable	Applicable
Noise and vibration	Construction equipment, compressors, pumps, cooling towers and DG	Applicable	Applicable	Applicable
Water resources	Water demand, borewell use, cooling-water make-up and firefighting use	Applicable	Applicable	Applicable
Wastewater	Domestic sewage, cooling-tower blowdown, wash water and contaminated runoff	Applicable	Applicable	Applicable
Stormwater	Drainage, erosion, contaminated runoff and rainwater harvesting	Applicable	Applicable	Applicable
Solid waste	Construction debris, domestic waste, scrap, packaging and filters	Applicable	Applicable	Applicable

Hazardous waste	Used oil, oily rags, oil filters, chemical containers and spent adsorbents	Limited	Applicable	Applicable
Ecology	Vegetation clearance, disturbance to common fauna and plantation	Applicable	Applicable	Limited
Traffic	Construction vehicles, tankers, cylinder trucks and road safety	Applicable	Applicable	Applicable
Employment	Construction jobs, operational jobs and local procurement	Beneficial	Beneficial	Beneficial
Community safety	Vehicle movement, fire, gas leak, emergency communication	Applicable	Applicable	Applicable
Occupational health and safety	Falls, lifting, electrical work, noise, pressure systems and cryogenic exposure	Applicable	Applicable	Applicable
Energy consumption	Construction machinery and ASU electricity demand	Limited	Applicable	Applicable
Climate change	Indirect GHG emissions from electricity and vehicle fuel	Limited	Applicable	Applicable

The checklist indicates that the most important impacts requiring detailed assessment are compressor noise, electricity consumption, water use, wastewater management, stormwater management, hazardous waste, cryogenic safety, oxygen enrichment, oxygen deficiency, fire protection, tanker movement, and occupational health and safety.

5.4.2 Interaction Matrix Method

An interaction matrix has been used to link individual project activities with potentially affected environmental receptors. The matrix assists in identifying where impacts are likely to occur and whether they are potentially adverse or beneficial.

The impact rating used in the matrix is as follows:

- **H:** High potential significance.
- **M:** Moderate potential significance.
- **L:** Low potential significance.
- **B:** Beneficial impact.
- **N:** Negligible or no material impact.

Table 5.2: Preliminary Project Activity–Receptor Interaction Matrix

Project activity	Air quality	Noise	Soil/land	Water/drainage	Waste	Ecology	Traffic	Occupational health & safety	Community safety	Socioeconomic
Site preparation and excavation	M	M	M	M	M	L	M	M	L	B
Civil works and construction	M	M	L	M	M	L	M	H	L	B
Equipment delivery and installation	L	M	L	L	M	N	M	H	M	B
Compressor operation	L	H	L	L	L	N	N	H	L	B
Cooling-water operation	N	L	L	M	L	N	N	M	L	N
Standby DG operation	M	M	L	L	L	N	N	M	L	N
Cryogenic storage and filling	N	L	M	L	L	N	M	H	H	B
Cylinder filling and dispatch	L	M	L	L	L	N	H	H	M	B
Tanker transport	M	M	L	L	N	N	H	H	H	B
Workshop and maintenance	L	L	M	L	M	N	L	H	L	N
Waste storage and disposal	L	N	M	M	H	N	L	M	L	N
Green belt and plantation	B	B	B	B	N	B	N	N	N	B

The matrix shows that the highest-priority issues are expected to be occupational health and safety, cryogenic-product storage and filling, tanker movement, compressor noise, hazardous-waste handling, construction safety, and traffic management. These matters are addressed in the subsequent impact-assessment, mitigation, EMP, monitoring, and emergency-response chapters.

5.4.3 Network Analysis

Network analysis has been used to identify primary impacts and the secondary impacts that may result from them. This is particularly relevant for the proposed ASU because some impacts arise indirectly through resource consumption, vehicle movement, and emergency scenarios.

Examples of impact pathways are given below:

- **Electricity consumption → grid power demand → indirect greenhouse-gas emissions → contribution to climate-change impacts.**
- **Compressor operation → noise and vibration → worker exposure and boundary noise → potential nuisance or hearing-risk impacts.**
- **Cooling-water use → water demand → cooling-tower blowdown → wastewater-management requirement → potential drainage/water-quality impact if unmanaged.**
- **Oil/chemical storage → accidental spill → soil contamination → possible groundwater contamination if not contained.**
- **Cryogenic liquid leak → rapid vaporization → oxygen enrichment or oxygen deficiency → increased fire or asphyxiation risk → emergency response requirement.**
- **Tanker dispatch → heavy-vehicle movement → traffic congestion/road accident risk → potential gas release and community-safety consequence.**
- **Construction activity → dust/noise/traffic → temporary nuisance to nearby industrial workers and road users.**
- **Tree plantation and rainwater harvesting → improved green cover/recharge → reduced dust movement and improved site drainage.**

Table 5.3: Key Impact Networks

Primary project activity	Primary impact	Secondary impact	Management response
Compressor operation	Elevated noise and vibration	Worker exposure and possible boundary noise	Acoustic enclosure, silencer, anti-vibration mounts, PPE and monitoring
Cooling-tower operation	Water consumption and blowdown	Potential wastewater impact if uncontrolled	Closed-loop cooling, drift control, water metering and approved disposal arrangement
DG operation	Stack emissions and noise	Localized air/noise effects	Adequate stack, maintenance, controlled operating hours and monitoring
Used-oil generation	Hazardous waste	Soil and groundwater contamination risk	Bunded storage, labelled containers, spill kits and authorized disposal
LOX/LIN/LAR storage	Cryogenic leak or release	Cold burns, oxygen enrichment or oxygen-deficiency condition	Monitors, ventilation, isolation valves, fire protection and emergency training
Tanker movement	Increased heavy traffic	Accident and public-safety risk	Traffic plan, driver training, route controls and emergency procedures
Green belt/rainwater harvesting	Increased vegetation and water conservation	Improved visual environment and reduced runoff	Plantation maintenance and rainwater-system upkeep

5.4.4 Overlays and Mapping

Environmental overlays and maps shall be used to assess the relationship between the project and nearby environmental receptors.

- Project location and site boundary.
- Site layout and land-use allocation.
- AIIC roads, access points, and product-dispatch routes.
- Nearby industrial plots and facilities.

- Nearest settlements, worker facilities, schools, mosques, health facilities, and other sensitive receptors, if present.
- Stormwater drains, sewerage lines, water-supply lines, and utility corridors.
- Existing vegetation, plantation areas, and proposed green belt.
- Water bodies, canals, drains, ponds, or low-lying areas within the broader study area, if any.
- Emergency access routes, firewater facilities, assembly points, and tanker loading areas.
- Air-quality and noise-monitoring locations.
- Soil, groundwater, and wastewater sampling locations.

The overlay assessment will help confirm that the selected project layout maintains suitable separation from receptors, avoids drainage conflicts, provides emergency access, and incorporates green belt and stormwater controls.

5.4.5 GIS and Computer-Based Assessment

GIS and computer-based tools may be used during final EIA preparation to prepare location maps, buffers, land-use maps, receptor maps, drainage maps, transport-route maps, and emergency-response maps. GIS-based analysis is particularly useful for verification of the 1 km core study area and 5 km general study area.

Computer-based noise modelling may be undertaken if final equipment sound-power data, plant layout, building dimensions, boundary-wall details, and receptor locations are available. Similarly, quantitative risk assessment and consequence modelling may be completed for major cryogenic storage scenarios, subject to final confirmation of tank capacities, operating pressure, product inventory, transfer arrangements, isolation systems, and meteorological data.

The project refer to a preliminary risk assessment for LOX storage and indicate that detailed safety controls, oxygen monitoring, emergency procedures, and storage safety distances will be required. Any final modelled results included in the EIA must be supported by model input data, assumptions, drawings, and output reports.

5.5 Impact Characteristics and Significance Criteria

Each impact has been assessed using the characteristics described below.

5.5.1 Nature of Impact

The nature of impact describes whether the effect is:

- **Adverse:** Causes deterioration of environmental quality, safety, health, or social conditions.

- **Beneficial:** Produces a positive environmental, social, or economic outcome.
- **Direct:** Occurs as an immediate result of a project activity.
- **Indirect:** Occurs as a secondary consequence of project activity.
- **Cumulative:** Combines with impacts from existing or planned activities in the area.
- **Accidental:** Arises from an unplanned event such as equipment failure, spill, leak, fire, or transport accident.

5.5.2 Magnitude

Magnitude represents the anticipated degree of change in the affected environmental component.

Magnitude	Description
High	Major change in baseline condition, potential exceedance of standards, large-scale safety consequence, or impact requiring major intervention
Moderate	Noticeable change requiring effective mitigation and regular monitoring
Low	Minor and localized change that can be managed through routine good practice
Negligible	No material change from baseline or effect too small to be environmentally significant
Beneficial	Positive effect, such as employment, local supply of gases, plantation, energy efficiency or water conservation

5.5.3 Extent and Location

Extent refers to the geographical area over which an impact may occur.

Extent	Description
Site-specific	Limited to the project footprint or a particular plant area
Local	Extends to the project boundary, adjacent plots, internal roads or nearby receptors
Area-wide	Extends across the AIIC industrial area or surrounding settlements
Regional	Extends beyond the local area, such as indirect GHG emissions, regional transport, or supply-chain effects

5.5.4 Timing and Duration

Timing identifies when an impact occurs, while duration describes how long it is expected to last.

Timing / duration	Description
Immediate	Occurs at the time of activity, such as construction dust or equipment noise
Short-term	Lasts for days, weeks or a limited construction period
Medium-term	Continues for months during construction, installation or commissioning
Long-term	Continues throughout the operational life of the facility
Intermittent	Occurs periodically, such as DG use, maintenance, tanker loading or blowdown
Permanent	Continues for the life of the development, such as industrial land use
Temporary	Stops once the activity is completed, such as civil-work noise

5.5.5 Reversibility

Reversibility describes whether the environmental condition can return to its baseline state after the activity stops.

Reversibility	Description
Reversible	Condition can return to baseline after the activity ceases or mitigation is applied
Partially reversible	Improvement is possible but may require restoration or extended time
Irreversible	Permanent change that cannot practically be restored, such as long-term land-use conversion

5.5.6 Probability and Risk

Probability reflects the likelihood of an impact occurring. Risk is evaluated by considering the probability of an event and the severity of its potential consequence.

Risk level	Description
High	Serious consequence and/or relatively credible likelihood; requires engineered controls, procedures, training and emergency preparedness
Moderate	Manageable through standard mitigation, inspection, monitoring and supervision
Low	Minor consequence and low likelihood; manageable through routine procedures
Acceptable residual risk	Risk remaining after controls is implemented and verified

5.6 Impact Significance Rating

Impact significance has been assessed by combining the sensitivity of the receptor with the magnitude of the predicted impact before and after mitigation.

Table 5.4: Receptor Sensitivity Criteria

Sensitivity level	Description
High	Sensitive community receptor, drinking-water source, protected area, surface-water body, school, hospital, highly vulnerable worker population, or high-consequence safety receptor
Medium	Industrial workers, adjacent industrial plots, estate drainage, local roads, groundwater, common vegetation, commercial facilities, and local settlements
Low	Disturbed industrial land, vacant plots, common roadside vegetation, on-site paved areas, and areas with low ecological/social sensitivity

Table 5.5: Impact Significance Classification

Significance rating	Description	Required management response
Major adverse	High-magnitude effect on a sensitive receptor, significant risk of standard exceedance, or potentially serious safety consequence	Avoidance or major design change required; detailed management and monitoring essential
Moderate adverse	Noticeable effect requiring specific mitigation and monitoring	Implement mitigation measures, supervision and periodic monitoring
Minor adverse	Small, localized and manageable effect	Apply routine good practice and inspection
Negligible	No material impact expected	No special mitigation beyond normal controls
Moderate beneficial	Clear local benefit, such as jobs, green belt or supply improvement	Enhance benefit through local hiring, plantation and stakeholder engagement
Major beneficial	Significant, lasting regional benefit	Maintain and strengthen through project planning and operational commitments

5.7 Summary of Potential Impacts

Table 5.6: Impact Characteristics by Project Phase

Project activity	Potential impact	Nature	Magnitude before mitigation	Extent	Duration	Reversibility	Probability / risk	Residual significance after mitigation
Site preparation and excavation	Dust generation and reduced local air quality	Direct adverse	Moderate	Site/local	Short-term	Reversible	High probability / moderate risk	Minor
Civil construction	Noise and vibration	Direct adverse	Moderate	Site/local	Temporary	Reversible	High probability / moderate risk	Minor
Construction traffic	Road congestion, dust and accident risk	Direct adverse	Moderate	Local	Temporary	Reversible	Medium probability / moderate risk	Minor to moderate
Construction workforce	Employment and local economic activity	Direct beneficial	Moderate	Local	Temporary	Reversible	High probability	Moderate beneficial
Construction waste	Soil/visual pollution if unmanaged	Direct adverse	Moderate	Site-specific	Temporary	Reversible	Medium probability / moderate risk	Minor
Compressor operation	Noise and vibration	Direct adverse	High without control	Site/local	Long-term	Reversible with controls	High probability / moderate risk	Minor to moderate
Cooling system	Water use and blowdown generation	Direct adverse	Moderate	Site-specific	Long-term	Reversible	High probability / moderate risk	Minor
Electricity consumption	Indirect GHG emissions	Indirect adverse	Moderate	Regional/global	Long-term	Partially reversible	High probability / moderate risk	Moderate
Standby DG operation	Air emissions and noise	Direct adverse	Low to moderate	Site/local	Intermittent	Reversible	Low probability / low to moderate risk	Minor
Domestic sewage	Water/soil contamination if untreated	Direct adverse	Moderate	Site/local	Long-term	Reversible with treatment	Medium probability / moderate risk	Minor
Cooling-tower blowdown	Water-quality impact if uncontrolled	Direct adverse	Moderate	Site/local	Intermittent	Reversible with treatment	Medium probability / moderate risk	Minor

Used oil and maintenance waste	Soil/groundwater contamination	Direct adverse	Moderate	Site-specific	Long-term/intermittent	Partially reversible	Low to medium probability / moderate risk	Minor
Cryogenic storage/filling	Cryogenic burns, oxygen enrichment, oxygen deficiency, pressure release	Direct adverse / accidental	High	Site/local	Intermittent / emergency	Reversible with response; potential serious consequence	Low probability / high risk	Moderate
Tanker transport	Road accident, product release and public safety risk	Direct adverse / accidental	High	Local/regional route	Intermittent	Reversible; potential serious consequence	Low probability / high risk	Moderate
Green belt and plantation	Improved visual quality, dust interception and ecological enhancement	Direct beneficial	Moderate	Site/local	Long-term	Beneficial	High probability	Moderate beneficial
Rainwater harvesting	Reduced runoff and water conservation	Direct beneficial	Moderate	Site-specific	Long-term	Beneficial	High probability	Moderate beneficial
Solar-energy system	Reduced grid-power demand for suitable loads	Indirect beneficial	Low to moderate	Site/regional	Long-term	Beneficial	Medium probability	Minor to moderate beneficial

5.8 Construction-Phase Impact Characteristics

Construction activities will include site preparation, excavation, foundation works, civil construction, equipment installation, electrical works, piping, tank erection, internal road development, drainage works, and landscaping. These activities will be temporary but may generate dust, noise, waste, traffic, and worker-safety risks.

5.8.1 Dust and Air Emissions

Dust may arise from excavation, earth handling, movement of trucks, storage of construction materials, concrete works, cutting/grinding, and unpaved internal roads. The impact will be direct, short-term, localized, reversible, and moderate before mitigation. With water sprinkling, covered trucks, speed control, stockpile management, housekeeping, and proper material storage, the residual impact is expected to be minor.

5.8.2 Construction Noise and Vibration

Noise may be generated by excavators, concrete mixers, cranes, generators, welding machines, power tools, vehicles, and equipment installation. The impact will be temporary, localized, and reversible. Construction activities shall be scheduled during daytime where practicable, high-noise equipment shall be maintained,

workers shall use hearing protection, and unnecessary idling shall be avoided. The residual impact is expected to be minor.

5.8.3 Soil, Drainage and Waste

Excavation and construction may disturb soil and increase erosion or sediment runoff during rainfall. Construction waste may include scrap metal, wood, concrete debris, packaging material, surplus soil, and domestic waste. The impact is localized and temporary but may become moderate if waste is dumped or runoff is uncontrolled. Segregated waste storage, reuse of suitable excavated material, covered storage, temporary drains, silt-control measures, and disposal through approved channels will reduce the impact to minor.

5.8.4 Worker Health and Safety

Construction presents high occupational safety risks because of work at height, heavy lifting, electrical work, excavation, vehicle movement, welding, cutting, scaffolding, and machinery operation. The impact has high potential consequence but can be effectively managed through contractor HSE plans, induction training, PPE, permit-to-work systems, barricading, first aid, emergency arrangements, inspections, and supervision. Residual risk is expected to be moderate and manageable.

5.8.5 Traffic and Community Interaction

Construction traffic may temporarily increase movement of trucks, cranes, trailers, equipment, and workers. The impact is localized and temporary but may affect road users and adjacent industrial activities. A traffic-management plan, designated vehicle routes, speed limits, controlled entry/exit, covered vehicles, and avoidance of peak periods will reduce the impact to minor.

5.9 Operational-Phase Impact Characteristics

5.9.1 Operational Noise and Vibration

The main air compressor and associated rotating equipment are expected to be the most important operational noise sources. The draft project information indicates that compressor noise may be high at source without acoustic treatment. The impact is direct, long-term, and localized, with possible effect on workers and plant-boundary receptors.

The compressor house shall be equipped with acoustic enclosure, silencers, anti-vibration mounts, suitable building treatment, preventive maintenance, and noise monitoring. Workers in high-noise zones shall use hearing

protection. With these measures, noise at the plant boundary is expected to remain within applicable industrial-area requirements, and residual impact is expected to be minor to moderate.

5.9.2 Air Quality and DG Emissions

The ASU does not involve routine process combustion or chemical-reaction emissions. The main air-emission sources during operation will be standby DG exhaust, vehicle emissions, occasional maintenance activities, and controlled process venting. The impact is expected to be low to moderate, intermittent, localized, and reversible.

The DG set shall be properly maintained, provided with an adequate exhaust stack, operated only for emergency/backup requirements, and monitored as required. Product-dispatch and employee vehicles shall have valid fitness certification and shall not be allowed unnecessary idling. Residual impact on ambient air quality is expected to be minor.

5.9.3 Electricity Consumption and Indirect GHG Emissions

The cryogenic ASU requires substantial electricity for air compression, refrigeration, cooling-water circulation, pumping, instrumentation, filling, and auxiliary systems. This impact is indirect, long-term, and regional/global in extent because grid electricity consumption contributes to indirect greenhouse-gas emissions.

The project will reduce this impact through energy-efficient equipment, turbo-expander energy recovery, variable-frequency drives, energy metering, preventive maintenance, efficient lighting, and solar electricity for suitable auxiliary loads. Residual impact remains moderate because electricity demand is inherent to cryogenic air separation, but the project shall continuously pursue energy-efficiency improvement.

5.9.4 Water Consumption and Cooling-Tower Operation

Water will be used mainly for cooling-system make-up, domestic use, cleaning, green-belt irrigation, and firefighting-system testing. The impact is direct, long-term, site-specific, and moderate before mitigation. The project proposes a closed-loop cooling-water system, which reduces freshwater demand by recirculating cooling water.

The final design shall include water metering, a confirmed water balance, drift eliminators, water-treatment chemical control, blowdown management, rainwater harvesting, and reuse of treated water where feasible. With these controls, the impact is expected to be minor.

5.9.5 Wastewater and Stormwater

The ASU itself is not expected to generate conventional process effluent. Potential wastewater streams include domestic sewage, cooling-tower blowdown, wash water, and potentially contaminated runoff from workshop, oil/chemical storage, tanker loading, or maintenance areas.

Without appropriate controls, uncontrolled wastewater or contaminated runoff could affect soil, groundwater, and estate drainage. The impact is localized, long-term/intermittent, and reversible if managed properly. The project shall provide separate stormwater and wastewater drains, oil-and-grit separators, approved treatment/disposal arrangements, monitoring, and record keeping. Residual impact is expected to be minor.

5.9.6 Solid and Hazardous Waste

Operational waste will include domestic waste, packaging, scrap metal, used oil, oil filters, oily rags, chemical containers, spent filters, and periodic spent adsorbent/molecular sieve material. The main risk is contamination of soil and groundwater from oil or chemical waste.

The project shall segregate wastes at source, provide covered storage, use impermeable flooring and secondary containment for hazardous waste, maintain waste manifests, recycle usable material, and dispose hazardous waste through authorized channels. With proper implementation, residual impact is expected to be minor.

5.9.7 Cryogenic, Oxygen-Enrichment and Oxygen-Deficiency Hazards

Liquid oxygen, liquid nitrogen, liquid argon, high-pressure oxygen, and nitrogen systems present potentially high-consequence safety risks. Liquid products can cause cryogenic burns and frostbite. Oxygen enrichment can significantly increase the intensity of combustion, especially where combustible materials, oil, grease, or ignition sources are present. Nitrogen release can reduce oxygen concentration in confined or poorly ventilated areas, creating an asphyxiation hazard.

These impacts are accidental in nature and unlikely during normal operation if design and operational controls are effective; however, their consequence may be high. The project shall implement fixed oxygen monitors, alarms, ventilation, oxygen-service cleanliness, no-oil/no-grease procedures, emergency isolation, fire protection, pressure-relief devices, safe tank separation, signage, restricted access, PPE, SCBA, permit-to-work controls, operator training, and emergency drills. Residual risk is expected to be moderate and acceptable only with continuous implementation of the safety-management system.

5.9.8 Transport and Traffic

Product distribution through tankers, ISO containers, and cylinder vehicles will increase heavy-vehicle movement. Impacts may include traffic congestion, road accident risk, vehicle emissions, noise, and potential product release during an accident. This impact is intermittent, local to regional in extent, and potentially high in consequence.

A transport-management plan shall define routes, schedules, vehicle inspection, driver competency, loading controls, emergency information, communication procedures, fitness certificates, speed limits, route restrictions where necessary, and incident reporting. The residual impact is expected to be moderate and manageable.

5.9.9 Socioeconomic Benefits

The project is expected to generate positive socioeconomic impacts through construction employment, technical employment, logistics, local procurement, support services, and improved availability of industrial and medical gases. The project documents indicate planned employment growth over the first five years of operation.

The impact is beneficial, local to regional in extent, long-term during operation, and potentially moderate. MCL should give preference to suitably qualified local workers, provide equal-opportunity recruitment, offer skills development, maintain safe working conditions, and establish a grievance mechanism.

5.10 Accidental and Emergency Impact Characteristics

Potential emergency scenarios include:

- Cryogenic liquid leak from tank, pipeline, pump, hose, fitting, or transfer operation.
- Oxygen enrichment due to loss of containment of oxygen.
- Nitrogen release causing oxygen-deficient atmosphere.
- Failure of pressure-relief valve, pipeline, vessel, or filling manifold.
- Fire in or near oxygen-service equipment or combustible materials.
- Electrical fire in control room, transformer area, cable trench, or electrical panels.
- Diesel spill or fire associated with standby DG set or fuel handling.
- Road accident involving cryogenic tanker or cylinder-delivery vehicle.
- Severe weather, flooding, power failure, or equipment malfunction.
- Injury during confined-space entry, work at height, lifting operation, or maintenance.

Table 5.7: Emergency Impact Characteristics

Emergency scenario	Nature	Potential consequence	Likelihood without controls	Main prevention/mitigation measures	Residual risk
LOX leak/spill	Accidental	Cryogenic injury, oxygen enrichment and increased fire intensity	Low to medium	Tank integrity, inspection, isolation valves, spill procedures, exclusion zone, no ignition sources, PPE and emergency response	Moderate
LIN/LAR leak	Accidental	Cryogenic injury and oxygen-deficiency hazard	Low to medium	Ventilation, oxygen monitors, alarms, confined-space controls, PPE, evacuation and rescue arrangements	Moderate
Oxygen-enriched atmosphere	Accidental	Rapid combustion/fire escalation where ignition source or combustible material exists	Low	No oil/grease policy, ignition control, oxygen-service cleaning, monitoring, fire protection and training	Moderate
High-pressure release	Accidental	Injury, equipment damage and gas release	Low	Pressure-relief devices, inspection, test certification, maintenance and exclusion zones	Low to moderate
DG fuel spill/fire	Accidental	Soil contamination, local fire and smoke	Low	Bunding, safe storage, spill kits, extinguishers and trained staff	Low
Tanker accident	Accidental	Injury, traffic disruption, product release and possible fire escalation	Low	Driver training, approved routes, fitness checks, vehicle inspection, emergency information and coordination with responders	Moderate
Electrical fire	Accidental	Injury, equipment damage and operational disruption	Low to medium	Earthing, cable protection, preventive maintenance, fire detection, extinguishers and emergency shutdown	Low to moderate

5.11 Cumulative Impacts

The project is located within AIIC, where other industrial activities are existing, under construction, or planned. Cumulative impacts may arise from combined traffic, dust, noise, utility demand, drainage load, wastewater generation, waste movement, and air emissions from multiple industrial units.

The key cumulative issues requiring attention are:

- Traffic increase on AIIC internal roads and access routes.
- Dust and vehicle emissions during simultaneous construction activities.
- Combined noise from multiple industrial facilities.
- Demand on electricity, water, drainage, sewerage, and emergency-response infrastructure.
- Industrial-estate stormwater management and prevention of drain contamination.
- Cumulative fire and safety risks associated with storage, transport, and industrial operations.

The project will reduce cumulative impacts by maintaining internal roads, controlling vehicle movement, implementing dust suppression, managing wastewater and runoff within the plot, maintaining a green belt, coordinating emergency preparedness with AIIC/FIEDMC, and complying with environmental approval conditions.

5.12 Positive Impacts

The proposed project is expected to provide several beneficial impacts:

- Increased availability of oxygen, nitrogen, and argon for medical and industrial use.
- Improved reliability of regional gas supply.
- Potential support to hospitals, healthcare services, metal fabrication, welding, chemical, food-processing, pharmaceutical, and manufacturing sectors.
- Direct and indirect employment during construction and operation.
- Local procurement and support to transport, maintenance, service, and supply businesses.
- Development of industrial infrastructure within AIIC.
- Plantation and green-belt development within the project area.
- Rainwater harvesting and improved stormwater management.
- Energy-efficiency measures, including turbo-expander recovery, VFDs, efficient equipment, and proposed solar power for suitable loads.
- Environmental monitoring, safety training, emergency preparedness, and improved industrial environmental-management practices.

5.13 Conclusion

The impact assessment identifies that the proposed 240 TPD Cryogenic Air Separation Unit can create temporary construction-phase impacts and longer-term operational impacts. The most significant adverse issues relate to compressor noise, electricity consumption, cooling-water management, wastewater and stormwater control, hazardous maintenance waste, tanker movement, cryogenic hazards, oxygen enrichment, oxygen deficiency, fire safety, and occupational health and safety.

The assessment confirms that most routine impacts are localized, manageable, and reversible when the proposed mitigation measures are incorporated into final design, construction contracts, operating procedures, and the Environmental and Social Management Plan. Accidental events involving cryogenic liquids, oxygen enrichment, nitrogen release, pressure systems, and tanker transport have potentially higher consequences and therefore require robust engineering controls, trained personnel, continuous monitoring, emergency planning, and coordination with relevant emergency services.

The subsequent chapters of this EIA provide detailed mitigation measures, institutional responsibilities, monitoring requirements, waste-management procedures, occupational health and safety measures, emergency-response arrangements, and environmental-management commitments for the project.

CHAPTER 6

SCREENING OF POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

6.1 Introduction

This chapter presents the screening of potential environmental, occupational health and safety, and socioeconomic impacts associated with the proposed **240 TPD Cryogenic Air Separation Unit (ASU)** of Multan Chemicals Limited (MCL) at Plot No. 57C, Allama Iqbal Industrial City (AIIC), Sahianwala, Faisalabad.

The screening considers likely impacts related to the project location, plant design, construction activities, operational activities, product storage and dispatch, use of water and energy, wastewater and waste generation, traffic, occupational safety, emergency conditions, and opportunities for environmental enhancement.

The proposed project is an air-separation facility in which atmospheric air will be compressed, purified, cooled to cryogenic temperature, and separated into oxygen, nitrogen, and argon. The process does not involve a conventional chemical reaction or routine process combustion. However, the project requires detailed management of compressor noise, electricity use, cooling-water systems, wastewater, drainage, maintenance waste, cryogenic liquids, oxygen-enrichment hazards, nitrogen-related oxygen-deficiency hazards, tanker movement, and fire safety.

6.2 Environmental Screening Criteria

Potential impacts have been screened according to the following criteria:

- Nature of impact: adverse or beneficial; direct, indirect, cumulative, or accidental.
- Magnitude: low, moderate, or high.
- Extent: site-specific, local, area-wide, or regional.
- Duration: temporary, short-term, intermittent, long-term, or permanent.
- Reversibility: reversible, partially reversible, or irreversible.
- Likelihood: high, medium, low, or very low.
- Receptor sensitivity: low, medium, or high.
- Residual significance after mitigation: negligible, minor, moderate, or major.

The main management principle applied is the mitigation hierarchy:

1. Avoid the impact through proper site selection and design.
2. Minimize the impact through engineering and operational controls.

3. Control the impact through monitoring, maintenance, training, and supervision.
4. Restore affected areas where disturbance occurs.
5. Enhance beneficial impacts through plantation, resource conservation, local employment, and community engagement.

6.3 Screening of Impacts Related to Project Location

6.3.1 Land Use Compatibility

The project is proposed at Plot No. 57C, AIIC, Faisalabad. The plot is located within a planned industrial estate and Special Economic Zone managed by FIEDMC. The site has been provisionally allotted to Multan Chemicals Limited for establishment of an Air Separation Unit for production of oxygen, nitrogen, argon, and related by-products. The land use is therefore compatible with the proposed industrial activity.

The project will change the existing vacant or undeveloped industrial plot into a developed ASU facility. This change will be permanent but is consistent with the approved industrial character of the area. No residential resettlement or conversion of agricultural land is anticipated.

Mitigation and management measures will include compliance with approved site layout, building-control requirements, setbacks, storage safety distances, internal roads, drainage provisions, emergency access, firewater facilities, and green-belt requirements.

6.3.2 Proximity to Sensitive Receptors

The immediate surroundings are predominantly industrial or designated for industrial development. The project draft indicates that nearby residential settlements are buffered from the site by industrial plots and infrastructure. The final EIA shall verify all nearby settlements, schools, healthcare facilities, mosques, water bodies, drainage channels, and other sensitive receptors through a current field survey and map.

The key potential off-site concerns are compressor noise, tanker movement, product-dispatch traffic, and accidental cryogenic-gas release. These impacts will be managed through acoustic controls, route management, safety distances, emergency planning, and continuous coordination with AIIC/FIEDMC.

6.3.3 Drainage, Groundwater and Surface Water

The site is located in an industrial area where stormwater and sewerage infrastructure is available or under development. The proposed project will require a clear separation between clean stormwater, domestic wastewater, cooling-tower blowdown, and potentially contaminated runoff from maintenance, fuel, chemical-storage, product-filling, and tanker-loading areas.

The project shall not allow direct discharge of untreated wastewater, fuel-contaminated runoff, used oil, or chemical spills to open land, stormwater drains, or groundwater. Drainage design shall incorporate appropriate slopes, collection channels, inspection chambers, silt traps, oil-and-grit separators, and controlled discharge/treatment arrangements.

Table 6.1: Location-Related Impact Screening

Environmental aspect	Potential impact	Pre-mitigation significance	Mitigation measure	Residual significance
Industrial land use	Permanent conversion of vacant industrial plot into ASU facility	Minor	Develop only according to approved industrial land use, layout, setbacks, and building requirements	Negligible
Nearby industrial receptors	Noise, vehicle movement and temporary construction disturbance	Moderate	Acoustic treatment, controlled construction hours, traffic plan and boundary monitoring	Minor
Nearby settlements/receptors	Potential noise, traffic or emergency concern	Moderate	Receptor verification, safety layout, emergency plan, controlled dispatch and grievance mechanism	Minor
Drainage infrastructure	Risk of drain contamination from wastewater or spills	Moderate	Separate drainage, oil-and-grit traps, wastewater treatment/disposal and spill-control procedures	Minor
Groundwater	Potential contamination from	Moderate	Impervious floors, bunding, hazardous-waste storage,	Minor

	oil, fuel, chemicals or waste		spill kits and routine inspection	
Regional air environment	Existing particulate levels may already be influenced by industrial/traffic dust	Moderate	Strict construction dust control, vehicle maintenance, DG management and green belt	Minor
Transport access	Increased heavy-vehicle movement at estate roads and access points	Moderate	Approved transport routes, traffic scheduling, trained drivers, speed control and GPS/communication arrangements	Minor to moderate

6.4 Screening of Design-Related Impacts

6.4.1 Process Design

The selected process is cryogenic air separation. Atmospheric air is filtered, compressed, purified, cooled, liquefied, and separated through distillation into oxygen, nitrogen, and argon. The process does not generate conventional chemical-reaction waste or continuous combustion emissions. However, it uses substantial electricity, compressor systems, cooling equipment, cryogenic tanks, high-pressure equipment, and product-filling facilities.

The main design-related environmental issues are noise from compressors, water use in cooling, cooling-tower blowdown, wastewater management, emergency power emissions, and prevention of gas leaks, fire escalation, oxygen deficiency, and cryogenic exposure.

6.4.2 Compressor Noise and Vibration

The main air compressor and associated rotating machinery will be the principal sources of operational noise and vibration. The draft project information indicates that compressor noise may be high at source if not controlled.

The design shall include acoustic enclosures, equipment silencers, anti-vibration mounts, flexible connections, suitable foundations, preventive-maintenance access, and noise monitoring points at the boundary. Compressor-house design shall prevent excessive noise transmission to adjacent areas, while workers in high-noise zones shall receive hearing-protection equipment.

6.4.3 Cooling-Water and Water-Management Design

The project is expected to use a closed-loop cooling-water system. Freshwater will be needed mainly for cooling-system make-up and domestic purposes. The draft indicates approximately 35 KLD water demand, comprising cooling-tower make-up and domestic consumption, although the final water balance must be confirmed through detailed engineering.

The cooling system shall include high-efficiency drift eliminators, water metering, non-chromate treatment chemicals, monitoring of water quality, controlled blowdown, and integration with rainwater harvesting where technically feasible. The final design shall avoid once-through cooling and uncontrolled release of blowdown.

6.4.4 Wastewater and Drainage Design

The ASU is not expected to generate conventional process effluent. Potential liquid waste streams will include domestic sewage, cooling-tower blowdown, wash water, and contaminated runoff from workshop, oil/chemical-storage, filling, and loading areas.

The final design shall include:

- Separate drains for clean stormwater, domestic sewage, cooling-tower blowdown, and potentially contaminated runoff.
- Adequate sewage-treatment/disposal arrangement approved by AIIC/FIEDMC and relevant authorities.
- Oil-and-grit separators at workshop, chemical-storage, DG, vehicle-maintenance, and tanker-handling areas.
- Impervious floors and contained drainage in oil/chemical-storage areas.
- Inspection chambers and sampling points before final discharge or reuse.
- Rainwater harvesting and recharge/collection structures.
- No connection of contaminated wastewater to clean stormwater drains.

6.4.5 Cryogenic Storage and Product-Handling Design

The main safety risk arises from storage and handling of liquid oxygen, liquid nitrogen, liquid argon, and gaseous oxygen. Liquid products can cause cryogenic burns and frostbite. Oxygen leaks can increase fire intensity in the presence of combustible materials or ignition sources, while nitrogen release can reduce oxygen concentration in confined or poorly ventilated areas.

The design shall provide properly engineered cryogenic tanks, safe separation between storage and occupied areas, pressure-relief valves, emergency isolation valves, safe venting arrangements, controlled tanker-loading

positions, and access restrictions. Fixed oxygen-deficiency and oxygen-enrichment monitors shall be installed at identified locations such as storage areas, filling areas, cold-box area, enclosed spaces, and other risk-prone locations.

6.4.6 Fire Protection and Emergency Design

The ASU shall be provided with a fire-protection system appropriate to the final risk assessment and approved design. The system shall include firewater storage, fire pumps, hydrant network, hose reels, portable fire extinguishers, emergency lighting, alarms, emergency exits, assembly points, communication arrangements, and access for emergency vehicles.

The detailed design shall also include earthing, lightning protection, emergency shutdown system, safe electrical installation, hazard signage, no-smoking controls, and a clear separation between oxygen-service facilities and potential ignition/combustible sources.

Table 6.2: Design-Related Impact Screening

Design aspect	Potential impact	Pre-mitigation significance	Mitigation measure	Residual significance
Main air compressor	High source noise and vibration	High	Acoustic enclosure, silencers, anti-vibration mounts, equipment maintenance and PPE	Minor to moderate
Electrical system	High energy consumption and indirect GHG emissions	Moderate	Efficient motors, VFDs, turbo-expander recovery, metering, preventive maintenance and solar system	Moderate
Cooling-water system	Water use, drift and blowdown	Moderate	Closed-loop system, drift eliminators, water treatment, metering and controlled blowdown	Minor
Wastewater design	Soil/drain contamination from sewage, blowdown or runoff	Moderate	Separate drains, treatment/disposal system, oil traps and monitoring points	Minor

Oil/chemical storage	Soil and groundwater contamination from leakage/spill	Moderate	Bunded storage, impervious floor, labelled containers, spill kits and inspections	Minor
Cryogenic storage	Cryogenic injury, oxygen enrichment, oxygen deficiency, pressure release	High	Approved equipment, pressure relief, oxygen monitors, ventilation, isolation valves, training and emergency response	Moderate
Filling/loading area	Leakage, fire escalation, vehicle collision and worker injury	High	Controlled loading bays, barriers, grounding, operating procedures, supervision and emergency equipment	Moderate
DG set	Intermittent emissions and noise	Moderate	Adequate stack, acoustic treatment, proper maintenance and limited emergency operation	Minor
Fire protection	Fire spread or delayed response in emergency	High	Firewater, hydrants, pumps, extinguishers, emergency access, alarms and drills	Moderate

6.5 Screening of Construction-Phase Impacts

6.5.1 Construction Activities

The construction phase will include site preparation, boundary works, excavation, foundation construction, civil works, installation of structural steel, erection of tanks and equipment, piping, electrical works, internal roads, drainage works, utility installation, landscaping, and commissioning support. The duration is expected to be approximately 12–14 months, subject to final implementation schedule.

Construction impacts will generally be temporary, localized, and reversible. Their significance will depend on contractor performance, weather conditions, material storage, vehicle management, waste handling, and compliance with environmental and safety requirements.

6.5.2 Dust and Air Quality

Dust may be generated from excavation, earthworks, vehicle movement, loading/unloading of materials, stockpiles, concrete works, cutting/grinding, and internal roads. Diesel vehicles and equipment may also emit exhaust gases.

Dust shall be controlled through regular water sprinkling, covering of trucks, controlled vehicle speed, stabilization of exposed areas, covered storage of fine materials, wheel-cleaning where required, proper housekeeping, and prompt removal of construction debris. Equipment and vehicles shall be maintained to minimize smoke and exhaust emissions.

6.5.3 Construction Noise and Vibration

Construction machinery, vehicles, cranes, concrete mixers, generators, welding equipment, cutting tools, and installation activities may generate noise. The impact will be temporary and mostly limited to the project site and nearby industrial plots.

Contractors shall maintain machinery, avoid unnecessary idling, use quieter equipment where feasible, restrict high-noise activities to daytime, provide hearing protection to workers, and monitor noise where required. Work schedules shall be coordinated to avoid unnecessary disturbance to nearby industrial operations.

6.5.4 Soil, Drainage and Waste

Excavation and exposed soil may create erosion, sediment movement, and muddy runoff during rainfall. Construction waste may include soil, concrete debris, wood, steel scrap, packaging, cable waste, plastic, welding rods, and domestic waste.

The contractor shall prepare a Construction Waste Management Plan. Suitable excavated material shall be reused for levelling and backfilling where technically suitable. Waste shall be segregated, stored at designated locations, recycled where feasible, and removed through approved disposal arrangements. Open burning and uncontrolled dumping shall be prohibited.

6.5.5 Labour Welfare and Occupational Safety

Construction will involve risks from excavation, lifting operations, work at height, electrical installation, welding, grinding, hot work, scaffolding, mobile equipment, traffic movement, and manual handling. Workers may also experience heat stress during summer.

The contractor shall prepare and implement a site-specific Health, Safety and Environment Plan. The plan shall include worker induction, toolbox talks, PPE, first aid, emergency response, safe drinking water, sanitation, rest areas, heat-stress management, incident reporting, permit-to-work system, lifting plans, traffic controls, and regular safety inspections.

Table 6.3: Construction-Phase Impact Screening and Mitigation

Construction activity	Potential impact	Pre-mitigation significance	Mitigation measures	Residual significance
Site clearing and earthworks	Dust, exposed soil, erosion and runoff	Moderate	Water sprinkling, phased clearing, temporary drainage, covered stockpiles and housekeeping	Minor
Excavation and foundation works	Soil disturbance, safety risks and waste generation	Moderate	Barricading, safe excavation, reuse of soil, waste segregation and drain protection	Minor
Concrete, steel and civil works	Dust, noise, debris and worker hazards	Moderate	Controlled work practices, PPE, waste collection, equipment maintenance and supervision	Minor
Equipment installation	Lifting hazards, traffic disruption, noise and safety risks	High	Lifting plan, certified cranes/rigging, barricading, banksmen, permit-to-work and emergency readiness	Moderate
Welding and cutting	Fire risk, fumes, sparks and metal waste	Moderate	Hot-work permits, fire watch, ventilation, extinguishers, PPE and scrap collection	Minor
Construction machinery	Exhaust emissions, noise and fuel/oil leakage	Moderate	Vehicle maintenance, no-idling, designated fueling, drip trays and spill kits	Minor
Worker camps/temporary facilities, if any	Domestic waste, wastewater and sanitation issues	Moderate	Toilets, waste bins, potable water, septic arrangement and regular housekeeping	Minor
Construction transport	Congestion, road-safety risk, dust and community disturbance	Moderate	Traffic plan, covered trucks, speed limits, routing, signage and trained drivers	Minor
Landscaping and plantation	Positive improvement in green cover	Beneficial	Native/adapted species, irrigation, survival monitoring and replacement planting	Moderate beneficial

6.6 Screening of Operational-Phase Impacts

6.6.1 General Operational Impacts

The operational phase will include continuous ASU operation, air compression, purification, cryogenic cooling, distillation, product storage, pumping, vaporization, cylinder filling, tanker loading, dispatch, cooling-water circulation, standby DG testing/operation, maintenance, waste handling, and administrative activities.

The project will operate approximately 24 hours per day, subject to planned maintenance shutdowns. The draft indicates annual operation for approximately 330 days.

6.6.2 Air Emissions

The ASU does not use routine process combustion. Consequently, emissions from the core process are expected to be limited. The main operational emission sources will be diesel-generator exhaust, vehicle emissions, occasional maintenance activity, and controlled process venting.

The standby DG set shall be operated only when required. It shall be fitted with a suitable exhaust stack, maintained regularly, and supplied with appropriate-quality fuel. The generator area shall be inspected for smoke, fuel leakage, noise, and maintenance condition. Vehicle emissions shall be controlled through fitness certification, preventive maintenance, no-idling instructions, and route optimization.

6.6.3 Noise and Vibration

The highest operational noise is expected from the main air compressor, auxiliary compressors, pumps, cooling tower, vaporizers, blow-off valves, filling systems, and DG set. The impact may be significant without controls because the plant will operate continuously.

Noise will be controlled through acoustic enclosures, silencers, anti-vibration mounts, closed buildings where necessary, equipment balancing, preventive maintenance, hearing protection, and periodic boundary noise monitoring. The EMP proposes that noise shall be monitored at compressor house, plant boundary, and site corners.

6.6.4 Water Consumption and Wastewater

The project requires freshwater mainly for cooling-system make-up and domestic use. The draft refers to a closed-loop cooling-water system, approximately 35 KLD freshwater requirement, domestic wastewater of approximately 5.6 KLD, and cooling-tower blowdown requiring controlled management. These figures shall be verified in the final water balance.

Water conservation shall be achieved through closed-loop cooling, leak prevention, water metering, high-efficiency drift eliminators, controlled blowdown, rainwater harvesting, and reuse of treated water where technically feasible and legally permissible.

Domestic sewage shall be treated through an approved arrangement or discharged to the approved AIIC sewerage system. Cooling-tower blowdown shall be treated, reused, or discharged only through an approved route. No wastewater shall be discharged to open land, clean stormwater drains, or groundwater.

6.6.5 Solid and Hazardous Waste

Operational waste is expected to include general office waste, food waste, packaging material, metal scrap, spent filters, damaged insulation, used oil, oil filters, oily rags, empty chemical containers, and periodic spent adsorbent/molecular sieve material.

The project shall provide colour-coded bins, segregated storage areas, recycling arrangements, covered municipal-waste storage, and a dedicated hazardous-waste area. Used oil and hazardous maintenance waste shall be stored in labelled leak-proof containers on an impervious floor with secondary containment. Disposal shall be through authorized contractors, and all records shall be maintained.

6.6.6 Cryogenic Products, Storage and Filling

Cryogenic product handling is the most important operational safety consideration. Oxygen does not burn itself, but oxygen-enriched conditions can make materials ignite more easily and burn more intensely. Nitrogen and argon can displace atmospheric oxygen in enclosed areas and create an oxygen-deficient atmosphere. Cryogenic liquids can cause severe cold burns on skin or eyes.

The plant shall establish controlled tank-farm and filling areas, use oxygen-compatible equipment, strictly prohibit oil and grease in oxygen-service equipment, provide ventilation, install fixed oxygen monitors, maintain emergency isolation valves, test pressure-relief systems, provide cryogenic PPE, and conduct regular training and emergency drills.

6.6.7 Transport and Dispatch

The project will dispatch liquid gases through tankers/ISO containers and gaseous products through cylinders. This activity may create traffic, road-safety, and accidental-release risks.

MCL shall operate an approved transport-management system including tanker/cylinder vehicle inspection, driver training, journey planning, emergency information, route selection, vehicle fitness checks, speed control, dispatch scheduling, loading supervision, communication system, and incident-reporting procedure.

6.6.8 Occupational Health and Safety

Employees may face exposure to high noise, high pressure, cryogenic liquids, oxygen-enriched or oxygen-deficient atmospheres, electrical systems, moving machinery, hot surfaces, manual handling, cylinders, work at height, confined spaces, and maintenance hazards.

The project shall implement a full HSE management system, including risk assessment, standard operating procedures, permit-to-work, PPE, safety training, medical fitness, incident reporting, internal audits, emergency drills, fire-system testing, and corrective-action tracking.

Table 6.4: Operational-Phase Impact Screening and Mitigation

Operational activity	Potential impact	Pre-mitigation significance	Mitigation measures	Residual significance
Air compression and ASU operation	Compressor noise, vibration and high energy use	High	Acoustic enclosure, silencers, vibration isolation, VFDs, energy monitoring and preventive maintenance	Minor to moderate
Electricity use	Indirect greenhouse-gas emissions	Moderate	Efficient motors, VFDs, turbo-expander energy recovery, solar power and energy audits	Moderate
Cooling-water operation	Water consumption, drift and blowdown	Moderate	Closed-loop system, drift eliminators, water metering, chemical control, rainwater harvesting and controlled blowdown	Minor
Domestic activities	Domestic sewage and solid waste	Moderate	Approved sewage treatment/disposal, bins, collection and housekeeping	Minor
DG operation	Stack emissions, noise and diesel spill risk	Moderate	Suitable stack, maintenance, fuel containment, spill kits, acoustic measures and limited use	Minor
Workshop/maintenance	Used oil, filters, oily rags and scrap	Moderate	Hazardous-waste storage, labelled containers, bunding, inventory and authorized disposal	Minor
Cryogenic storage	Cryogenic burns, oxygen enrichment, oxygen deficiency and pressure-release risk	High	Safe design, alarms, monitors, ventilation, PPE, isolation, inspections and emergency response	Moderate

Cylinder filling	Leak, high-pressure injury, noise and manual-handling risk	High	SOPs, secured cylinders, filling manifold inspection, PPE, barriers and trained operators	Moderate
Tanker loading and dispatch	Accident risk, traffic congestion and gas release	High	Loading procedures, driver training, vehicle inspection, route plan and emergency communication	Moderate
Green belt maintenance	Water requirement and pesticide/fertilizer misuse if unmanaged	Low	Drip irrigation, controlled use of inputs, native/adapted species and survival monitoring	Negligible
Security and lighting	Light disturbance and power use	Low	Downward-facing LED lights, timers/sensors and efficient lighting	Negligible

6.7 Potential Environmental Enhancement Measures

The project provides an opportunity to improve environmental performance beyond minimum compliance requirements. The following enhancement measures are proposed as part of project design and operation.

6.7.1 Rainwater Harvesting and Stormwater Management

The draft project information proposes a rainwater-harvesting system comprising recharge trenches and an underground storage tank. Roof runoff and other suitable clean runoff shall be collected through a properly designed drainage system, passed through silt traps and oil-and-grit separators where required, and directed to storage or recharge structures.

Rainwater harvesting will reduce stormwater runoff, support landscaping/cleaning demand, contribute to groundwater recharge where technically appropriate, and reduce pressure on industrial-estate drainage infrastructure.

6.7.2 Solar Power and Energy Conservation

The project proposes a rooftop solar photovoltaic system for suitable auxiliary loads, subject to final design and roof availability. The facility refers to a 5 MW solar system.

The project shall also implement variable-frequency drives, turbo-expander energy recovery, high-efficiency motors, efficient pumps, LED lighting, automatic lighting controls, energy metering, and periodic energy audits. These measures will reduce electricity use and associated indirect greenhouse-gas emissions.

6.7.3 Green Belt and Tree Plantation

The draft proposes that approximately 15% of the plot area, equivalent to about 7,679 m², will be developed as green belt with around 400 trees, subject to final layout and regulatory requirements.

The green belt shall be developed along the site boundary, road-facing areas, open spaces, and appropriate buffer locations. Locally suitable species such as Neem, Shisham, Bottle Brush, and other adapted species shall be selected. The plantation plan shall include drip irrigation, mulch, protective guards where required, replacement planting, survival monitoring, and maintenance for at least three years.

6.7.4 Waste Minimization and Circular Practices

The project shall minimize waste through proper procurement, inventory control, reuse of suitable packaging, recycling of metal scrap and cardboard, return of spent adsorbent to supplier where feasible, use of reusable spill-control materials where appropriate, and segregated disposal of hazardous waste.

6.7.5 Cleaner Transport and Traffic Management

The project shall reduce transport impacts by optimizing dispatch routes, avoiding unnecessary trips, maintaining vehicles, discouraging idling, scheduling tanker movement to avoid peak times where practicable, and training drivers in fuel-efficient and defensive driving practices.

6.7.6 Environmental Management System

MCL shall establish an Environment, Health and Safety Cell responsible for environmental monitoring, waste records, safety inspections, emergency drills, compliance reporting, green-belt maintenance, rainwater-harvesting upkeep, stakeholder communication, and corrective actions. The EMP proposes an EHS Manager, Environmental Officer, and Safety Officer, supported by third-party environmental monitoring.

Table 6.5: Environmental Enhancement Measures

Enhancement measure	Proposed action	Expected benefit
Closed-loop cooling	Recirculate cooling water and control blowdown	Reduced freshwater requirement and lower wastewater generation
Rainwater harvesting	Provide recharge trenches and rainwater storage, subject to final design	Reduced runoff, water conservation and possible landscaping reuse
Solar PV system	Install rooftop solar system for suitable auxiliary loads	Reduced grid electricity use and indirect carbon emissions
Turbo-expander recovery	Use energy recovery within cryogenic process	Improved process energy efficiency
VFDs and efficient motors	Install VFDs on suitable motors, pumps and cooling fans	Lower electricity consumption and reduced mechanical wear
Green belt	Develop plantation on available site area	Dust interception, visual improvement, shading and ecological enhancement
Drip irrigation	Use controlled irrigation for green belt	Reduced water use and improved plant survival
Waste segregation	Separate recyclable, general and hazardous waste at source	Increased recycling and reduced contamination risk
Oil-spill prevention	Bunded storage, drip trays, spill kits and inspections	Protection of soil, drainage and groundwater
Vehicle management	Journey planning, maintained vehicles and controlled dispatch	Reduced fuel use, emissions, congestion and accident risk
Environmental monitoring	Routine air, noise, water, waste and safety monitoring	Early identification and correction of non-compliance
Training and emergency drills	Monthly toolbox talks and periodic drills	Improved worker competency and reduced incident risk

6.8 Summary of Mitigation Commitments

Multan Chemicals Limited shall ensure that the following commitments are integrated into detailed design, construction contracts, commissioning procedures, and operational management:

- Construction will commence only after environmental approval and other relevant permits are obtained.

- The final layout will maintain approved setbacks, safety distances, emergency access, drainage systems, firewater provisions, and green-belt areas.
- Construction dust, noise, traffic, waste, wastewater, and worker-safety risks will be controlled through a contractor-specific HSE and environmental-management plan.
- Main compressors and other major noise sources will be fitted with acoustic enclosures, silencers, vibration isolation, and maintenance arrangements.
- A closed-loop cooling-water system, water metering, drift control, rainwater harvesting, and approved wastewater-management arrangement will be installed.
- Domestic sewage, cooling-tower blowdown, stormwater, and potentially contaminated runoff will be kept separate and managed through approved treatment/disposal systems.
- Oil, diesel, chemicals, used oil, filters, oily rags, and other hazardous waste will be stored safely and disposed of through authorized channels.
- Cryogenic tanks, piping, pumps, filling systems, and pressure-relief devices will be designed, inspected, tested, and maintained according to applicable standards and manufacturer requirements.
- Fixed oxygen monitors, alarms, ventilation, emergency isolation valves, firewater systems, fire extinguishers, earthing, lightning protection, PPE, emergency showers/eyewash, and emergency communication systems will be provided.
- All employees, contractors, and drivers will receive relevant environmental, safety, cryogenic-handling, emergency-response, and fire-prevention training.
- Tanker and cylinder dispatch will be controlled through route planning, vehicle inspection, driver competency, loading procedures, traffic management, and emergency-response arrangements.
- A green belt, rainwater-harvesting system, energy-efficiency programme, and solar-energy system for suitable loads will be implemented.
- An EHS Cell will maintain monitoring records, compliance reports, waste manifests, incident reports, training records, corrective actions, and stakeholder grievance records.

6.9 Conclusion

The proposed 240 TPD Cryogenic Air Separation Unit is located within a designated industrial area and is compatible with the planned land use of AIIC. The project does not involve conventional process combustion or chemical synthesis; however, it has important environmental and safety aspects requiring careful management.

The main impacts requiring mitigation are construction dust and noise, compressor noise and vibration, electricity consumption, cooling-water demand, wastewater and stormwater control, used oil and hazardous

maintenance waste, tanker movement, cryogenic-fluid handling, oxygen enrichment, oxygen deficiency, fire safety, and occupational health and safety.

With implementation of the proposed design measures, construction controls, operational procedures, environmental monitoring, waste-management arrangements, green-belt development, rainwater harvesting, energy-efficiency measures, safety systems, and emergency-response plan, the residual routine environmental impacts are expected to remain minor or manageable. The principal residual risks relate to accidental cryogenic-product release, oxygen-enriched conditions, nitrogen-related oxygen deficiency, and transport incidents; these risks will remain acceptable only with continuous compliance with engineered safeguards, trained personnel, inspection, monitoring, and emergency preparedness.

CHAPTER 7

ENVIRONMENTAL MANAGEMENT AND MONITORING PROGRAM

7.1 Introduction

This Environmental Management and Monitoring Program (EMMP) has been prepared for the proposed **240 TPD Cryogenic Air Separation Unit (ASU)** of Multan Chemicals Limited (MCL) at Plot No. 57C, Allama Iqbal Industrial City (AIIC), Sahianwala, Faisalabad.

The EMMP provides practical measures for prevention, minimization, control, monitoring, reporting, and review of environmental, health, safety, and community impacts during construction, commissioning, operation, maintenance, and product-dispatch activities. The main environmental priorities are construction dust and noise, compressor noise, water consumption, wastewater and drainage, waste management, energy use, cryogenic safety, tanker movement, green belt, rainwater harvesting, and emergency preparedness.

7.2 Environmental Management Objectives

The objectives of the EMMP are to:

- Ensure compliance with environmental approval conditions and applicable environmental standards.
- Control construction-phase dust, noise, traffic, waste, drainage, and worker-safety impacts.
- Control operational noise, water use, wastewater, stormwater, and hazardous waste.
- Prevent soil, drain, and groundwater contamination from oil, fuel, chemicals, and maintenance waste.
- Ensure safe storage, filling, handling, and transportation of oxygen, nitrogen, argon, and cryogenic liquids.
- Implement energy conservation, rainwater harvesting, solar-energy use, and tree plantation.
- Establish environmental monitoring, reporting, inspection, corrective action, and management-review procedures.
- Provide necessary training to employees, contractors, drivers, and emergency-response personnel.

7.3 Environmental Management Team

Multan Chemicals Limited shall establish an **Environment, Health and Safety (EHS) Cell** before commencement of construction. The EHS Cell will report to the Chief Executive Officer/Project Director and will be responsible for implementation of this EMMP.

Table 7.1: Environmental Management Team and Responsibilities

Position	Main roles and responsibilities
Chief Executive Officer / Project Director	Overall responsibility for compliance, provision of resources, approval of environmental budget, review of EHS performance, and liaison with senior management
Plant Manager	Ensures daily compliance during operation; coordinates production, maintenance, utility, safety, and environmental activities
EHS Manager	Overall implementation of EMMP; liaison with EPA Punjab, FIEDMC/AIIC and other authorities; review of monitoring results, incident investigation, compliance reporting, audits, and corrective actions
Environmental Officer	Conducts site inspections; maintains monitoring records; manages water, wastewater, waste, drainage, green belt, rainwater harvesting, laboratory coordination, and environmental reporting
Safety Officer	Implements occupational health and safety procedures; manages oxygen/cryogenic safety, fire prevention, emergency drills, PPE, permit-to-work, oxygen monitors, and incident reporting
Maintenance Manager / Engineer	Ensures preventive maintenance of compressors, cooling systems, DG set, pumps, tanks, pipelines, safety devices, noise-control equipment, and fire-protection system
Utilities Engineer	Maintains water balance, cooling-water operation, blowdown control, water-treatment chemicals, rainwater-harvesting system, drainage, and wastewater-treatment arrangements
Logistics Manager	Manages tanker/cylinder dispatch, vehicle inspection, driver training, route planning, traffic controls, loading procedures, and transport incident reporting
Contractor EHS Representative	Implements construction-phase dust, noise, waste, traffic, labour welfare, emergency, and safety requirements under supervision of MCL EHS Cell
Security Supervisor	Controls site access, vehicle entry/exit, visitor induction, emergency gate access, firefighting support, and maintenance of emergency contact list
Third-Party Approved Laboratory	Conducts periodic monitoring of air, noise, water, wastewater, and soil, where required, and provides analytical reports

7.4 Proposed Mitigation Measures

The proposed mitigation actions shall be implemented through project design, construction contracts, standard operating procedures, routine inspection, preventive maintenance, environmental monitoring, and emergency preparedness.

Table 7.2: Environmental Mitigation and Management Measures

Environmental aspect	Proposed mitigation action	Responsibility
Construction dust	Water sprinkling, covered trucks, speed limits, covered material storage, housekeeping, wheel cleaning where required, and prompt removal of debris	Contractor / Environmental Officer
Construction noise	Daytime work where practicable, equipment maintenance, controlled work schedule, PPE, and avoidance of unnecessary idling	Contractor / Safety Officer
Construction waste	Segregation of soil, scrap, packaging, domestic waste and hazardous waste; reuse/recycling where feasible; approved disposal	Contractor / Environmental Officer
Soil and groundwater protection	Impervious floors in oil/chemical areas, bunding, drip trays, spill kits, oil-and-grit traps, and prohibition of open dumping	Environmental Officer / Maintenance Manager
Compressor noise	Acoustic enclosure, silencers, anti-vibration mounts, preventive maintenance, hearing protection and boundary monitoring	Plant Manager / Maintenance Manager
DG emissions and noise	Adequate exhaust stack, proper maintenance, fuel-quality control, limited emergency use, acoustic treatment and monitoring where required	Maintenance Manager / Environmental Officer
Water conservation	Closed-loop cooling system, water metering, leak inspection, drift eliminators, controlled blowdown, rainwater harvesting and reuse where feasible	Utilities Engineer
Wastewater management	Separate drainage systems; treatment/disposal through approved route; monitoring of domestic sewage and cooling-tower blowdown	Utilities Engineer / Environmental Officer
Hazardous waste	Labelled containers, covered storage, impervious floor, secondary containment, waste manifests and disposal through authorized contractor	Environmental Officer

Cryogenic safety	Oxygen/deficiency monitors, emergency isolation valves, ventilation, no-oil/no-grease procedure, PPE, signage, safe operating procedures and drills	Safety Officer / Plant Manager
Fire protection	Firewater system, hydrants, pumps, extinguishers, alarm system, emergency exits, assembly areas and regular equipment testing	Safety Officer
Tanker/cylinder dispatch	Vehicle fitness checks, driver training, route planning, loading procedure, speed limit, GPS/communication where applicable, and incident reporting	Logistics Manager / Safety Officer
Green belt	Plantation, drip irrigation, replacement planting, survival monitoring and maintenance	Environmental Officer
Energy management	VFDs, turbo-expander recovery, efficient motors, LED lighting, energy metering, preventive maintenance and solar system for suitable loads	Plant Manager / Utilities Engineer

7.5 Implementation Schedule

Environmental and safety measures shall be integrated into the project from the pre-construction stage and continued throughout operation.

Table 7.3: EMMP Implementation Schedule

Phase	Main activities	Timeline	Responsibility
Pre-construction	Environmental approval, EHS team appointment, detailed design review, approval of drainage, wastewater, fire and safety systems	Before construction	CEO / Project Director / EHS Manager
Construction	Dust suppression, waste management, labour welfare, traffic control, safety inspections, temporary drainage and contractor monitoring	Throughout construction	Contractor / EHS Cell
Installation	Installation of acoustic enclosure, fire system, oxygen monitors, drainage, oil traps, waste storage, rainwater harvesting and green-belt preparation	During equipment installation	Project Manager / EHS Manager

Commissioning	Testing of fire system, alarms, oxygen monitors, pressure-relief systems, wastewater arrangements, noise levels and emergency drills	Before commercial operation	Plant Manager / Safety Officer / Environmental Officer
Operation	Environmental monitoring, waste disposal, water management, energy review, plantation maintenance, training and compliance reporting	Continuous	EHS Cell / Plant Management
Annual review	Environmental audit, EMP review, budget review, corrective action and management review	Once every year	CEO / EHS Manager

7.6 Environmental Budget

The estimated environmental-management budget of approximately **PKR 45 million as capital cost** and **PKR 6.5 million per year as recurring cost**. These figures shall be reviewed against final engineering, environmental-approval conditions, and approved procurement plan.

Table 7.4: Environmental Management Budget

Item	Estimated capital cost, PKR million
Acoustic enclosures, VFDs and energy-efficiency measures	15.00
Closed-loop cooling system and drift-control measures	5.00
Oxygen safety, fixed oxygen monitors and fire-protection system	20.00
Tanker-dispatch safety, route planning and tracking arrangements	2.00
Rainwater harvesting system and recharge/storage structures	1.50
Green belt, plantation and drip irrigation	1.00
Solar-system civil/structural arrangements	0.50
Total estimated capital cost	**45.00**

Table 7.5: Recurring Annual Environmental Cost

Item	Estimated annual cost, PKR million
Hazardous-waste collection and disposal	1.00
Environmental monitoring through approved laboratory	1.20
Green-belt maintenance, rainwater-harvesting maintenance, solar O&M and oxygen-monitor calibration	1.30
EHS staff salaries and environmental-management support	3.00
Total estimated annual recurring cost	**6.50**

7.7 Environmental Monitoring Programme

The monitoring programme will assess the performance of mitigation measures and identify any non-compliance requiring corrective action. Monitoring shall be conducted by trained MCL personnel and, where required, by an EPA Punjab approved laboratory.

Table 7.6: Proposed Environmental Monitoring Programme

Environmental component	Parameters	Location	Frequency	Responsibility
Ambient air quality	$PM_{2.5}$, PM_{10}, SO_2, NO_2, CO and other required parameters	Upwind, downwind, roadside and representative receptor	Quarterly	Environmental Officer / approved laboratory
Noise	Day and night Leq dB(A)	Compressor house, four plot boundaries, DG area and representative receptor	Monthly internal; quarterly third-party	Environmental Officer
DG emissions	Relevant stack-emission parameters	DG exhaust stack	As required by operating hours/approval conditions	Environmental Officer / approved laboratory
Water consumption	Water use, cooling-water make-up, leak record and meter readings	Water source, utility area and cooling tower	Daily log; monthly review	Utilities Engineer
Wastewater	Flow, pH, BOD_5, COD, TSS, TDS, oil and grease, temperature	Sewage-treatment outlet and/or cooling-tower blowdown point	Monthly internal; quarterly laboratory	Environmental Officer / Utilities Engineer
Drinking water	Applicable drinking-water parameters	Office/canteen drinking-water points	Quarterly	Environmental Officer / approved laboratory

Waste management	Quantity, storage condition, manifest and disposal record	Waste-storage area, workshop and oil store	Monthly	Environmental Officer
Soil contamination	Oil and grease, visible contamination and spill record	Oil/chemical storage, workshop and hazardous-waste area	Annual and after major spill	Environmental Officer / approved laboratory
Oxygen atmosphere	Oxygen concentration and alarm status	Cold box, tank farm, filling area and enclosed spaces	Continuous; calibration as per manufacturer schedule	Safety Officer
Fire and emergency equipment	Hydrants, pumps, extinguishers, alarms, eyewash, shower and SCBA	Entire facility	Monthly inspection; periodic functional test	Safety Officer
Green belt	Number of trees, survival rate, irrigation and replacement plantation	Green-belt area	Monthly during first three years	Environmental Officer
Energy performance	Electricity consumption, DG fuel use, solar generation and specific energy performance	Electrical room, compressor area and utility meters	Daily meter log; monthly review	Plant Manager / Utilities Engineer
Traffic and transport	Vehicle inspection, driver training, dispatch record and incidents	Main gate, loading area and transport fleet	Daily dispatch check; monthly review	Logistics Manager

7.8 EMP Reporting and Review Procedures

The EHS Cell shall maintain environmental and safety records in both hard and electronic form. The Environmental Officer shall prepare a monthly compliance summary covering water consumption, wastewater, air/noise monitoring, waste generation, hazardous-waste disposal, plantation, complaints, inspections, incidents, corrective actions, and pending actions.

The EHS Manager shall review monitoring results and prepare quarterly compliance reports for management and submission to relevant authorities where required by environmental approval conditions. Any non-compliance, spill, fire, gas release, accident, public complaint, or exceedance of environmental standards shall be reported immediately to plant management and investigated through a Corrective and Preventive Action procedure.

Table 7.7: EMP Reporting and Review Mechanism

Report / record	Frequency	Prepared by	Reviewed by
Daily environmental and safety inspection checklist	Daily	Environmental Officer / Safety Officer	EHS Manager
Water, energy and waste logbook	Daily / monthly	Utilities Engineer / Environmental Officer	Plant Manager
Waste-manifest and disposal record	Per consignment	Environmental Officer	EHS Manager
Noise, air and wastewater monitoring report	As per monitoring schedule	Approved laboratory / Environmental Officer	EHS Manager
Monthly EMP compliance report	Monthly	Environmental Officer	EHS Manager / Plant Manager
Incident, spill or emergency report	Immediately after event	Safety Officer / Environmental Officer	CEO / EHS Manager
Quarterly compliance report	Quarterly	EHS Manager	CEO / relevant authority where required
Environmental performance review	Annually	EHS Manager	CEO / senior management
EMP revision	Annual or after major change/incident	EHS Manager	CEO / Project Director

7.9 Training and Capacity Building

Environmental and safety training is essential because the facility will operate high-pressure equipment and handle cryogenic oxygen, nitrogen, and argon. All employees, contractors, drivers, and visitors shall receive induction before entering the facility. Job-specific training shall be provided before personnel undertake operational, maintenance, filling, loading, or emergency-response duties.

Table 7.8: Training Requirements

Training topic	Target participants	Frequency
EHS induction and site rules	All employees, contractors and visitors	Before site entry / joining
Environmental Management Plan	Management, supervisors, EHS staff and contractors	At induction and annual refresher
Dust, noise, waste and spill management	Construction workers and relevant operational staff	Monthly toolbox talk
Hazardous-waste handling	Maintenance, workshop and environmental staff	Quarterly
Cryogenic-product handling	Operators, maintenance staff, filling staff and drivers	Before assignment and annual refresher
Oxygen-enrichment and oxygen-deficiency hazards	All plant personnel	Quarterly
Fire prevention and firefighting	All employees and security staff	Quarterly
Emergency evacuation and mock drills	All employees, contractors and drivers	Quarterly
Permit-to-work and confined-space entry	Maintenance and operations personnel	Before assignment and annual refresher
First aid and emergency medical response	Selected employees and security staff	Annual refresher
Tanker/cylinder transport safety	Drivers, dispatch staff and loaders	Before assignment and annual refresher
Energy and water conservation	Plant operators, utilities staff and office personnel	Six-monthly

Training attendance, material, assessment results, trainer details, and refresher dates shall be documented and maintained by the EHS Cell.

7.10 Conclusion

The Environmental Management and Monitoring Program provides the framework for managing the environmental and safety impacts of the proposed 240 TPD Cryogenic Air Separation Unit. MCL shall establish an EHS Cell, allocate adequate environmental budget, implement mitigation measures during all project phases, conduct regular monitoring, maintain records, report compliance, review performance, and provide continuous training.

With proper implementation of this EMMP, the project's routine environmental impacts are expected to remain manageable. Particular attention shall be given to compressor noise, water and wastewater management, waste disposal, energy efficiency, cryogenic-product safety, oxygen monitoring, fire prevention, tanker movement, emergency response, rainwater harvesting, and green-belt maintenance.

CHAPTER 8

STAKEHOLDER CONSULTATION AND PUBLIC PARTICIPATION

8.1 Introduction

Stakeholder consultation is an integral part of the Environmental Impact Assessment process. It ensures that relevant authorities, technical experts, nearby industries, workers, local communities, and other interested parties are informed about the proposed **240 TPD Cryogenic Air Separation Unit (ASU)** of Multan Chemicals Limited at Plot No. 57C, Allama Iqbal Industrial City (AIIC), Sahianwala, Faisalabad.

The consultation process was designed to communicate the nature of the project, likely environmental and safety impacts, proposed mitigation measures, and opportunities for employment and local economic benefits. It also provides stakeholders with an opportunity to raise concerns and contribute suggestions for improvement of the project design, Environmental Management and Monitoring Program, traffic management, emergency response, and community-safety arrangements.

The key concerns identified during preliminary consultation include local employment, compressor noise, water use, cryogenic-gas safety, fire protection, and tanker/cylinder traffic. These issues have been incorporated into the impact assessment and environmental management measures of this EIA.

8.2 Objectives of Consultation

The objectives of stakeholder consultation are to:

- Inform stakeholders about the project location, capacity, process, construction activities, operational activities, and product-dispatch arrangements.
- Explain anticipated environmental, occupational health and safety, traffic, and community-safety impacts.
- Communicate proposed mitigation measures, monitoring arrangements, green-belt development, rainwater harvesting, energy-efficiency measures, and emergency-response provisions.
- Obtain stakeholder concerns, suggestions, and local information relevant to environmental assessment.
- Identify issues requiring further assessment, mitigation, monitoring, or design modification.
- Ensure that relevant government agencies and departments are consulted for permits, approvals, technical input, and coordination.
- Establish a transparent grievance and communication mechanism for construction and operation phases.

- Support statutory public disclosure and public-hearing requirements of the environmental-approval process.

8.3 Stakeholder Identification

The stakeholder consultation programme covers the project proponent, regulatory authorities, utility and industrial-estate authorities, technical practitioners, emergency services, nearby industrial units, workers, road users, local residents, and communities within the broader study area.

Table 8.1: Main Stakeholders

Stakeholder group	Relevant stakeholders
Project proponent	Multan Chemicals Limited management, Project Director, Plant Manager, EHS Manager, Environmental Officer, Safety Officer, Utilities Engineer and Logistics Manager
Environmental authority	Punjab Environmental Protection Agency and relevant district/regional environmental office
Industrial-estate authority	FIEDMC and AIIC management
Local administration	District Administration Faisalabad, Assistant Commissioner, local government and relevant municipal authorities
Utility agencies	Electricity-supply agency, water-supply agency, sewerage/drainage authority and telecommunication services where applicable
Safety and emergency agencies	Rescue 1122, Fire Brigade, Civil Defence, hospitals, police, traffic police and emergency medical services
Technical departments	Labour Department, Industries Department, Mines and Minerals/other relevant departments where applicable, Building Control, Public Health Engineering and relevant licensing authorities
Environmental practitioners	EIA consultants, environmental scientists, chemical engineers, industrial-safety specialists, occupational-health experts, water/wastewater experts and transport-safety experts
Nearby industrial units	Existing and planned industries within AIIC and adjoining industrial areas
Affected/wider community	Residents of nearby settlements, workers, shopkeepers, transporters, community representatives, local businesses, labourers and road users
Vulnerable groups	Women, elderly persons, children, low-income households, persons with disabilities, temporary workers and informal workers, where applicable

8.4 Consultation with Proponent's Environmental Management Team

The EHS Cell of Multan Chemicals Limited will play the central role in implementing environmental and safety commitments. The team will include the Chief Executive Officer/Project Director, Plant Manager, EHS Manager, Environmental Officer, Safety Officer, Utilities Engineer, Maintenance Manager, Logistics Manager, Security Supervisor, and contractor representatives during construction.

Consultation with the project team shall focus on finalization of the project layout, water balance, wastewater-disposal arrangement, drainage plan, compressor acoustic design, tank storage and safety distances, firewater system, oxygen-monitoring locations, waste-storage area, transport routes, emergency access, green-belt layout, rainwater harvesting, and monitoring requirements.

The project team shall ensure that all stakeholder concerns are entered into a consultation register and that feasible recommendations are incorporated into project design, construction contracts, operational procedures, and the Environmental Management and Monitoring Program.

Table 8.2: Internal Consultation Topics

Topic	Responsible MCL representative
Environmental approval and regulatory liaison	EHS Manager
Site layout, safety distances and emergency access	Project Director / Plant Manager / Safety Officer
Air, noise, wastewater and waste monitoring	Environmental Officer
Cooling water, water balance, rainwater harvesting and drainage	Utilities Engineer
Compressor enclosure, DG maintenance and machinery controls	Maintenance Manager
Cryogenic-product storage, filling and leak response	Safety Officer / Plant Manager
Tanker dispatch and road safety	Logistics Manager
Green belt and plantation	Environmental Officer
Construction environmental compliance	Contractor EHS Representative
Budget allocation and management review	CEO / Project Director

8.5 Consultation with Responsible Authority

The primary responsible authority for environmental review and approval is the **Punjab Environmental Protection Agency**. The EIA shall be submitted to the relevant EPA office for review in accordance with the applicable environmental-approval procedure.

The Punjab EPA shall be consulted regarding EIA categorization, scope of study, environmental-quality standards, public disclosure, public-hearing requirements, monitoring requirements, environmental approval conditions, and reporting obligations. The project shall not commence construction until environmental approval and other applicable statutory permissions are obtained.

FIEDMC/AIIC management is also a key authority because the project is located within AIIC. Coordination with FIEDMC/AIIC will be required for plot development, building approval, access roads, water supply, drainage, sewerage, electricity, utility corridors, fire access, waste management, landscaping, and industrial-estate operational requirements. The FIEDMC provisional allotment letter confirms that the plot has been allotted to MCL for establishment of an ASU for production of oxygen, nitrogen, argon, and related by-products.

Table 8.3: Consultation with Responsible Authorities

Authority	Consultation purpose
Punjab Environmental Protection Agency	EIA review, environmental approval, public hearing, standards, monitoring, reporting and compliance conditions
FIEDMC / AIIC management	Land-use compliance, plot development, building approval, utilities, drainage, sewerage, access, estate safety and coordination
District Administration Faisalabad	Local coordination, emergency planning, public consultation and administrative support
Rescue 1122 / Fire Brigade / Civil Defence	Fire protection, emergency response, evacuation, access routes and joint mock drills
Labour Department	Labour welfare, occupational safety, working conditions and worker protections
Traffic Police / Highway authorities	Tanker routing, traffic safety, access management and emergency response
Electricity-supply agency	Dedicated power supply, transformer arrangements, electrical safety and emergency backup
Water / sewerage agency or AIIC utility section	Water supply, wastewater-treatment/disposal arrangement, drainage and connection approvals

8.6 Consultation with Other Departments and Agencies

Other departments and agencies will be consulted based on their statutory role, technical expertise, or emergency-response function. Consultation will take place before construction and will continue during project operation where required.

The following matters will be communicated to relevant agencies:

- Nature and capacity of the ASU.
- Site layout and cryogenic storage arrangement.
- Water demand, cooling-water management, wastewater and drainage plan.
- Product storage, cylinder filling, tanker loading, and dispatch activities.
- Fire prevention, emergency isolation, oxygen monitoring, evacuation, and emergency access.
- Traffic routes, vehicle safety, tanker movement, and driver training.
- Waste-generation and hazardous-waste-disposal arrangements.
- Green-belt development, rainwater harvesting, solar power, and energy-efficiency measures.
- Environmental-monitoring and reporting programme.

Table 8.4: Consultation with Other Agencies

Department / agency	Key consultation issue
FIEDMC / AIIC utility section	Water, sewerage, stormwater drainage, roads, plot layout and utility connections
Building-control authority	Structural/building approval, factory layout and emergency access
Fire and Civil Defence authorities	Firewater system, hydrants, fire pumps, emergency exits, tank safety and emergency response
Rescue 1122	Medical response, evacuation route, communication protocol and emergency drills
Labour Department	Worker welfare, PPE, training, medical support and occupational health
Traffic Police / transport authorities	Heavy-vehicle movement, tanker routes, traffic controls and accident response
Health Department / nearby hospitals	Medical emergency support and coordination for serious incidents
Waste-management contractor / authorized facility	Hazardous-waste collection, transport, treatment/disposal and manifest system
Approved environmental laboratory	Baseline sampling, compliance monitoring and environmental reporting
Local government / municipal services	Waste collection, local services, drainage and community coordination

8.7 Consultation with Environmental Practitioners and Experts

Environmental practitioners and technical experts will be consulted to ensure that the EIA and project safeguards are technically sound. Relevant experts may include environmental scientists, chemical engineers, process engineers, industrial safety specialists, fire-safety specialists, occupational health professionals, water/wastewater experts, geotechnical engineers, ecologists, traffic experts, and emergency-response professionals.

Technical consultation shall focus on the following issues:

- Verification of cryogenic ASU process description and utility requirements.
- Confirmation of compressor-noise control and boundary-noise compliance.
- Review of water balance, cooling-water system, blowdown, wastewater-treatment/disposal route, and rainwater-harvesting design.
- Review of storage-tank layout, separation distances, product filling, tanker loading, venting, and pressure-relief systems.
- Hazard identification, risk assessment, emergency-response planning, and fire-protection design.
- Hazardous-waste management, oil/chemical storage, spill control, and soil/groundwater protection.
- Review of air, noise, water, wastewater, soil, and occupational-safety monitoring plans.
- Review of plantation species, green-belt design, irrigation requirements, and survival monitoring.
- Review of traffic route, tanker safety, driver training, and incident-management arrangements.

Any technical recommendations that are practicable and necessary for safety or environmental compliance shall be incorporated in the final EIA, detailed engineering, EMP, and standard operating procedures.

8.8 Consultation with Affected and Wider Community

The wider community includes nearby residents, industrial workers, local businesses, transporters, contractors, shopkeepers, road users, community representatives, and people living in settlements within the broader study area.

Consultation shall be undertaken in a respectful, accessible, and inclusive manner. Meetings should be conducted at convenient times and locations. Women, workers, vulnerable groups, and persons who may be affected by traffic or construction activity should be given an opportunity to participate. Consultation may be carried out through focus-group discussions, individual interviews, meetings with community representatives, questionnaires, disclosure of project information, and the statutory public-hearing process.

The project draft records that initial focus-group discussions and key-informant interviews identified concerns regarding employment opportunities, noise, water use, safety, and traffic.

Table 8.5: Community Concerns and Project Response

Issue raised	Community concern	Proposed project response
Employment	Preference for local jobs during construction and operation	Give preference to suitably qualified local workers, provide transparent recruitment and skills-development opportunities
Compressor noise	Potential disturbance from compressor, DG and industrial machinery	Install acoustic enclosures, silencers, vibration-control measures and conduct boundary noise monitoring
Water use	Concern over demand on local water resources	Use closed-loop cooling, water metering, rainwater harvesting, leakage control and water-conservation measures
Wastewater and drainage	Concern regarding discharge to drains or land	Provide separate drainage, approved treatment/disposal arrangement and monitoring before discharge/reuse
Cryogenic-gas safety	Concern about oxygen leaks, fire, tank safety and emergency response	Provide safe layout, oxygen monitors, emergency isolation, firewater system, trained staff, drills and emergency communication
Nitrogen safety	Concern about oxygen deficiency in enclosed spaces	Provide ventilation, oxygen-deficiency alarms, confined-space procedures and emergency rescue arrangements
Tanker and cylinder traffic	Concern about congestion, road accidents and hazardous transport	Implement route planning, vehicle checks, trained drivers, controlled dispatch timing, speed limits and emergency procedure
Construction disturbance	Dust, noise, debris and truck movement	Implement dust suppression, covered vehicles, waste management, controlled work hours and traffic management
Plantation	Need for better green cover and site appearance	Develop and maintain green belt with suitable local species and survival monitoring
Information sharing	Need for a contact point to raise concerns	Establish grievance register, complaint contact number and response mechanism

8.9 Public Disclosure and Public Hearing

The EIA shall be disclosed and processed in accordance with the applicable Punjab EPA environmental-review procedure. A public hearing shall be arranged by the responsible authority as required during the EIA review process.

Before the public hearing, relevant project information should be made available in an understandable form. The information shall include:

- Project title, location, proponent details, and contact person.
- Nature and capacity of the ASU.
- Description of oxygen, nitrogen, and argon production process.
- Main construction and operational activities.
- Potential environmental and safety impacts.
- Proposed mitigation measures.
- Wastewater, waste-management, noise-control, traffic-management, and emergency-response measures.
- Green-belt, rainwater-harvesting, and energy-efficiency features.
- Procedure for submitting questions, comments, and objections.

8.10 Grievance Redress Mechanism

MCL shall establish a simple grievance redress mechanism before commencement of construction. The mechanism shall be accessible to workers, contractors, nearby industrial units, local residents, transporters, and other stakeholders.

A grievance may relate to dust, noise, traffic, road damage, water, drainage, waste, worker behaviour, safety, emergency concerns, employment, or any other project-related issue.

The grievance mechanism shall include:

- Display of MCL contact person and complaint telephone number at the site gate.
- Complaint register maintained by the Environmental Officer or Security Supervisor.
- Receipt of complaints through telephone, written application, email, meeting, or verbal communication.
- Record of complainant name, contact detail, issue, date, location, and evidence where available.
- Acknowledgement of complaint within two working days.
- Investigation and response within seven working days for routine matters.

- Immediate escalation to Plant Manager/EHS Manager for safety incidents, spills, gas leaks, fire, or serious complaints.
- Record of action taken, response provided, closure date, and complainant feedback.
- Monthly review of complaints by the EHS Manager.

Table 8.6: Grievance Handling Procedure

Step	Action	Responsible person	Timeframe
1	Receive and register complaint	Security Supervisor / Environmental Officer	Same day
2	Acknowledge complaint	Environmental Officer	Within 2 working days
3	Investigate issue	Environmental Officer / Safety Officer / concerned department	Within 5 working days
4	Implement corrective action	Plant Manager / Contractor / concerned manager	As per issue severity
5	Communicate response	Environmental Officer	Within 7 working days for routine issues
6	Close complaint and maintain record	EHS Manager	After verification
7	Review trends and recurring issues	EHS Manager / Plant Manager	Monthly

8.11 Consultation Record and Follow-Up

All consultation activities shall be documented. Records shall include meeting notices, agenda, participant lists, gender-disaggregated attendance, photographs, location, date, issues raised, responses provided, commitments made, and follow-up actions.

The consultation register shall be updated during construction and operation. Stakeholder feedback shall be considered during annual review of the Environmental Management and Monitoring Program, emergency-response plan, traffic-management plan, and community-grievance mechanism.

Table 8.7: Consultation Documentation Requirements

Record	Requirement
Stakeholder list	Name, organization/community, role, contact details and relevance to project
Meeting record	Date, time, venue, agenda, facilitator and attendance sheet
Photographs	Dated photographs of consultation meetings and site visits
Issues register	Concern raised, stakeholder group, date, location and priority
Response register	MCL response, responsible person, action, completion date and status
Public-hearing record	Notice, attendance, proceedings, comments, responses and EPA record
Grievance register	Complaint, investigation, corrective action, closure and feedback
Annual consultation review	Summary of concerns, trends, actions and lessons learned

8.12 Conclusion

Stakeholder consultation for the proposed 240 TPD Cryogenic Air Separation Unit will involve Multan Chemicals Limited's EHS team, Punjab EPA, FIEDMC/AIIC management, local administration, utility agencies, emergency services, technical experts, nearby industrial units, workers, road users, and the wider community.

The main concerns identified during preliminary consultation are employment, compressor noise, water consumption, wastewater/drainage, cryogenic-product safety, fire protection, and tanker traffic. These concerns have been addressed through proposed acoustic controls, water conservation, rainwater harvesting, drainage management, waste controls, oxygen monitoring, fire-protection systems, emergency-response planning, traffic management, tree plantation, environmental monitoring, and grievance procedures.

The consultation process shall continue throughout EIA review, construction, commissioning, and operation to ensure transparent decision-making, timely resolution of concerns, and continuous improvement of environmental and safety performance.

9 Conclusion and Recommendations

The proposed 240 Tons Per Day (TPD) Cryogenic Air Separation Unit of Multan Chemicals Limited (MCL) at Plot No. 57C, Allama Iqbal Industrial City (AIIC), Sahianwala, Faisalabad, is intended to produce oxygen, nitrogen, and argon for medical, industrial, manufacturing, fabrication, healthcare, food-processing, and other commercial applications. The project is proposed on a 12.65-acre industrial plot within AIIC, a planned industrial estate and Special Economic Zone managed by FIEDMC. The site is considered suitable in principle because it is designated for industrial use, has access to internal industrial roads and regional transport links, and has sufficient area for the ASU process units, cryogenic storage tanks, filling facilities, utilities, internal circulation, emergency access, drainage, rainwater harvesting, and green-belt development. The plot has been provisionally allotted to MCL for establishment of an Air Separation Unit for manufacturing oxygen, nitrogen, argon, and related by-products.

The project will use cryogenic air-separation technology, in which atmospheric air is filtered, compressed, purified, cooled to cryogenic temperature, and separated by fractional distillation. As the process uses atmospheric air as the principal feedstock and does not involve conventional chemical reactions or routine process combustion, direct process emissions and process effluent are expected to be limited. However, the EIA has identified important environmental, occupational health, safety, and community considerations. These include construction dust and noise; noise and vibration from air compressors; high electricity demand and associated indirect greenhouse-gas emissions; cooling-water use and blowdown; domestic sewage; stormwater management; used oil and maintenance waste; vehicle and tanker movement; cryogenic burns; high-pressure hazards; oxygen-enriched atmospheres that can intensify fire; oxygen-deficient atmospheres associated with nitrogen release; and potential emergency events involving storage, filling, transfer, or transport of cryogenic products.

The potential impacts during construction are expected to be temporary, localized, and reversible, provided that dust suppression, covered transport, waste segregation, controlled work hours, safe excavation, traffic management, labour welfare, PPE, and contractor safety controls are implemented. During operation, compressor noise, water management, DG emissions, waste handling, cryogenic storage, cylinder filling, tanker loading, and transport safety will require continuous management. With installation of acoustic enclosures, silencers, vibration isolation, closed-loop cooling, controlled wastewater handling, separate stormwater drainage, hazardous-waste storage, oxygen-deficiency/enrichment monitoring, fire-protection systems, emergency isolation valves, trained staff, preventive maintenance, and an effective emergency-response plan, the routine residual environmental impacts are expected to remain minor to moderate and manageable. The principal higher-consequence risks relate to accidental cryogenic liquid release, oxygen enrichment, nitrogen-induced oxygen deficiency, fire escalation, and tanker accidents; these risks can only be maintained at an

acceptable level through strict compliance with approved design, operating procedures, inspections, monitoring, training, and emergency drills.

The project is also expected to generate beneficial socioeconomic impacts through increased availability of medical and industrial gases, direct and indirect employment, technical-skills development, local procurement, logistics activity, and support to healthcare and industrial sectors. The MCL intends to expand production capacity and improve supply reliability for oxygen, nitrogen, and argon to customers in Punjab and other regions. The planned green belt, rainwater-harvesting system, closed-loop cooling arrangement, energy-efficiency measures, turbo-expander energy recovery, variable-frequency drives, and proposed solar system will further improve environmental performance if implemented and maintained as committed.

It is recommended that Multan Chemicals Limited obtain environmental approval from Punjab EPA and all other relevant statutory approvals before beginning construction. Before final EIA submission and before commissioning, MCL should verify and harmonize the project's capacity, storage configuration, electrical load, water balance, cooling-water circulation, freshwater demand, wastewater quantity, final wastewater-treatment/disposal route, tank separation distances, vehicle-dispatch plan, and emergency-response arrangements. The EIA should include approved layout drawings, surveyed coordinates, land-use and drainage maps, baseline laboratory reports for ambient air, noise, water, soil, and geo-technical investigation, waste-disposal arrangements, water-source approval, sewerage/drainage approval, fire-safety approvals, technical equipment specifications, and consultation/public-hearing records.

MCL should establish a dedicated Environment, Health and Safety Cell led by an EHS Manager and supported by an Environmental Officer, Safety Officer, Plant Manager, Utilities Engineer, Maintenance Manager, Logistics Manager, and trained contractor representatives. The company should implement the Environmental Management and Monitoring Program, maintain regular monitoring of ambient air, noise, water use, wastewater, waste, energy performance, oxygen levels, fire-protection equipment, green-belt survival, and tanker dispatch records, and submit compliance reports as required by the environmental approval. Hazardous wastes, including used oil, oil filters, oily rags, contaminated absorbents, spent filters, and chemical containers, should be stored on an impervious, bunded surface and disposed of only through authorized channels with complete manifest records.

The facility should operate with strict oxygen-service cleanliness controls, prohibition of oil and grease in oxygen-handling areas, adequate ventilation, fixed oxygen monitors, calibrated alarms, emergency isolation valves, pressure-relief systems, firewater storage, hydrants, extinguishers, eyewash and emergency shower facilities, PPE, SCBA, permit-to-work procedures, and regular mock drills. Tanker and cylinder transport should be controlled through driver training, vehicle fitness checks, planned routes, controlled dispatch timing, loading supervision, communication arrangements, and emergency information carried with each vehicle. A grievance

mechanism should also be maintained for workers, nearby industries, and community members to report concerns related to dust, noise, traffic, safety, drainage, or any other project-related issue.

Subject to implementation of the recommended mitigation measures, monitoring programme, environmental-management arrangements, occupational health and safety procedures, emergency-response plan, green-belt development, rainwater-harvesting system, and all conditions imposed by Punjab EPA and other competent authorities, the proposed 240 TPD Cryogenic Air Separation Unit is considered environmentally manageable and suitable for implementation at the proposed AIIC site.