

LIST OF ABBREVIATIONS

CO₂	Carbon dioxide
°C	Degree Celsius
dB(A)	A weighted decibel scale
DRP	Defecation-Remelt-Phosphatation
EIA	Environmental Impact Assessment
EMMP	Environmental Management and Monitoring Plan
EMP	Environmental Management Plan
Engr.	Engineer
EPA	Environmental Protection Agency
EPD	Environmental Protection Department
GEL	Global Environmental Lab
HWSML	Haseeb Waqas Sugar Mill Limited
IEE	Initial Environmental Examination
km	Kilometer
KPK	Khyber Pakhtunkhwa
Ltd.	Limited
LTI	Loss Time Injury
LWI	Loss Work Injury
m³	Cubic meter
m³/h	Cubic meter per hour
M	Million
M/S	Messrs
MMT	Million metric tons
NEQS	National Environmental Quality Standards
No.	Number
NOC	No Objection Certificate
NO_x	Oxides of Nitrogen
NW	North-West

PEPA, 1997	Pakistan Environmental Protection Act, 1997
PEPA, 2012	Punjab Environmental Protection (Amendment) Act, 2012
PKR	Pakistani Rupees
PM	Particulate Matter
PPEs	Personal Protective Equipments
Pvt.	Private
SOPs	Standard Operation Procedures
SO_x	Oxides of Sulfur
SE	South-east
TCD	tonnes sugar cane crushed per day

EXECUTIVE SUMMARY

INTRODUCTION

Haseeb Waqas Sugar Mills Limited (HWSML), one of the largest white refined sugar manufacturers in Pakistan, intends to establish a Sugar Manufacturing Unit at Maoza Jugmull, Tehsil Jatoi, District Muzaffargarh. M/S **Ecogreen Company (Pvt) Ltd.**, have been engaged for conducting Environment Impact Assessment (EIA) of the project.

The main objectives of this EIA are to establish baseline environmental conditions, identify potential impacts and suggest suitable mitigation measures for the execution of the proposed project. This study has been accomplished in line with the provisions – guidelines and directives of Punjab Environmental Protection Agency.

This executive summary presents an overview of the main findings of the EIA report for the aforesaid project i-e Sugar Mill.

PROPONENT:

Mr. Abdullah Ilyas,, Director HWSML is the proponent for the aforesaid proposed project. Haseeb Waqas group is working since 1992. The Haseeb Waqas group is the market leader in the sugar industry with bench marks that conform to international standards. The achievement of the group has enabled it to firmly assert itself as a large industry conglomerate.

PROJECT DESCRIPTION:

The HWSML is planning to establish a 8000-10000 TCD (tonnes sugar cane crushed per day) capacity sugar mill at Maoza Jugmull, Tehsil Jatoi, District Muzaffargarh. The whole sugar mill unit will have an area of 576 Kanals. The covered area for the project is 76 Kanals. The total estimated cost for the project is approx PKR 3.8 billion.

The sugar manufacturing process will consist of following steps:

1. Extraction of juice (crushing)
2. Clarification of juice
3. Concentration of juice (juice to syrup) by evaporation
4. Boiling of syrup to grain (crystallization)

5. Separation of crystals from mother liquor (centrifuging)

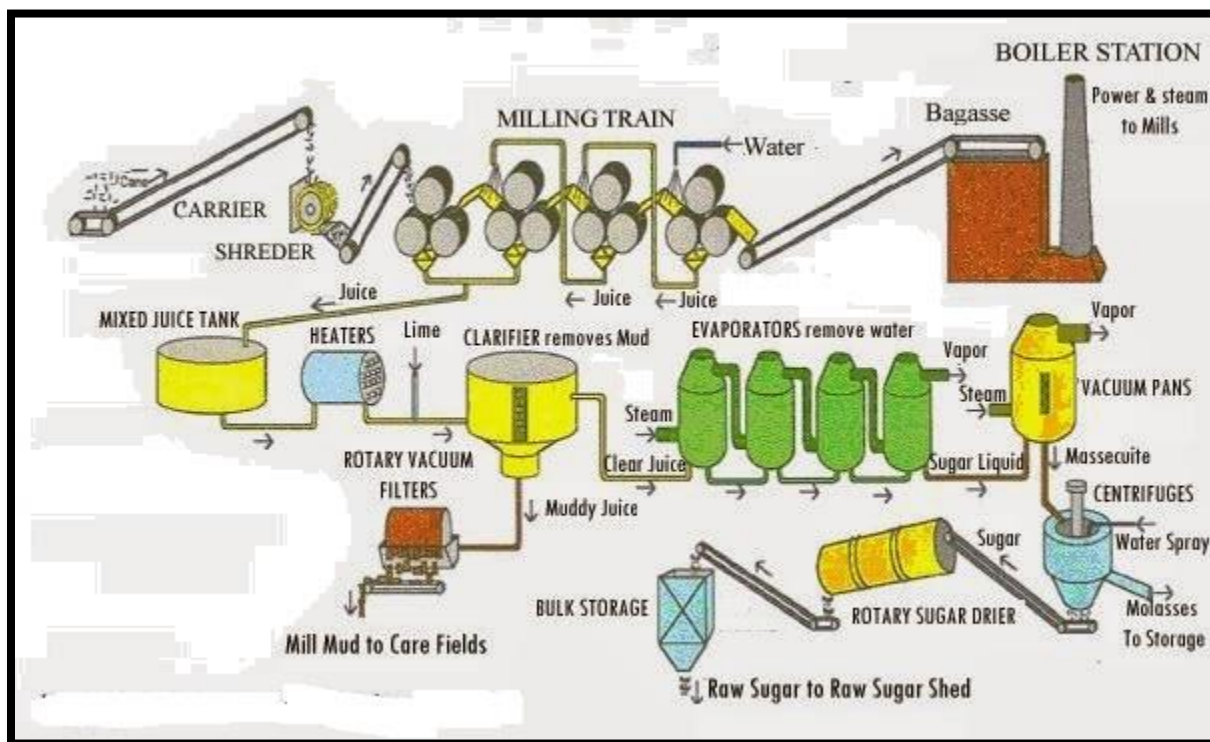


Figure 1: Sugar Manufacturing Process

The proposed project is justified by the vision and mission of Haseeb Waqas Group to encourage and promote industrialization in the county. The total manpower required for the sugar mill will be about 794 workers whose number will progressively increase as the factory gains momentum and becomes fully operational. Eventually, the factory operations are expected to support the livelihoods of approximately more than 50,000 people comprising of; farmers and their families, farm laborers, traders, tractor and vehicle operators which will then support the overall economic development vision of Country and the wider region.

MAJOR IMPACTS AND RECOMMENDED MITIGATION MEASURES:

Impact	Mitigation measure
Solid waste generation	<ul style="list-style-type: none"> • Provide solid waste handling facilities such as waste bins and skips in all sections of the sugar factory • Ensure that solid waste generated is regularly disposed off appropriately • Re-use the bagasse which is the residual woody fiber

	<p>of the cane as fuel for boilers.</p> <ul style="list-style-type: none"> • The filter mud will be used for the production of dry filter cake to be used as a fertilizer or cattle feed. • Non-biodegradable and recyclable matter, such as containers, waste papers, used materials, waste packaging materials, will be sold to local contractors for recycling or reuse purpose.
Wastewater generation	<ul style="list-style-type: none"> • Wastewater generated will be treated in lagoons over an area of 4 acre. After treatment, wastewater will be discharged in sugarcane fields owned by proponent (these fields will be grown nearby site by proponent in future)
Air pollution	<ul style="list-style-type: none"> • Use of captive Bagasse from cane crushing as a fuel • Complete combustion, wet scrubbers, ash collection system, and effective ash handling are the mitigation measures which will be adopted in said project for control of air emissions. • Mixing of collected ash with press mud to sell to farmers/ brick producers (available near site) is another suggested mitigation measure to minimize the probable impacts of fuel handling & safe ash disposal. • HWSML needs to regularly carry out checks of all motor driven vehicles and carry out regular servicing and maintenance of it in order to keep the environmental impact on account of their exhaust emissions to its minimum level. • For reducing fugitive dust, regular water sprinkling on Kachha roads will be done. • All trucks proposed to be used for transportation will be covered with tarpaulin, maintained and optimally loaded.
Noise & vibration	<ul style="list-style-type: none"> • Proper encasement of noise generating sources will be done to control the noise levels within limits. • The steam turbine generator will be provided with acoustic enclosures and silencers in the exhaust. The steam turbine will be housed in a closed building which will considerably reduce the noise. In case of maintenance, the persons working near the steam turbine generator building will be provided with ear muffs. • All the workers will be provided with PPEs

ENVIRONMENTAL MANAGEMENT & MONITORING PLANS:

During construction, ambient air quality for dust level in particular, noise level (tests), soil contamination, and community and workers' safety (visual) need to be monitored. Plan has been included in **Chapter-6** of this Report. During operation phase, boilers stack emissions, noise level of machinery and wastewater parameters are to be monitored.

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CHAPTER 1: INTRODUCTION

1.1 GENERAL

The world's largest consumers of sugar are India, China, Brazil, USA, Russia, Mexico, Pakistan, Indonesia, Germany and Egypt. Brazil & India are the largest sugar producing countries followed by China, USA, Thailand, Australia, Mexico, Pakistan, France and Germany. Global sugar production increased from approximately 125.88 MMT (Million Metric Tons) in 1995-1996 to 149.4 MMT in 2002-2003 and then declined to 143.7 MMT in 2003-2004, whereas consumption increased steadily from 118.1 MMT in 1995-1996 to 142.8 MMT in 2003-2004. The world consumption is projected to grow to 160.7 MMT in 2010 and 176.1 MMT by 2015.

Reference: Draft EIA Report for M/s. Shivashakti Sugars Limited

The sugar industry in Pakistan is the second largest agro based industry after Textiles. Pakistan is an important cane producing country and is ranked fifth in world cane acreage and 9th in sugar production. The share of sugar industry in value added of agriculture and GDP are 3.2 percent and 0.7 percent respectively. The sugar sector constitutes 4.2 percent of manufacturing. It employs over 1.5 million people, including management experts, technologists, engineers, and financial experts, skilled, semiskilled and unskilled workers. Pakistan's 2012-13 (Oct-Sep) sugar production is estimated at a 4.7 million metric tonnes in addition to 1.3 million metric tonnes of beginning stocks, making for a total 2012-2013 sugar supply of around 6.0 million metric tonnes.

The sugarcane production is reported at 62.5 million metric tonnes against the target of 59 million metric tonnes set by Pakistan Sugar Mills Association. This is 5.9% higher than the 2011-12 produce of 58.4 million metric tonnes. The detailed break-up of the sugar produced in 2011-12 is shown below in the table.

Table 1: Sugar Production 2015-16

Detailed break-up of sugar produced in 2011-12	
Sugarcane plantation	1,057,000 hectares
Sugarcane produced	58,038,000 tonnes
Sugarcane crushed (with 81.7 % utilization)	48,038,612 tonnes
Sugar produced from cane	4,638,361 tonnes
Sugar produced from beet	18,216 tonnes
Total Sugar Produced	4,656,577 tonnes
Carryover stocks (Mills & TCP)	1,109,321 tonnes
Availability for 2011-12	5,765,898 tonnes

Source: Pakistan Sugar Mills Association

Punjab is the highest producer of sugar with production of 3.1 million metric tonnes approx, followed by Sindh with total production of 1.25 million metric tonnes. KPK lags behind considerably with production of around 287,000 tonnes. The province wise production is summarized below in table.

Table 2: Province wise total production of Pakistan

Province	Cane Crushed	Raw	Beet Sliced	Sugar Production			Total production	Molasses
				(Cane)	(Raw)	(Beet)		
Punjab	32,203,007	-----	-----	3,116,348	-----	-----	3,116,348	1,445,830
Sindh	13,040,210	-----	-----	1,250,036	-----	-----	1,250,036	624,956
KPK	3,005,318		176,709	268,766	-----	18,216	286,982	153,583
Total 2011-12	48,248,535	-----	176,709	4,652,164	-----	18,216	4,670,380	2,224,369
Total 2010-11	44,526,719	42,360	151,265	4,119,516	39,678	13,535	4,172,729	2,034,555

Source: Pakistan Sugar Mills Association

The sugar consumption for the year 2012-13 is estimated to be around 4.4 million metric tonnes. Total consumption of sugar over the years is increasing mainly due to growing demand by the processed food sector. Bulk sugar consumers such as bakeries, candy, ice cream and soft drink manufacturers account for about 60 percent of the total sugar demand. The sugar consumption in 2011-12 was 4.385 million metric tonnes as compared to 4.096 million metric tonnes in 2010-11. The average monthly consumption

in 2011-12 was hence 365,688 tonnes, as compared to 341,367 tonnes in 2010-11. The yearly trend is shown below in the figure.

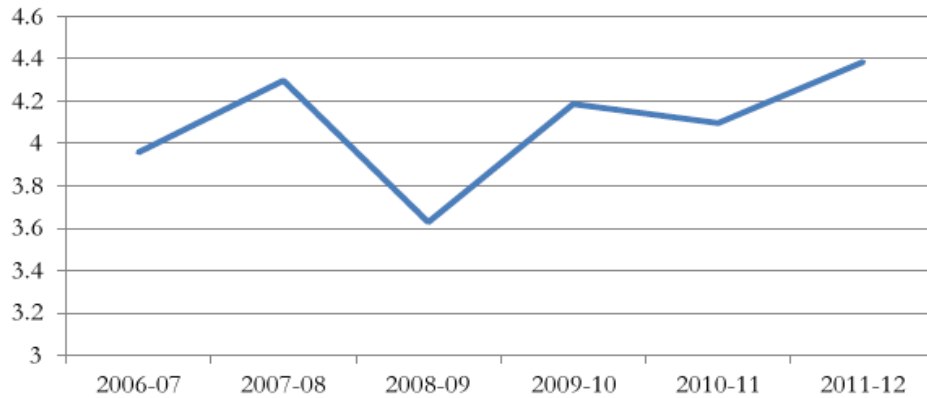


Figure 2: Sugar Consumption mmt

Source: Economic Survey of Pakistan

The kg per capita consumption in 2011-12 was 24.57, as compared to 23.12 in 2010-11.

The yearly trend in the export of sugar (fiscal year wise) is tabulated as follow:

Table 3: Export of Sugar

Fiscal Year	Quantity (Tonnes)	Value in "000" Rupees	Avg Price Rs / Tonne
1997-98	210,632	2,897,750	13,757
1998-99	906,602	11,549,170	12,739
1999-00	--	--	--
2000-01	--	--	--
2001-02	--	--	--
2002-03	45,669	627,949	13,750
2003-04	116,175	1,589,210	13,670
2004-05	54,771	1,028,710	18,782
2005-06	61,047	1,590,555	26,055
2006-07	12	330	27,500
2007-08	260,840	5,738,856	22,015
2008-09	23,980	639,677	26,675
2009-10	--	--	--
2010-11	--	--	--
2011-12	48,672	2,575,403	52,913

Source: Pakistan Bureau of Statistics

Reference: Overview of Sugar Industry in Pakistan, June 2013

As per PEPA 2012 and the IEE/EIA Regulations, 2000 it is mandatory for the proponent of any development project to obtain Environmental Approval from EPA Punjab by filing an IEE or EIA as the case may be, before the Agency. This Report presents the Environmental Impact Assessment (EIA) for this proposed Project. For this purpose, the proponent has engaged environmental consultants, M/s Ecogreen Company (Pvt.) Ltd. The purpose of this study is to identify the environmental baseline i.e. physical, biological and socio-economic/cultural conditions and assess all possible impacts arising during the construction and operation phase of the project with the aim to find out appropriate measures for their mitigation, to either eliminate those impacts or to bring them to acceptable level and formulate Environmental Management Plan (EMP) for implementation of the project in environment-friendly manner.

The report provides relevant information, as required under the officially approved format, to facilitate the decision makers i.e. EPA Punjab for the issuance of Environmental Approval.

1.2 THE PROPONENT

Name	Mr. Abdullah Ilyas Director HWSML
Address	6-F, Model Town, Lahore, Pakistan
Contact No.	042-35917321~23

1.3 THE PROJECT

The Proposed Project is the Establishment of Haseeb Waqas Sugar Mill. Its salient features have been described later in this Chapter, Chapter 2 and briefly in Executive Summary of this EIA Report.

1.4 NATURE OF PROJECT

This project is the Establishment of a Sugar Mill.

1.5 SIZE OF PROJECT

Proposed project is the establishment of 8000-10000 TCD (tonnes sugar cane crushed per day) capacity sugar mill.

1.6 LOCATION OF PROJECT

Proposed Project is located at Maoza Jugmull, Tehsil Jatoi, District Muzaffargarh.

1.7 COST OF THE PROJECT

Cost of project is approx. PKR 3.8 billion.

1.8 DETAILS OF CONSULTANTS

Consultant: Ecogreen Company (Pvt.) Ltd.

Address: 233-Rewaz Garden, Lahore

Contact No: 042-37171189

Study Team:

Table 4: List of experts

Sr. #	Name	Qualification
Team Leader		
i.	Muzna Manzoor	MS Environmental Engineering (Scholar)
Environmental Engineers		
i.	Hira Iqbal	MS Environmental Engineering (Scholar)
ii.	Bilal Khan	B.Sc. Environmental Engineering
iii.	Abdullah Chisty	MS Environmental Engineering (Scholar)
Environmental Scientist		
iv.	Houda Javed	Ph.D. Environmental Sciences (Scholar)
v.	Leenah Maqbool	M.Phil. Environmental Sciences
vi.	M. Waqas	BS Hons. Environmental Sciences
vii.	Adnan Naeem	M.Sc. Analytical Chemistry & MS Env. Science

1.9 PURPOSE OF REPORT

The main objectives of this EIA study were:

- To determine and document the state of the environment of the project area to establish a baseline in order to assess the suitability of the Proposed Project in that area.
- To identify pre construction, construction and operation activities and to assess their impacts on environment.
- Provide assistance to the proponent for planning, designing and implementing the project in a way that would eliminate or minimize the negative impact on the

biophysical and socio-economic environment and maximizing the benefits to all parties in cost effective manner.

- To present Mitigation and Monitoring Plan to smoothly implement the suggested mitigation measures and supervise their efficiency and effectiveness.
- To provide opportunity to the public for understanding the project and its impacts on the community and their environment in the context of sustainable development.
- Prepare an EIA Report for submittal to the Environmental Protection Agency, Punjab for according Environmental Approval.

CHAPTER 2: DESCRIPTION OF PROJECT

2.1 GENERAL

This section of the study concentrates on details of the project and its salient features; such as location, site layout, objectives, selection of alternatives, cost and magnitude of operation and various phases. Inputs and discharges relevant to different phases of the project, such as electricity & materials, etc. have also been examined as a response to possible environmental concerns.

2.2 TYPE AND CATEGORY OF PROJECT

As per Review of Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) Regulations, 2000 the Proposed Project falls in the **B(4) category** (*Food processing industries including **sugar mills**, beverages, milk and dairy products, with total cost of Rs.100 million and above*) of Projects mentioned in **Schedule II**.

2.3 OBJECTIVES OF PROJECT

HWSML is proposing to establish a sugar factory in District Muzaffargarh for the purpose of processing sugar cane and producing milled sugar and other related byproducts. The overall purpose for the establishment of sugar mill is to increase the Pakistan's competitiveness in the sugar sector and to meet domestic sugar demand using local resources.

Company is endeavoring to be the leading Industry in Sugar Sector by building the Company's image through quality improvement, customers' satisfaction and by maintaining a high level of Ethical and Professional Standards through the Optimum use of Resources. Another goal for the establishment of the factory is to create employment and support out-growers to grow and supply sugar cane by providing them with assistance in terms of land preparation extension services, seeds and fertilizers.

2.4 ALTERNATIVES

2.4.1 Site alternatives

No other site has been considered as a land under undisputed ownership is selected for the Establishment of proposed sugar mill. Selected site is an unproductive land at this

time and is going to be brought into industrial use which will be beneficial for the locals as they will get jobs. The site is well located in regard to the following:

- Easy road access to the Site
- Easy access to market
- Easy access to raw materials (Sugarcane)
- No settlements at a safe distance
- No watercourse within a safe distance
- No ecologically sensitive or declared protected area within safe radius

The choice of the proposed site is justified because Muzaffargarh is endowed with suitable natural conditions for increased sugarcane production so due to locally available raw material and aforesaid reasons the selected site is best feasible for establishment of proposed project. Distance from nearest receptors is:

Table 5: Distance of site from nearest receptors

Receptors	Name	Distance
Residence	Alipur	7.6km
Main bazar	Jatoi bazar	8.5km
School	Al-saeed public school	8km
Hospital	New malik surgical hospital	5.4km
Road	Alipur road	Adjacent
Water body	Qadra Nalla	4.2km



Figure 3: Distance of site from nearest receptors

2.4.2 Technology alternative

2.4.2.1 Juice extraction technology:

Juice from cane can be extracted by milling or diffusion methods.

Juice extraction by milling is the process of squeezing the juice from the cane under a set mills using high pressure between heavy iron rollers. Those mills can have from 3 up to 6 rolls; every set of mills are called tandem mill or mill train. For improve the milling extraction efficiency, imbibition water is added at each mill. Hot water is poured over the cane just before it enters the last mill in the milling train and is recirculated up to the reach the first mill.

Sugarcane diffusion is the process of extracting the sucrose from the cane with the use of imbibition but without the squeezing by mills. Shredded cane is introduced into the diffuser at the feed end, Hot water is poured over the shredded cane just before the discharge end of the diffuser.

With milling process, the bagasse obtained does not require subsequent drying; however the diffusion process leaves the fibre completely saturated with water and to extract this water, a powerful mill is required in addition to the diffusion apparatus. By diffusion process, the crushed cane become powdery, and their fuel-value is very inferior to that of the bagasse obtained by direct milling, so that supplementary fuel (wood or coal) becomes necessary. The diffusion process is a continuous one hence should be carried out day and night. The quantity of cane treated by diffusion in 24 hours is strictly limited by the number and capacity of the diffusers. The milling process is more adaptable, because the rollers can be adjusted to admit more cane per day.

Diffusion gives a lower starch with reduced purity and about 25% more colour. Diffusion is more sensitive to trash and gives around 6% more bagasse since all bagacillo is retained in the extraction unit.

Juice heating is fundamental for diffusion in order to eliminate microorganisms and to promote rate of extraction; for this reason there is a slight overall increase in the process steam demand for diffusion.

Considering above advantages of milling over diffusion process for juice extraction, milling technology alternative is adopted.

2.4.2.2 Granular sugar manufacturing technology alternative

White granular sugars can be undertaken using either the open pan (OP) or vacuum pan (VP) processes. The major difference between the VP and OPS technology is the method of evaporating or boiling the juice. In open pan process, the boiling operation uses cascade type furnaces of various configurations. The massecuite is removed from the final boiling pan at about 84°Brix, at a temperature of around 112°C. Whereas in vacuum pan process, the juice is boiled under vacuum, to about 70° Brix, inside closed vessels or 'effects'. Low pressure steam is used to boil the juice which circulates through tubes within a closed vessel. The vapor driven off passes into a second similar vessel and it is used to heat more juice. In order to maintain suitable temperature differentials for heat transfer to occur, a partial vacuum is applied to each vessel, effectively lowering the boiling temperature of the juice. This system is capital-intensive but is highly energy efficient and more importantly boils the juice at progressively lower temperatures from 103 to 50°C, reducing the effects of inversion, minimizing discoloration and enhancing the formation of sugar crystals. In OP technology, juice is boiled in open pan furnaces with little control over sugar losses due to inversion caused by boiling the juice at higher temperatures and for longer periods. The VP technology is energy self sufficient while OP needs additional fuel.

In VP Technology of insoluble materials and some undesirable dissolved substances from the juice is done with liming, sulphitation or carbonation in continuous clarifiers. In OP, usually batch clarification is done in open pans with vegetable bark extracts and manual skimming of the scum. Better clarification is achieved with VP than OP as purer juice is obtained with VP.

Considering above advantages of VP over OP process for sugar manufacturing, VP technology alternative is adopted.

2.5 LOCATION AND LAYOUT OF PROJECT

Details of location of project are provided in table below:

Particulars	Details
Latitude	29°26'35.6429"N
Longitude	70°52'52.94284"E
Location	Maoza Jugmull, Tehsil Jatoi, District

	Muzaffargarh
Tehsil	Jatoi
District	Muzaffargarh
Elevation above sea level	343ft
Nature of area	Agricultural
Road connectivity	Alipur Jatoi Road
Archeological or historical site	No archeological site was found within 2-3km radius

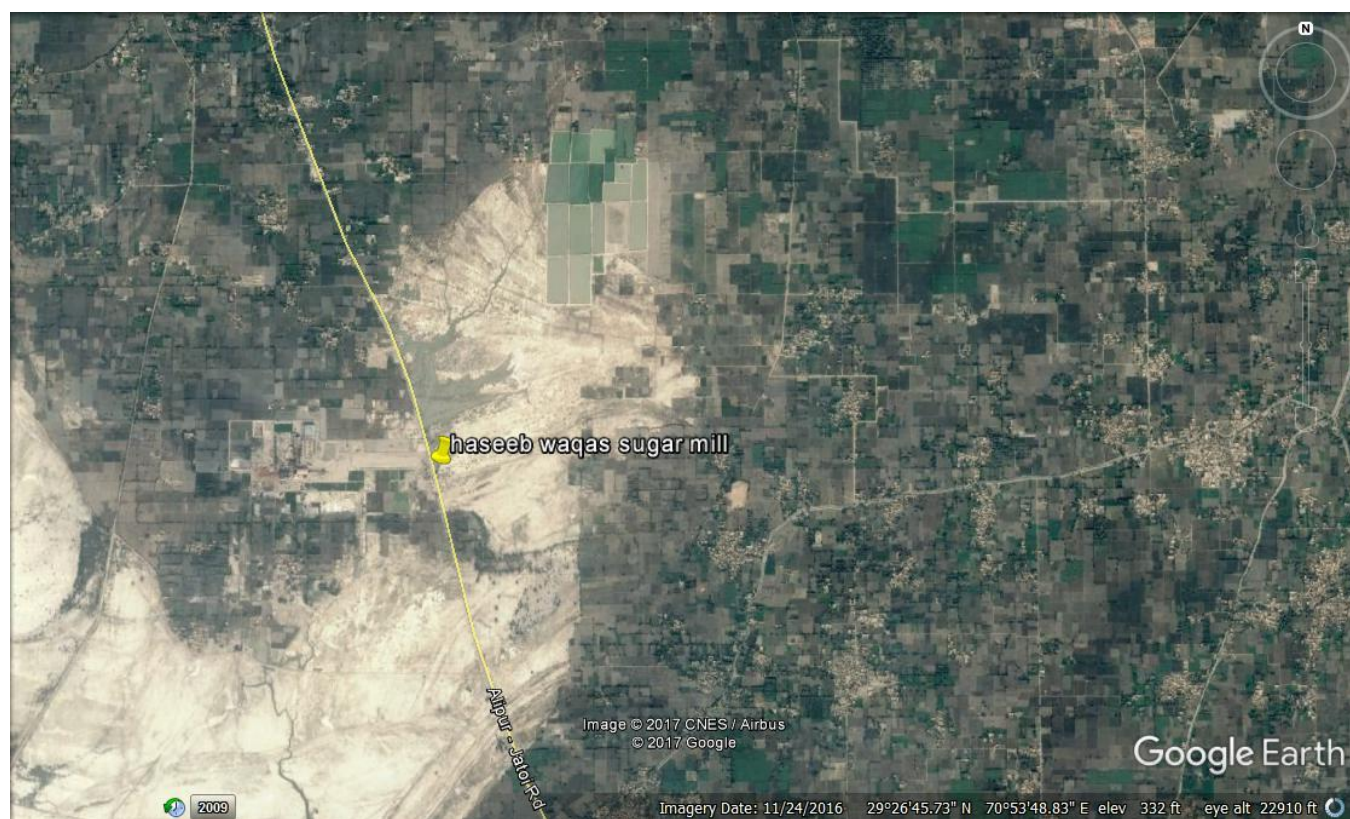


Figure 4: Location of project

2.6 LAND OWNERSHIP

Property documents are attached in annexure indicating that project is under undisputed ownership of proponent.

2.7 LAND USE ON SITE

Proposed project seems to be located in an agricultural area.

2.8 GOVERNMENT APPROVALS

All government approvals will be obtained after getting Environmental Approval from EPA Punjab.

2.9 ROAD ACCESS

Project site can be approached through Alipur-Jatoi road which is adjacent to site. Road network is shown in figure below:



Figure 5: Road network



Figure 6: Access road

2.10 VEGETATION FEATURES OF SITE

No vegetation is existing there to be removed due to the establishment of proposed mill. Site is located within an agricultural area and is surrounded by sugarcane fields and mango, kikar, shisham trees. Trees and agricultural fields in surroundings of site are given in below fig. Proponent intends to plant trees in multi-forest to compensate if any loss of vegetal cover occurs.







Figure 7: Vegetation in surroundings of project site

2.11 RELOCATION AND REHABILITATION PLANS

There exists no human settlement within a safe radius of the selected project site to be displaced owing to the commencement of the Proposed Project. No structure of any significance stands at the site to be relocated or dismantled. Land is already under proponent ownership, and no fresh land is to be occupied; hence, no relocation and rehabilitation is required. Nearest residences from project site are:

Residence	Distance from site and direction
Jatoi	8.51km - SE
Aipur	7.64km - NW

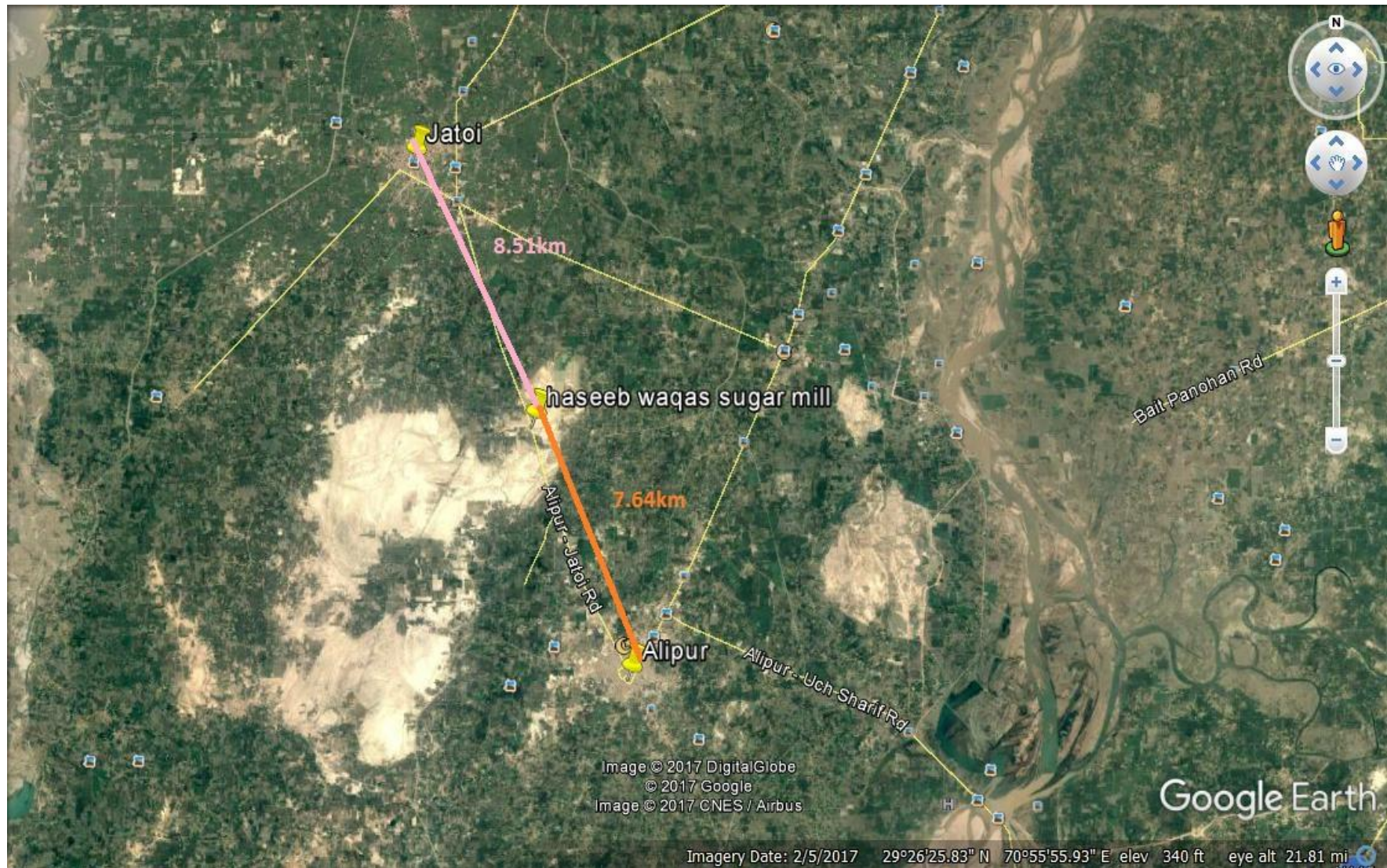


Figure 8: Distance from nearest Residence

2.12 DESCRIPTION OF PROJECT

Proposed project is the production of refined sugar (white) through sugarcane using Defecation-Remelt-phosphatation process. Main steps involved in sugar manufacturing are:

1. Extraction of juice (crushing)
2. Clarification of juice
3. Concentration of juice (juice to syrup) by evaporation
4. Boiling of Syrup to grain (crystallization)
5. Separation of crystals from mother liquor (centrifuging)

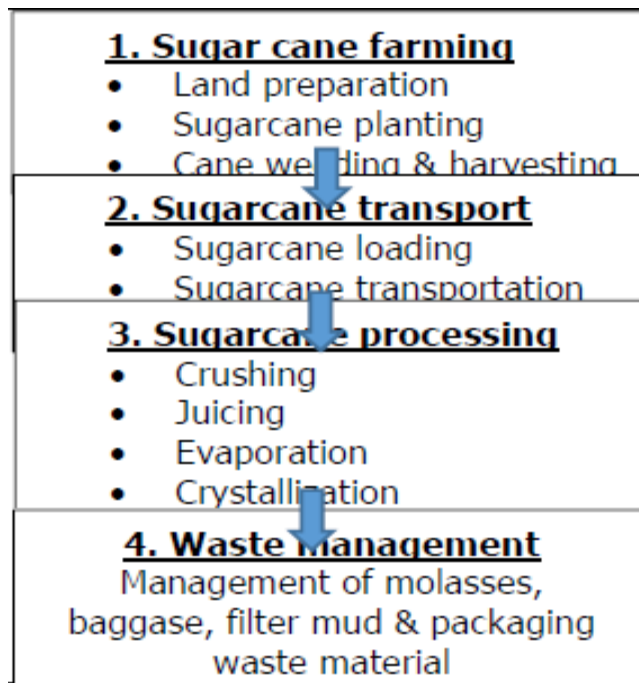


Figure 9: Operational flowchart in sugar sector

Cane receiving:

The sugar cane in the field is examined for its quality before harvesting and harvesting permits are given after its quality and maturity is found satisfactory. The sugar cane is then manually harvested and transported to factory by tractor trailers, trucks and bullock carts. The vehicles bringing sugar cane are received at the factory cane yard. Sugar cane in said project will be purchased locally.



Figure 10: Sugarcane transportation

Sugarcane Weighing:

The vehicles carrying the sugar cane are weighed on the platform type electronic weighbridges and released for unloading. The gross weight is recorded and printed. After unloading the vehicles are once again weighed for the tare weight. These weights are printed on the weighment slips, which also carry the details of the farmer, cane etc.

Sugarcane Unloading:

The cart cane is manually unloaded directly to the cane carrier. The cane from the trucks and tractor- trailers are unloaded with the help of cane un-loader crane. The cane is unloaded on to the feeder table of 100ton each.

Sugarcane Conveying:

The cane from the feeder table is then dumped to the main cane carrier, which conveys the cane to the cane preparatory devices. Electronic devices, depending on the cane-crushing rate control the speed of the cane carrier, and level in the cane carrier etc.

Sugarcane preparation:

The sugar cane is passed through the cane preparatory devices called leveler, cutter and shredder where in the cane is cut into small pieces to expose the juice cells for extraction.

Milling:

The prepared cane then passes through the milling tandem having 3 roller mills necessary feeding device. The milling train continues to extract the maximum sucrose from the prepared cane with addition of hot water spray in last two mill which is called compound imbibition system. The cane is conveyed between mills with the help of mechanical conveyors. Screens then filter the extracted juice and filtered juice is pumped for further processing. The fibrous residue after juice extraction known as bagasse is withdrawn and conveyed through bagasse conveyors to boiler for steam generation. Surplus bagasse is withdrawn from the conveyor and stored for reuse when necessary. This bagasse may be used as substrate of chip board plant and number of other industrial purposes. The bagasse conveyor also has return conveyor to feed the stored bagasse.

Juice clarification:

The mixed juice received from milling after filtration is weighed in a juice weighing scale or by a mass flow meter to know the quantity of juice flowing. The juice contains certain undesirable impurities, which are removed before it is taken for concentration in evaporators. The juice is first heated to a temperature of 65-70°C. The hot juice is then mixed with lime to increase pH upto 7.5-8.0. The treated juice is again heated to a temperature of 104-105°C. The heated juice is then sent to a gravity settler known as clarifier wherein it stays for 45min so that mud agglomerate to form flocs and settles.

The mud settled at bottom of clarifier is withdrawn continuously and is mixed with bagasse to form fine baggasalo. Then it is filtered in a rotary vacuum filter. The filtered mud after removing residual juice in the filter is scraped from the filter drum and sent out. The filtrate juice is returned to the raw juice tank and re-circulated. The mud is used as bio-fertilizer and cattle feed.

Evaporation:

The clear juice will then be concentrated into syrup by boiling using steam in a process called evaporation. The main aim of this is water removal by multiple effect evaporation. Multiple effect evaporation is the scheme where the juice is boiled in series 4 or 5 vessels, with the steam being fed to vessel 1 only. The vapour from vessel 1 will boil the juice in vessel 2 and the vapour from 2 will boil the juice in 3, and so on until vapour from the final vessel goes to

waste and the sugar is crystallized in vacuum pans. The clear juice gets concentrated from a brix of 15 to 65 after passing through multiple effect evaporators.

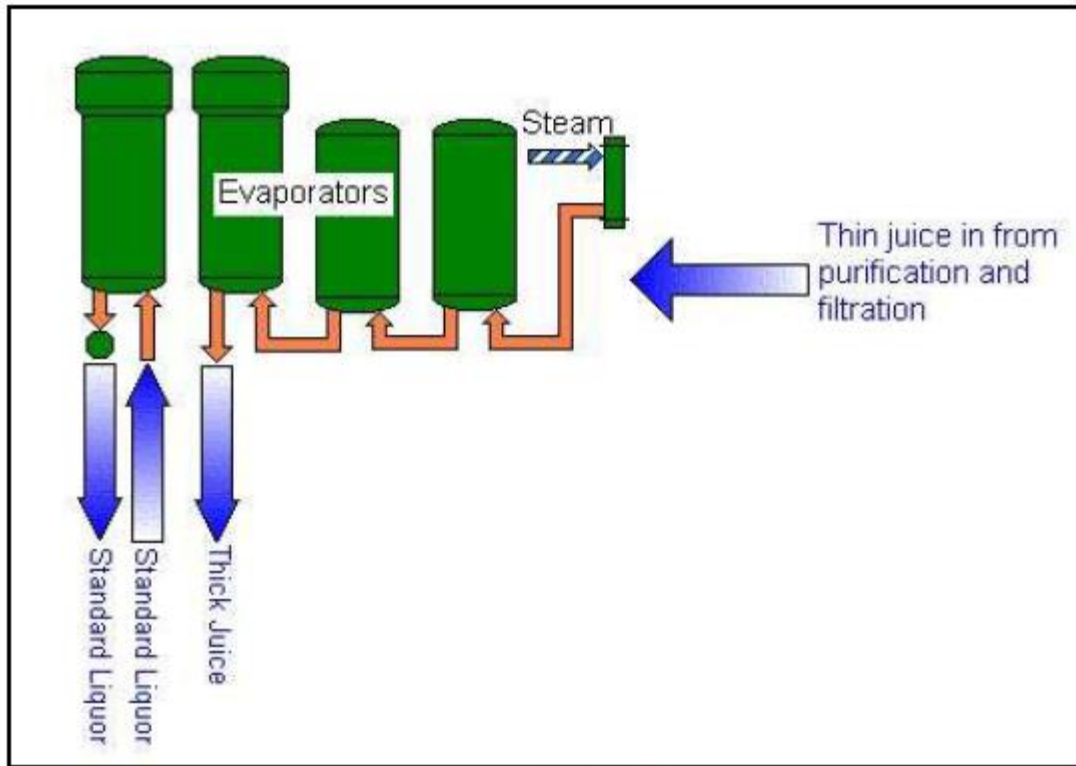


Figure 11: Multiple Effect evaporation

Crystallization:

Crystallization of sugar is one of the most vital steps in sugar milling which involves the formation of solid crystals. In the crystallization stage, the syrup will be boiled at low temperatures under partial vacuum and some sugar seeds added which will cause the development and growth of sugar crystals and the outcome is called massecuite. This will involve the feeding of pulverized sugar into the pan as the liquid evaporates, causing the formation of a thick mass of crystals. The crystals will then be spun dry in a centrifuge to produce crystal sugar. Crystallization is not only a means to convert the sucrose to a more usable form, but also an important refining step since pure sucrose tends to crystallize out of the solution, leaving most of the impurities in the associated syrup. The process will be undertaken under reduced pressure of 75-90kPa to allow a reduced boiling temperature (60-72°C) in order to avoid the formation of colored compounds. Crystals thus obtained will have a size of 1.5-4mm.

The sugar is then sent to sugar storage bins with the help of bucket elevators. The storage capacity of these storage bins is enough to store 24 hours production. The sugar is discharged from bins to fill 50kg bags and weighed automatically by electronic type automatic weighing machines. The sugar bags are transported to warehouse through belt conveyors. The quantity of sugar produced by a 10000 TCD plant shall be 33000 MT per month at 11% recovery on cane.

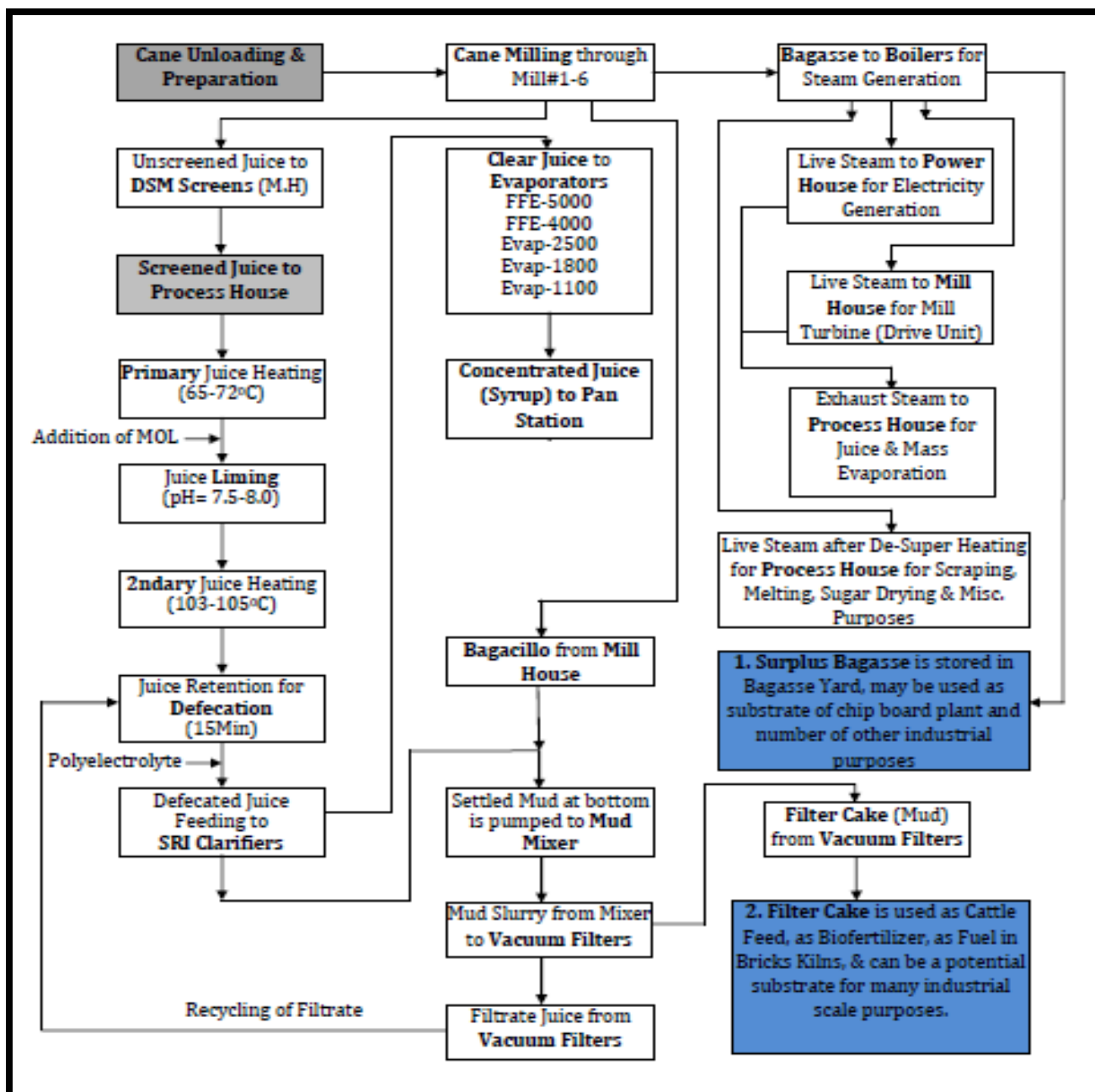


Figure 12: Process Flow Chart

2.13 POWER & STEAM REQUIREMENT

Steam requirement of plant will be fulfilled through 3 boilers of 80tons capacity each. The amount of bagasse produced by the factory is estimated to be adequate to provide the amount of heat required for the boilers. Bagasse will constitute the main source of fuel for processing, with its combustion being undertaken in a closed environment thus, making it possible for complete combustion for higher energy saving and minimal aerial discharges. Approx 129 t/hr bagasse will be required and 221 t/hr steam will be generated. Boilers will be equipped with wet scrubbers and ash catcher for proper emissions control. Approx. 13t/hr surplus bagasse (ash) will be generated and will be stored in Bagasse Yard for use as substrate of chip board plant and number of other industrial purposes.

Power requirement will be fulfilled through 2 Standby generators of 4MW each (Shinko). These generators will be enclosed in generator room to control emissions and noise level.

2.14 Water Requirement & Wastewater generation

The factory will require significant volumes of water in order to sustain various factory processes. This water will be required for process, boiler and domestic purpose. During initial startup of milling, in the absence of hot condensate from cane, the maximum water intake shall be around 3000-4000 m³/day after which the volume will reduce significantly. When the factory is finally in full operation, almost 50 % of water in the closed circuit will be re-circulated which will mean limited water abstraction. Water will be extracted from ground by using a 75 hp vertical turbine.

Wastewater generated will be treated in lagoons over an area of 4 acre. Anaerobic treatment (80-90% efficiency) process will be used to reduce the pollution load from waste water. Oil skimmers will be installed to obtain oil/grease free waste water for disposal. Moreover, wastewater will be treated through 5 lagoons. The dimensions of said lagoons are as under.

Lagoon # 1 07'x42'x67'

Lagoon # 2 07'x42'x50'

Lagoon#3 07'x25'x51'

Lagoon # 4 07'x22'x114'

Lagoon # 5 07'x42'x50'

Combined Holding Capacity = 76000 m³

After treatment in lagoons, wastewater will be discharged in sugarcane fields owned by the proponent (these fields will be grown by proponent in future nearby project site).

Water balance of proposed sugar mill is given below:

Table 6: Water Balance at 100000 TCD

Water in		Water Out	
Source	Quantity	Source	Quantity
Cane	7000 m ³ / day	Evaporation through spray pond	6500 m ³ /day
		Water in bagasse	
		Water in filter cake	
		Water in Molasses	
		Water in Boiler Ash	
		Evaporation from juice flash tank	
		Evaporation from Boiler blow down	
		Evaporation through steam leakages	
		Evaporation from soda boiling	
		Evaporation through non condensable gases	
		Evaporation from Molasses storage tank	
Source water	3000 m ³ /day	Effluent water	3500 m ³ /day
Total water in	10,000 m³/day	Total water out	10,000 m³/day

2.15 By-product

Molasses will constitute the final effluent obtained on the preparation of sugar by repeated crystallization and will be in the form of non-useable molasses (blackstrap) or as edible syrup for industrial use. The non-useable molasses (blackstrap) will be used as animal feed additive. In the latter stages, the molasses may also be used to produce ethanol, compressed yeast, citric acid and run through the establishment of a distillery in the factory. But at present the molasses will be stored in storage ponds and will be sold out.

2.16 MANPOWER

The factory workforce requirements will include both permanent and casual workers. Total number of workers will be 794. During off-season, number of workers will be 300. Complete workers strength is annexed.

2.17 SOLID WASTE GENERATION

The key solid wastes and by-products expected from the proposed project will include baggase, and filter or press mud. Baggase is cane milling waste fibre matter whose content will be about 30.98 % of the cane (129T/hr). HWSML is planning to re-use the bagasse which is the residual woody fiber of the cane as fuel for boilers for steam generation.

The baggase will be stored in a well-designed holding area before reuse at the sugar factory. The filter mud will be generated at rate of approx. 13t/hr and will be used for the production of dry filter cake to be used as a fertilizer or cattle feed. The filter cake will be distributed to the sugar cane farmers for recycling. The disposal of non-biodegradable and recyclable matter, such as containers, waste papers, used materials, waste packaging materials, will be sold to local contractors for recycling or reuse purpose.

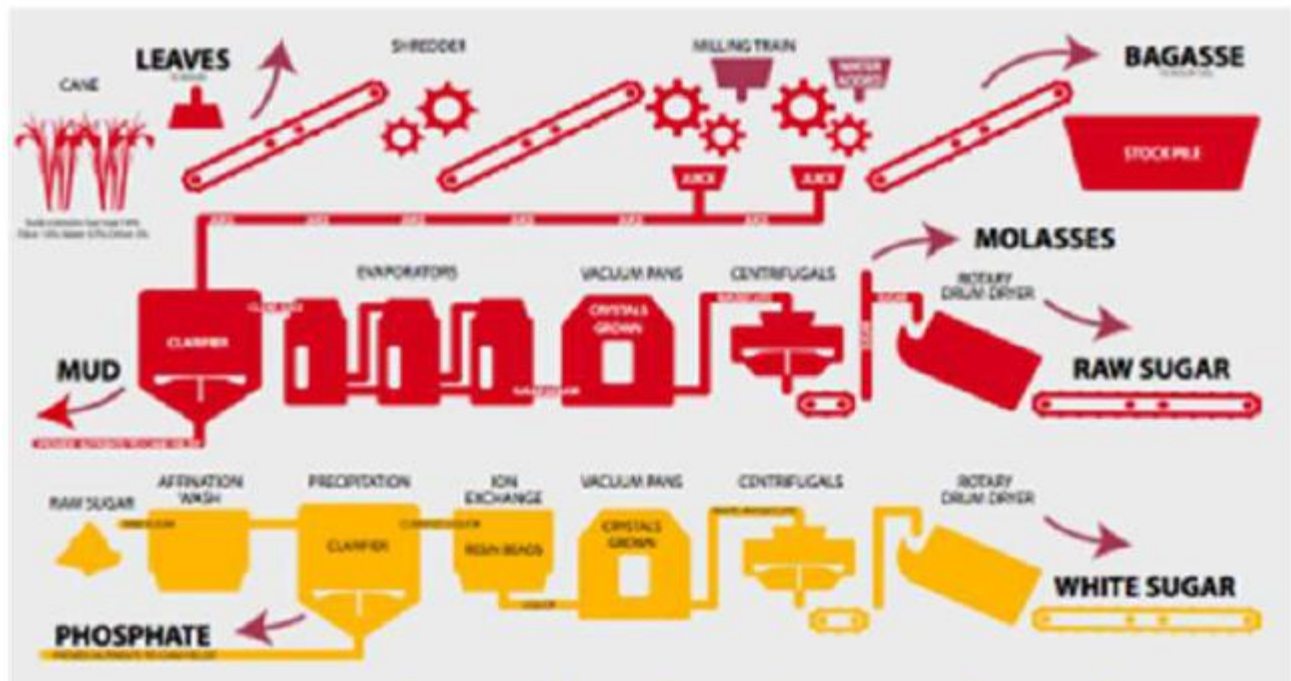


Figure 13: The typical by-products and wastes in sugar industry

2.18 LIST OF MACHINERY

List of machinery to be used in proposed project is annexed as annexure.

2.19 MASS BALANCE

Mass balance of proposed project is annexed as annexure

2.20 SCHEDULE OF IMPLEMENTATION

Project installation and completion period is 2 years.

Table 7: Tentative Schedule of Implementation

Sr #	Activities	6 Months			6 Months			6 Months			6 Months		
		2M	2M	2M	2M	2M	2M	2M	2M	2M	2M	2M	2M
1	Detailed Designing												
2	Mobilization of Contractors												
3	Construction and installation of machinery during year 1												
4	Construction and installation of machinery during year 2												
6	Trial Operation												
M-Month													

2.21 COST AND MAGNITUDE OF OPERATION

Civil construction of machinery foundations shall be carried out by the local contractor using locally available construction materials including brick, cement, steel etc. On the basis of present market price and anticipated escalation up to the scheduled date of commissioning, the capital cost of the proposed sugar plant of cane crushing capacity from 8000 TCD to 10000TCD will be around Rs. 3.8 billion. Magnitude of operation will include:

- Civil work (Offices construction)
- Installation of machinery
- Landscaping and tree plantation
- Trial operation

Cost breakup of project is as follows:

Plant & machinery	Rs 3234839054
Building	Rs 490942989
Land cost	Rs 75448714
Total	Rs 3801230757

CHAPTER 3: DESCRIPTION OF THE ENVIRONMENT

16.1 GENERAL

This section describes the baseline conditions, which cover the existing physical, ecological, and socio-economic environment of the Project Area. Information on these aspects has been derived from the desk study of available data, field visits to the project area as well as information obtained through visits to the Government departments and other relevant agencies.

16.2 PHYSICAL ENVIRONMENT

This part examines the physical resources such as topography, soil, climate, surface and ground water resources and quality, ambient air quality and geology of not only the Project site but also the city as a whole to assess whether the project under assessment can or does have any impacts on any of these parameters. The description of physical environment of city and the project area is present in the following sub sections.

16.2.1 TOPOGRAPHY

The topography of the project area is almost flat with no noticeable variation in the surface elevation. At the proposed Project site, a surface elevation is about 334 feet. The project area mainly consists of agricultural plains and cultivable fields. The site area adjacent to Muzaffargarh Canal is waterlogged. The water-logging effect gradually decreases while moving away from MC. Proposed site is located approx at a distance of 30km from site.

16.3 GEOLOGY & SEISMICITY

Pakistan is located within a seismically active area straddling the boundaries between the Indo-Pakistan, Arabian and Eurasian plates and its structure is predominantly affected by their past and present interrelationships. Two composite plates, comprising both continental and oceanic crust (Indo-Pakistan and Arabia) are separated by an intra-oceanic transform boundary, which within the Pakistan offshore area, is expressed as the Murray Ridge. This ridge continues in a northerly direction through the western flanks of Pakistan, in the form of the Chaman Fault, which forms the interface between the

Eurasian and Indo-Pakistan Plates. Within this interface area there are many faults reflecting the complex nature of the plate tectonics.

According to Building Code of Pakistan, the proposed project site lies within Zone 2A (a zone of moderate seismic activity).

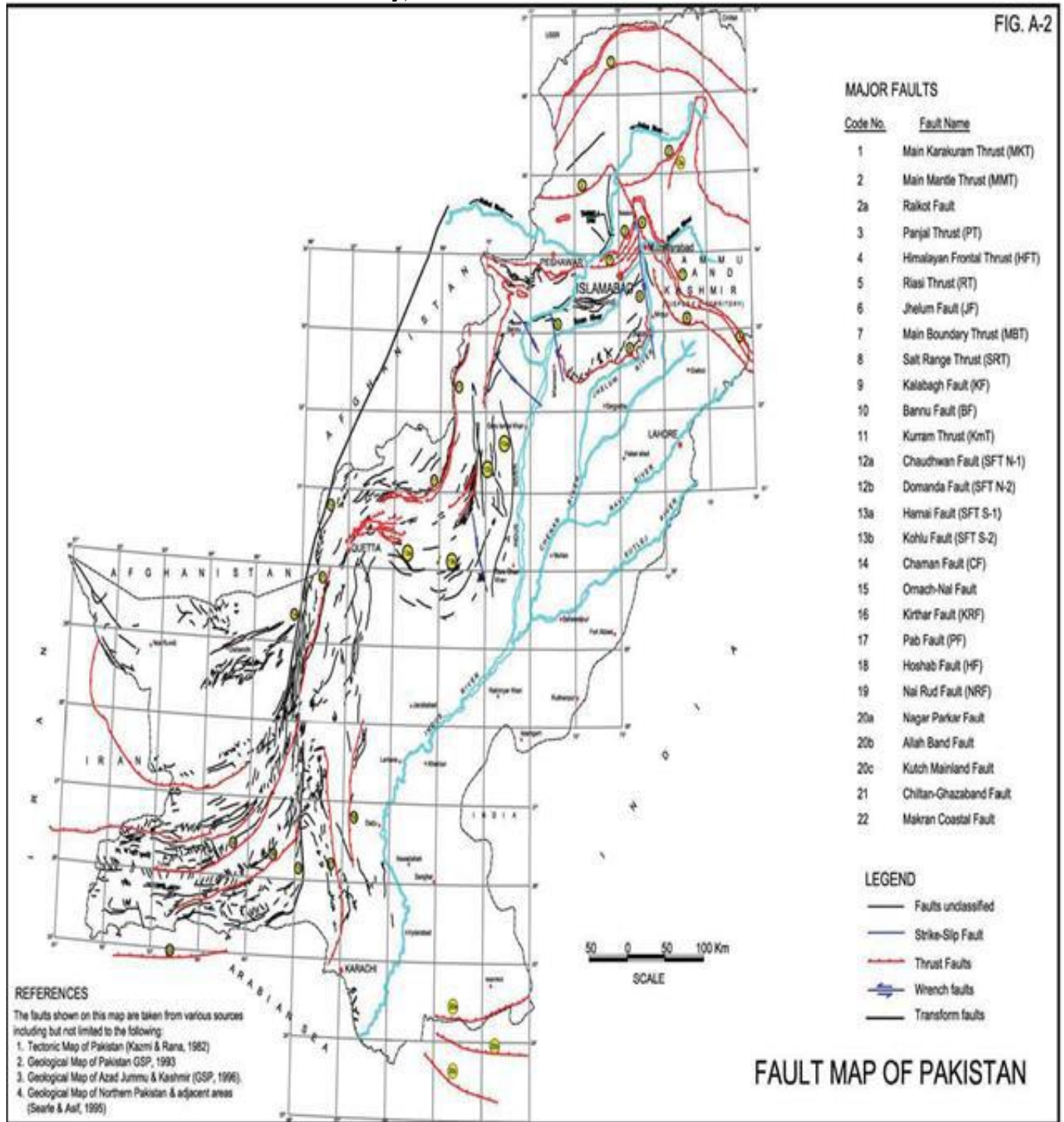


Figure 14: Fault map of Pakistan

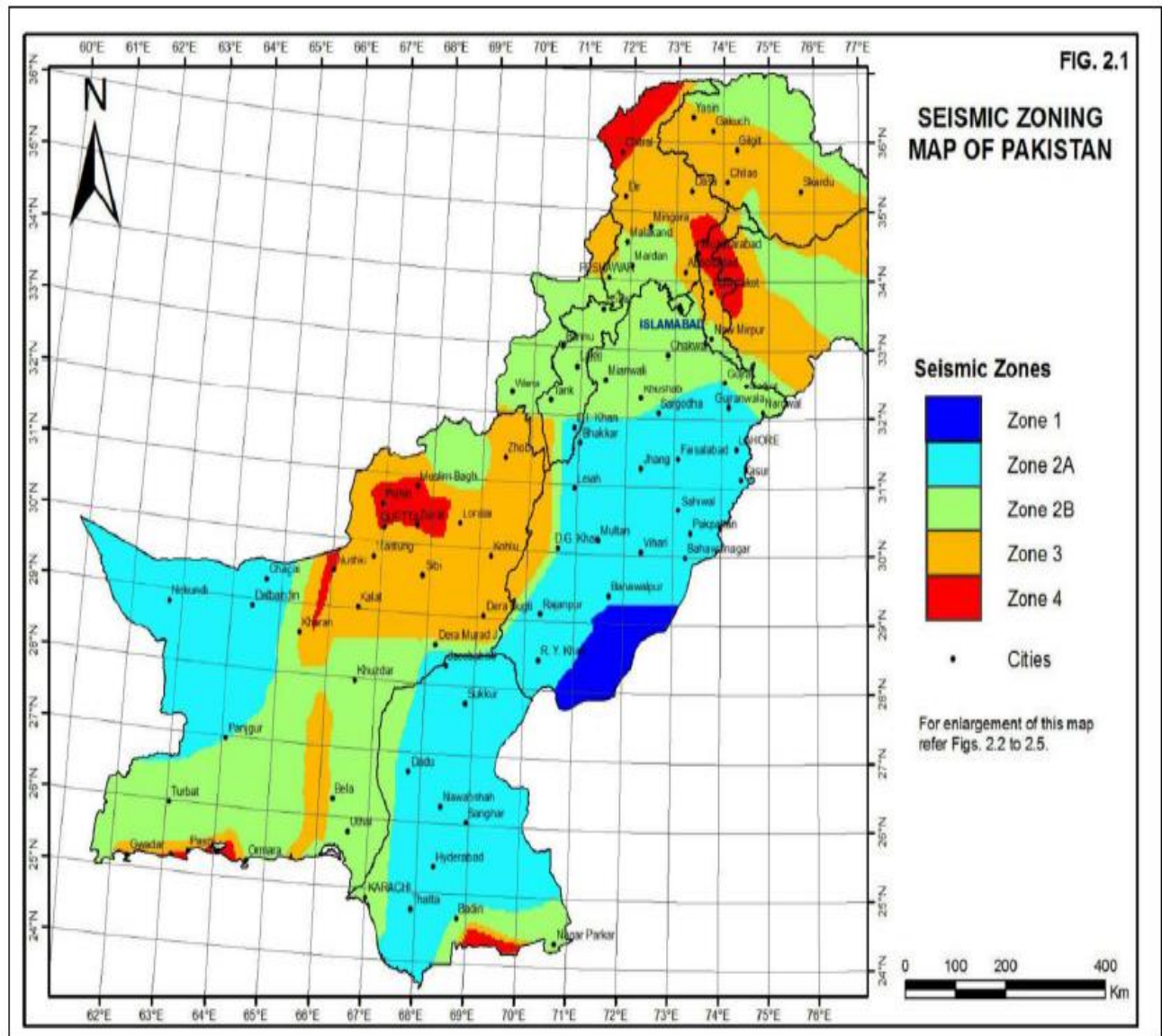


Figure 15: Seismic zoning map of Pakistan

16.3.1 WATER RESOURCES

Muzaffargarh Canal (MC), Indus River and Chenab River are the principle surface water resources of the area. River Indus flows at the distance of about 18 km towards the west of proposed Project site whereas River Chenab is located towards the east of proposed Project site at the distance of about 14 km.

MC is the major surface water bodies in the area flowing towards North-West side of the proposed Project site at a distance of approx 30km. MC is the perennial irrigation canal (flowing during 6-7month in a year) originating from Taunsa Barrage at River Indus.

Under the normal conditions, MC closure period is 1.5 month during January / February each year. The discharges of Muzaffargarh Canal vary from 5280 ft³/s to 205 ft³/s in summer, 4315 ft³/s to 115 ft³/s in winter and 7700 ft³/s to 330 ft³/s in monsoon season.

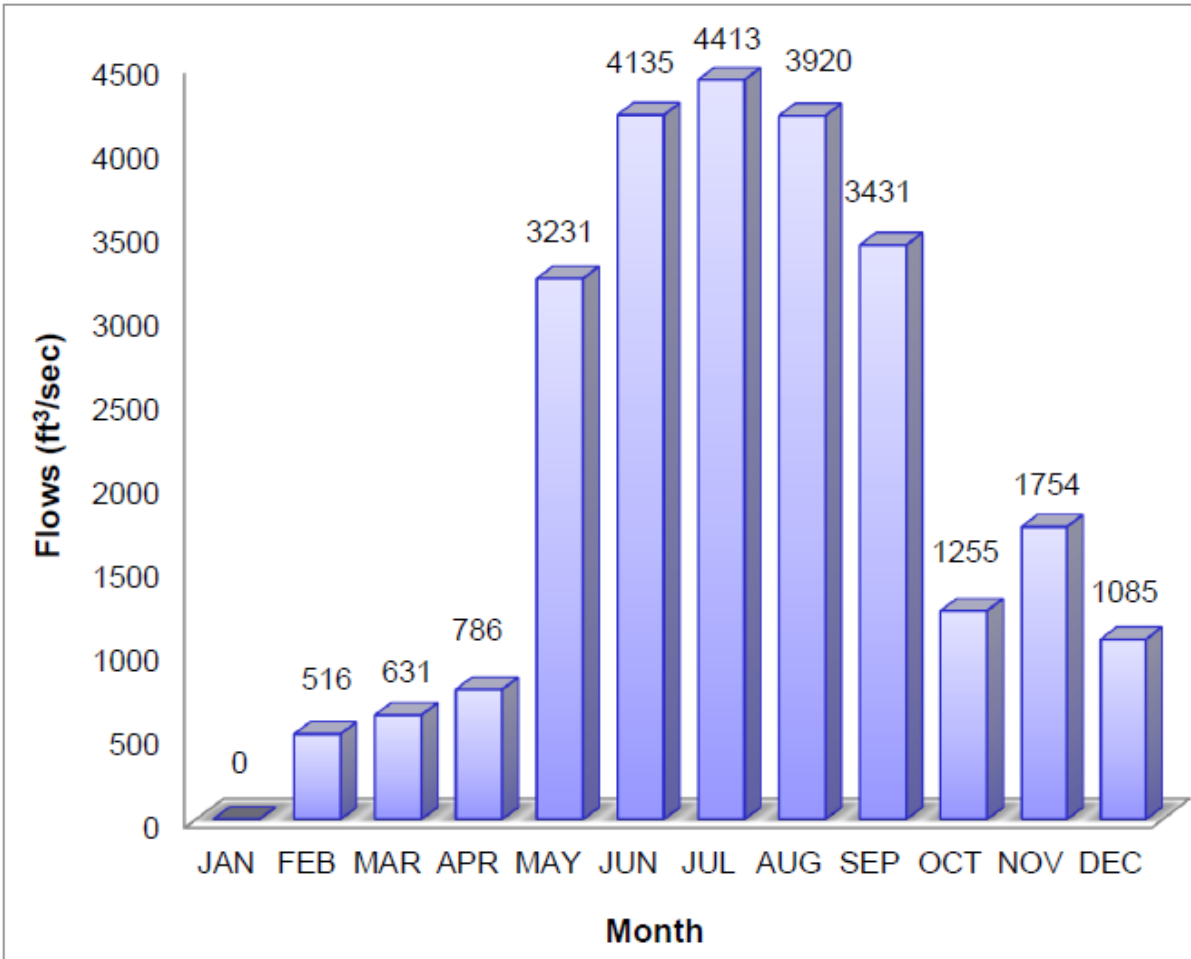


Figure 16: Monthly Average Flows in Muzaffargarh Canal

In the project area, large amount of water percolates into ground because of seepage from Muzaffargarh Canal. Groundwater table is mostly shallow (about 5-10 m). Local communities mostly rely on groundwater for drinking and household purposes (washing and bathing). People have installed hand pumps and electric motors to pump ground water. Groundwater quality results at some locations of area are given below:

S.#	Analytes	Standard	Units	Results			Test Method
		NEQS		S # 5	S # 6	S # 7	
1	pH value	6.5-8.5	-	7.81	8.32	8.24	USEPA 150.1
2	Total Dissolved Solids(TDS)	<1000	mg/L	604.3	1242.3	919	Hach 8160
3	Residual Chlorine	0.5-1.5	mg/L	0.03	0.03	0.04	Hach 8167
4	Barium	1.5	mg/L	06	10	18	Hach 8014
5	Copper	2	mg/L	BDL	0.09	0.11	Hach 8506
6	Manganese	≤ 0.5	mg/L	0.7	0.5	0.3	Hach 8034
7	Nitrate (NO ₃)	≤ 50	mg/L	02	04	4.7	Hach - 8153
8	Nitrite (NO ₂)	≤ 3	mg/L	0.481	0.006	0.005	Hach -8039
9	Chloride(as Cl ⁻)	< 500	mg/L	78	167	09	Hach 8206
10	Cyanide(as CN ⁻)total	1	mg/L	0.008	0.006	0.009	Hach 8027
11	Fluoride(as F ⁻)	10	mg/L	0.1	BDL	BDL	USEPA 340.1
12	Total Hardness(as CaCO ₃)	<500	mg/L	-	-	398	Hach 8213
13	Phenolic compounds(as phenol)	0.1	mg/L	BDL	BDL	BDL	USEPA 420.1
14	Arsenic	1	mg/L	BDL	BDL	BDL	Hach method
15	Zinc	5	mg/L	0.04	0.021	0.04	USEPA 3500 Zn B
16	Chromium(trivalent & hexavalent)	1	mg/L	BDL	BDL	BDL	ASTM D-1687
17	E-Coli	0	MPN/100ml	+ve	+ve	+ve	APHA SM-9221-F
18	Total Coliform	0	MPN/100ml	25	26	24	APHA SM-9221-B

S.#	Analytes	Standard	Units	Results			Test Method
		NEQS		S # 8	S # 9	S# 10	
1	pH value	6.5-8.5	-	8.08	7.89	8.08	USEPA 150.1
2	Total Dissolved Solids(TDS)	<1000	mg/L	1387.3	630	1365	Hach 8160
3	Residual Chlorine	0.5-1.5	mg/L	0.05	0.04	0.03	Hach 8167
4	Barium	1.5	mg/L	09	06	16	Hach 8014
5	Copper	2	mg/L	0.13	1.85	0.08	Hach 8506
6	Manganese	≤ 0.5	mg/L	0.2	0.4	0.5	Hach 8034
7	Nitrate (NO ₃)	≤ 50	mg/L	0.8	1.7	6.8	Hach - 8153
8	Nitrite (NO ₂)	≤ 3	mg/L	0.004	0.01	0.012	Hach -8039
9	Chloride(as Cl ⁻)	< 500	mg/L	12	82	07	Hach 8206
10	Cyanide(as CN ⁻)total	1	mg/L	0.007	0.012	0.006	Hach 8027
11	Fluoride(as F ⁻)	10	mg/L	BDL	0.26	0.28	USEPA 340.1
12	Total Hardness(as CaCO ₃)	<500	mg/L	291.6	489.6	310	Hach 8213
13	Phenolic compounds(as phenol)	0.1	mg/L	BDL	BDL	BDL	USEPA 420.1
14	Arsenic	1	mg/L	BDL	BDL	BDL	Hach method
15	Zinc	5	mg/L	0.019	0.02	0.14	USEPA 3500 Zn B
16	Chromium(trivalent & hexavalent)	1	mg/L	BDL	BDL	BDL	ASTM D-1687
17	E-Coli	0	MPN/100ml	+ve	+ve	+ve	APHA SM-9221-F
18	Total Coli	0	MPN/100ml	30	25	26	APHA SM-9221-B

Reference: Environmental and Social Impact Assessment (ESIA), KAPCO 660 MW Coal-Fired Power Plant

Groundwater quality of site is provided below:

Sr. No	Parameters	Unit	Concentration	Method
1	pH value		7.48	pH meter
2	TDS	mg/l	432	Evaporation
3	Taste		Normal	Taste panel
4	Odour	TON	0.0	Dilution
5	Chloride	mg/l	36.0	Digital titrator
6	Color	ptcu	0.0	Spectrophotometer
7	Total Hardness	mg/l	124.0	Digital titrator
8	Total Alkalinity	mg/l	152.0	Digital titrator

16.3.2 CLIMATE

The climate of the project area is broadly described as hot and arid. May is month of highest temperature (42°C) in Muzaffargarh during each year. June is the second hottest month in the area where average temperature of 41.5°C is recorded. The lowest temperature (5.4°C) is observed during the January each year. December is also very cold when temperature reaches to 6°C. Mean monthly temperature data of project area is given below:

Table 8: Mean Monthly Maximum Temperatures (°C), in Project Area

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2010	18.6	24.6	32.9	39.7	42.5	40.9	38.4	35.6	36.1	34.8	28.1	21.8
2011	18.2	22.2	29.9	34.6	46.2	41.7	39.4	37.0	34.6	33.9	29.5	23.3
2012	19.8	22.0	29.3	34.9	41.4	42.2	40.4	37.8	35.0	32.8	27.7	22.1
2013	19.4	21.6	29.2	34.5	41.6	41.0	39.5	37.0	37.1	34.2	27.3	21.3
2014	20.8	22.0	27.0	34.5	38.3	41.9	38.7	38.3	36.5	32.5	27.6	19.4

Table 9: Mean Monthly Minimum Temperatures (°C), in Project Area

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2010	6.6	9.1	17.6	22.9	26.5	28.6	28.9	27.5	25.3	21.9	12.1	5.7
2011	4.8	9.7	15.2	19.7	27.9	29.9	29.5	28.2	25.6	20.3	15.5	5.7
2012	4.8	6.2	13.6	20.3	26.1	29.6	29.4	28.5	25.8	19.4	13.4	8.0
2013	5.5	11.0	15.0	20.5	26.0	29.3	30.0	28.1	26.6	22.9	13.1	8.1
2014	5.5	8.9	14.3	14.3	24.7	29.3	29.4	28.2	26.1	21.3	12.7	6.9

Rainfall is higher during the months of August and September which is 53.76 mm and 51.38 mm respectively, whereas; it is minimum during the months of November, December and January, which is less than 1 mm.

Table 10: Mean Monthly rainfall (mm) in project area

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2010	TR	TR	42.0	3.0	8.6	TR	55.2	158.1	14.8	0.2	0.0	TR
2011	0.0	15.8	4.5	16.4	12.3	6.3	10.2	37.5	80.9	1.9	0.0	TR
2012	3.0	0.5	0.0	20.6	2.5	0.0	37.4	9.8	158.2	4.0	0.0	3.0
2013	0.0	67.7	13.7	6.8	3.8	33.8	56.8	37.4	0.0	4.7	1.0	0.0
2014	0.6	23.9	32.4	10.8	66.7	TR	71.0	26.0	3.0	23.0	0.1	0.0

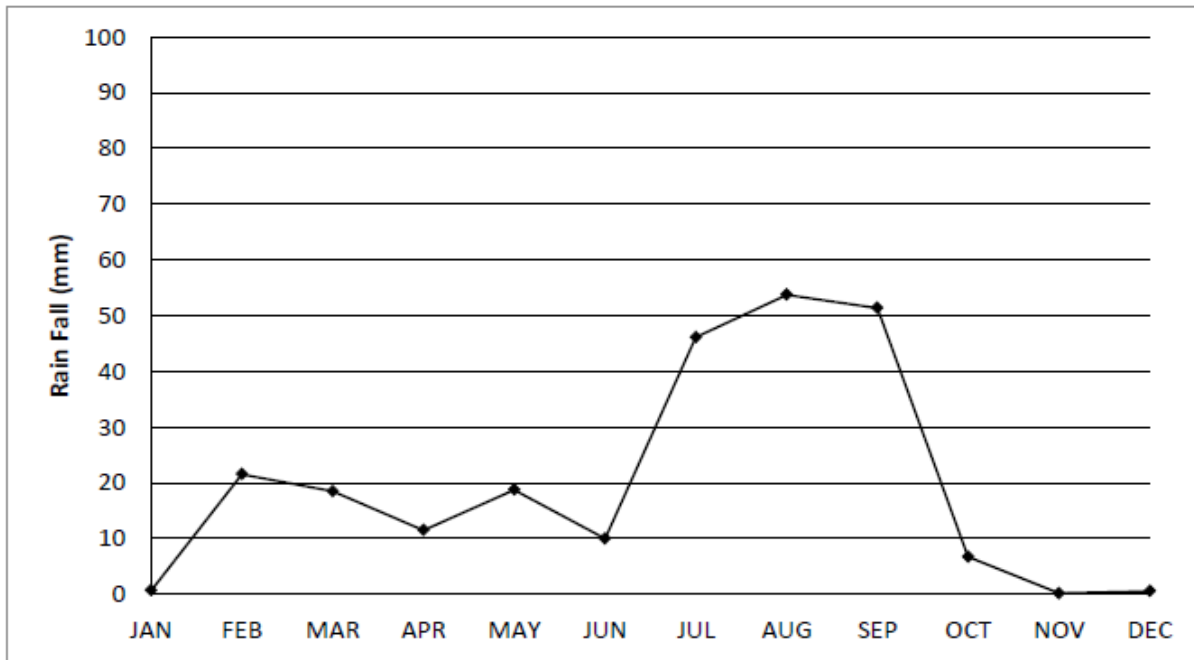


Figure 17: Weighted Mean Monthly Rainfall in Project Area:

Most of the time June, July and August are the months of maximum wind speed in project area whereas from November to January, wind speed is minimum. June is the month of highest wind speed in project area (8.26 km/h) whereas the minimum wind speed is recorded during the month of January when wind speed reaches to 1.52 km/h.

Table 11: Mean Monthly Wind Speed (Km/h) in Project Area (2010-2014)

Yr	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2010	0.5	5.2	3.9	5.6	7.2	10.3	9.3	8.9	6.3	2.6	2.0	1.5
2011	2.3	6.3	3.8	4.8	5.8	6.2	5.7	6.0	5.0	3.6	2.0	1.9
2012	2.0	6.3	3.9	5.2	4.7	8.7	7.0	6.0	5.3	2.9	2.2	1.4
2013	0.7	5.2	4.0	4.1	6.3	9.0	7.8	6.5	6.0	2.7	1.5	1.2
2014	2.1	3.5	4.9	5.6	7.1	7.1	8.1	9.2	7.0	3.8	2.4	2.3

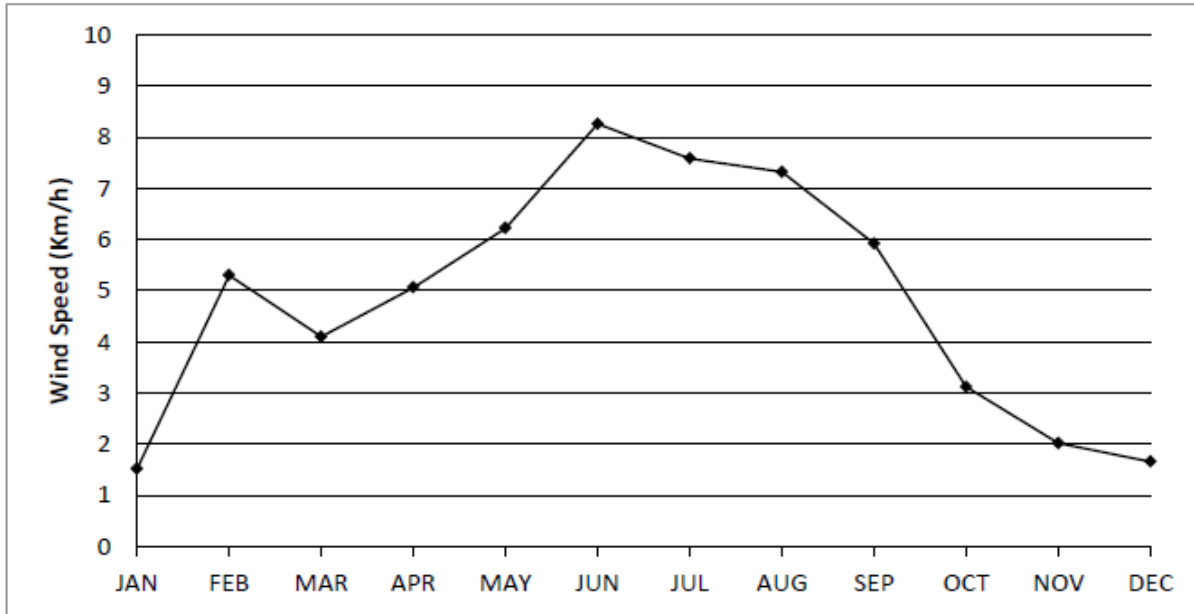


Figure 18: Weighted Mean Wind Speed (Km/h) in Project Area

Table 12: Monthly Average Wind Direction in Proposed Project Area

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2010	N	N	S	N	N	S	N	S	S	S	N	N
2011	NW	N	N	SW	S	S	S	S	S	S	S	N
2012	N	N	N	N	S	S	S	S	S	S	S	N
2013	N	N	S	VAR	SW	S	S	S	S	VAR	NE	N
2014	S	N	NE	NE	SW	SW	SW	SW	SW	S	NE	NE

Table below shows the irregular pattern of relative humidity in project area. Highest value of relative humidity (80%) is recorded during the month of January in 2010 whereas the lowest relative humidity (28%) is recorded during the month of May 2013.

Weighted mean humidity patterns for during the five year period are presented in Figure below. According to Figure, relative humidity in area is highest during the month of January whereas; during the month of May, relative humidity is lowest in the area.

Table 13: Mean Monthly Relative Humidity (%) in Project Area (2010-2014)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2010	80	61	61	36	33	43	60	75	61	49	53	57
2011	62	64	55	45	38	46	58	67	70	52	60	51
2012	57	42	40	44	31	38	51	59	65	51	56	60
2013	61	68	54	40	28	44	51	63	54	52	55	65
2014	59	59	56	41	37	40	53	45	59	54	53	71

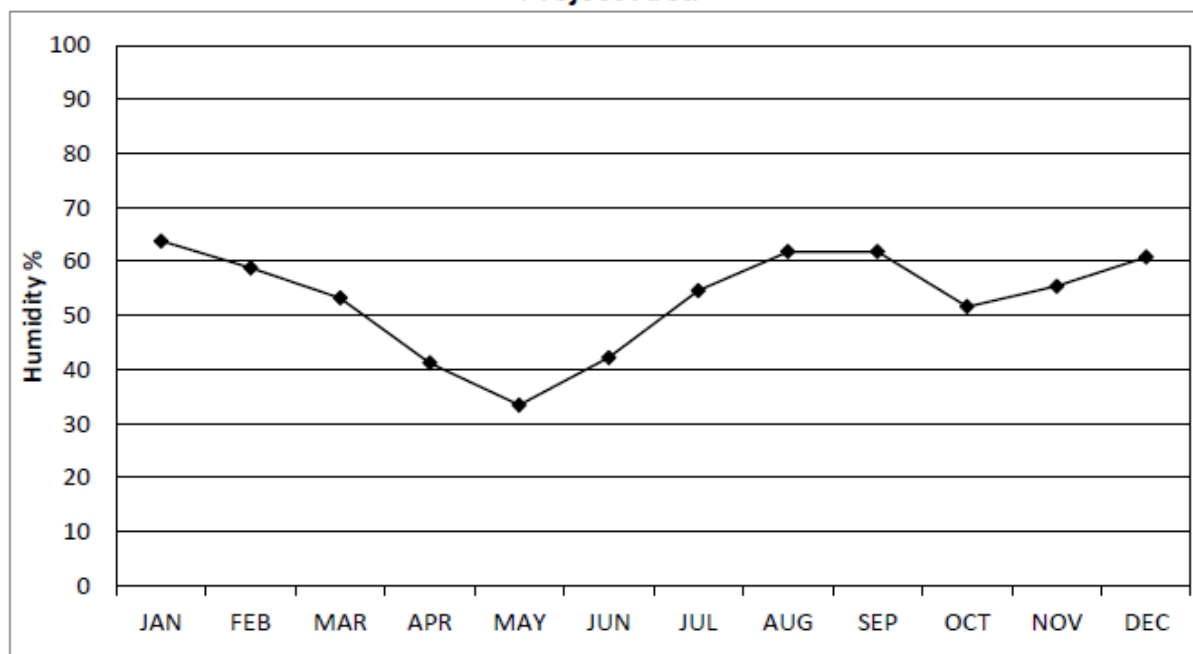


Figure 19: Five Years (2010 to 2014) Weighted Mean Relative Humidity in project area

16.3.3 AMBIENT AIR QUALITY

Ambient air quality measured at 12 different locations in project areas. **Figure below** shows the air quality sampling locations. Data was acquired for criteria air pollutants along with meteorological parameters. Duration of measurement for each pollutant was once every 15 minute interval for 24-hours.

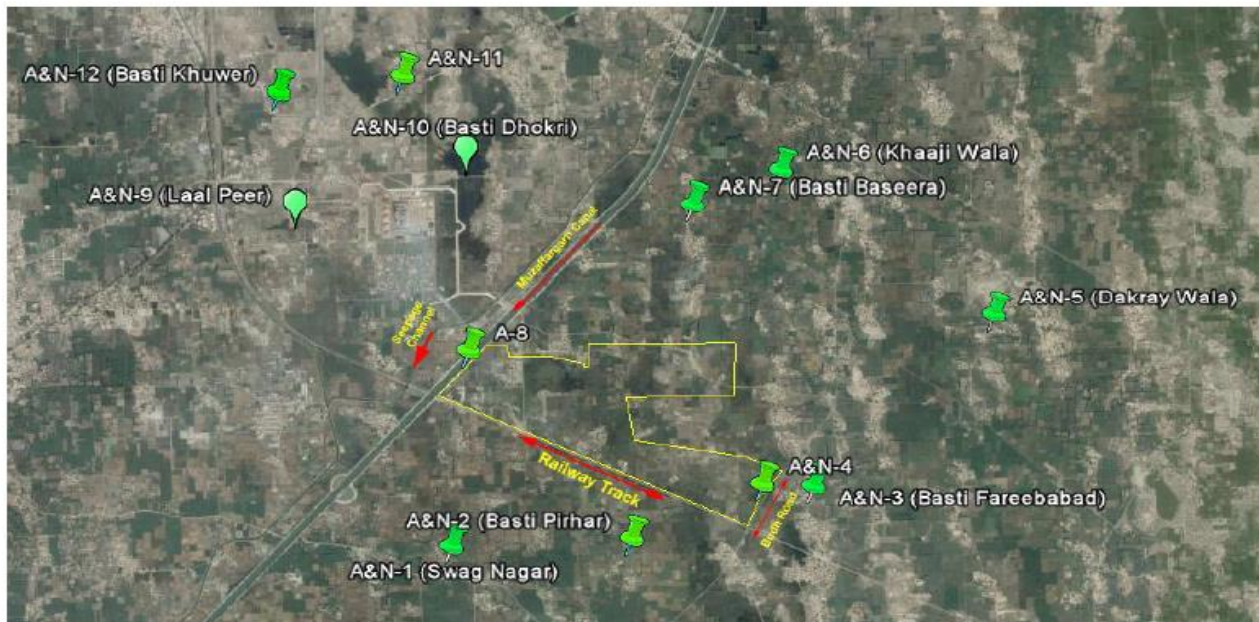


Figure 20: Ambient air quality locations

Results of ambient air quality analysis are provided below:

Table 14: Ambient air quality results

	Conc.	SO ₂	NO	NO ₂	CO	O ₃	SPM	PM ₁₀	PM _{2.5}	Lead	Noise
	Unit	µg/m ³	µg/m ³	µg/m ³	mg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	dB(A)
NEQS	Average	120	40	80	5	130	500	150	35	1.5	75
	Min	28.20	9.20	20.00	1.50	14.80					41.00
	Max	62.00	11.90	39.00	2.00	80.20					48.00
AQS1	Average	39.24	10.80	29.63	1.66	36.23	325.00	56.00	22.00	0	43.63
	Min	28.20	9.20	35.00	1.70	14.80					41.00
	Max	70.50	18.50	51.00	2.30	76.00					52.00
AQS2	Average	41.53	12.60	36.75	2.05	39.75	368.00	59.00	28.00	0	45.88
	Min	31.00	10.60	35.00	1.50	21.10					41.00
	Max	70.50	19.80	53.00	2.30	63.30					58.00
AQS3	Average	44.70	14.58	31.17	1.75	40.26	363.00	44.00	29.00	0	48.58
	Min	28.20	9.20	37.00	1.50	16.90					41.00
	Max	70.50	13.20	53.00	2.30	73.90					47.00
AQS4	Average	43.05	10.96	34.42	1.91	40.36	351.00	68.00	31.00	0	42.83
	Min	28.20	9.20	39.00	1.50	14.80					41.00
	Max	58.40	15.80	51.00	2.30	67.50					47.00
AQS5	Average	48.89	11.95	39.58	1.69	37.90	363.00	57.00	32.00	0	42.79
	Min	28.20	9.20	35.00	1.20	16.90					41.00
	Max	70.50	25.10	51.00	2.30	67.50					49.00
AQS6	Average	45.93	13.10	36.08	1.84	40.36	352.00	55.00	25.00	0	44.83
	Min	28.20	9.20	35.00	1.50	16.90					41.00
	Max	70.50	15.80	57.00	2.30	76.00					52.00
AQS7	Average	47.46	12.06	33.75	1.98	43.43	355.00	61.00	32.00	0	45.38
	Min	28.20	6.60	24.00	1.40	16.90					44.00
	Max	59.20	11.90	47.00	2.00	80.20					58.00
AQS8	Average	40.47	10.19	29.50	1.60	37.64	335.00	55.00	25.00	0	48.38
	Min	67.70	13.20	45.00	2.10	21.10					47.00
	Max	84.60	23.80	59.00	3.20	82.30					58.00
AQS9	Average	51.50	19.14	40.12	2.69	47.40	363.00	57.00	32.00	0.40	50.42
	Min	47.90	10.60	41.00	1.80	21.10					45.00
	Max	70.50	19.80	51.00	2.80	76.00					49.00
AQS10	Average	52.77	14.95	39.76	2.34	47.83	325.00	59.00	30.00	0	47.50
	Min	42.30	11.90	35.00	1.20	16.90					41.00
	Max	81.80	19.80	57.00	2.80	82.30					58.00
AQS11	Average	55.75	15.72	38.88	2.13	40.36	342.00	64.00	28.00	0	47.50
	Min	56.40	13.20	47.00	1.70	25.30					43.00
	Max	84.60	19.80	59.00	2.80	82.30					59.00
AQS12	Average	57.98	16.00	41.51	2.31	51.35	345.00	61.00	30.00	0.80	48.75
Average Background Level		47.27	13.5	35.93	2.00	41.91	348.91	58.00	28.66	0.1	46.37

AQS: Air Quality Sampling Location

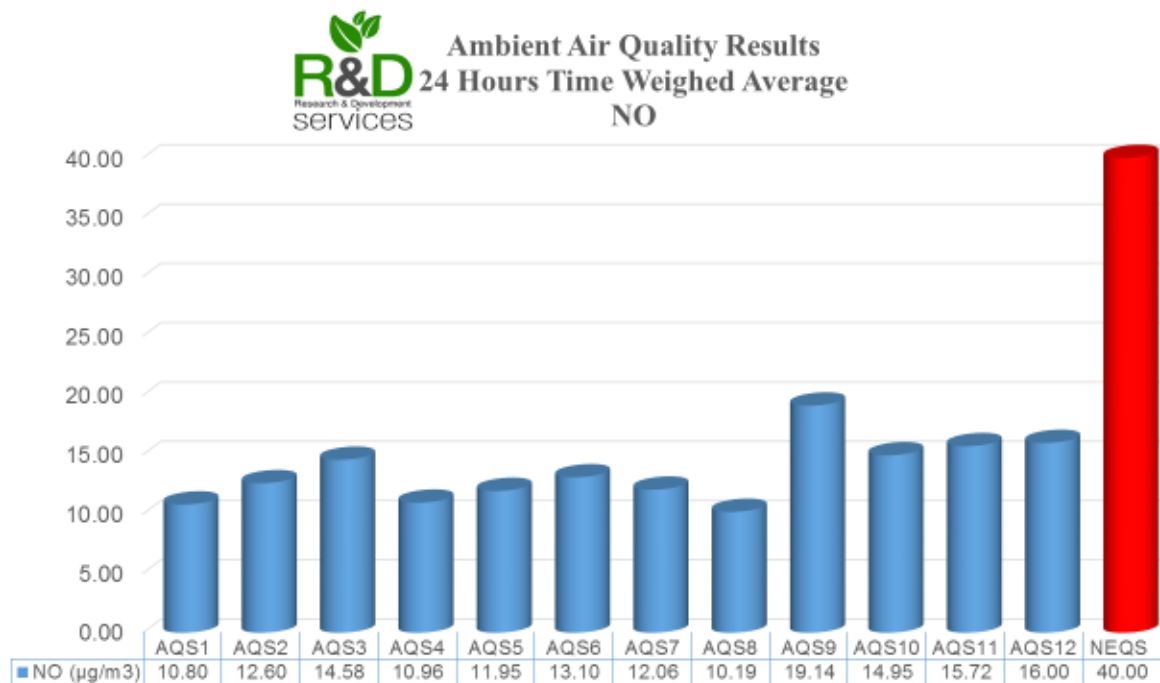


Figure 21: Hourly weighted Avg concentration of NO

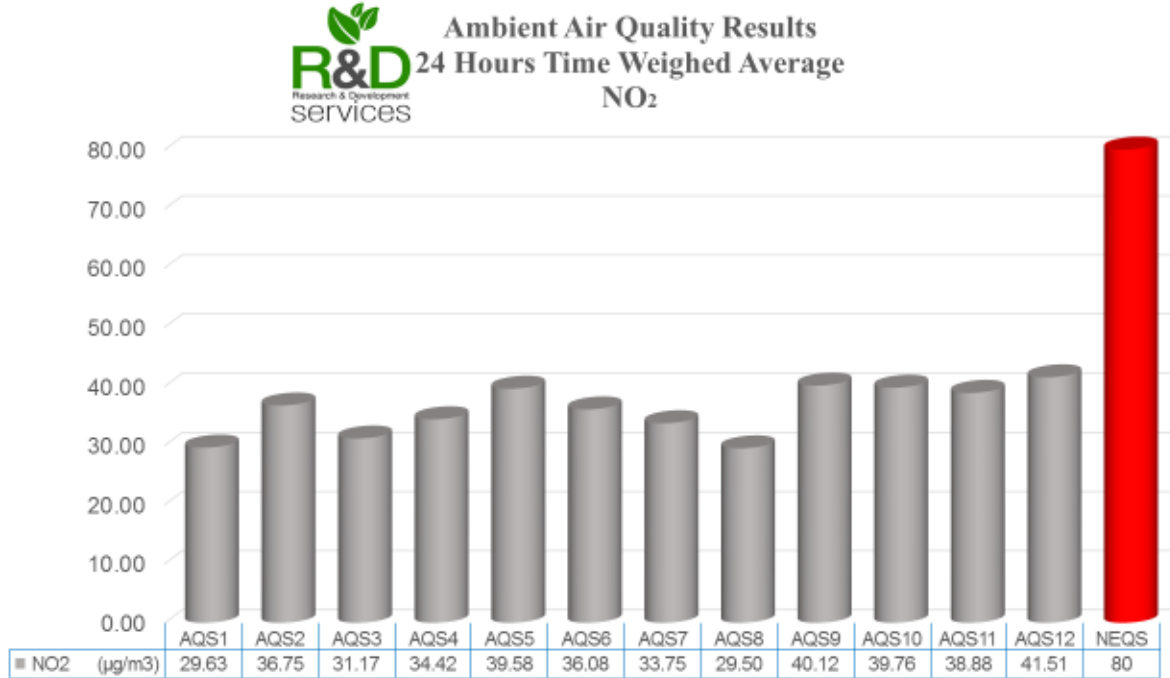


Figure 22: hourly weighted average concentration of NO2

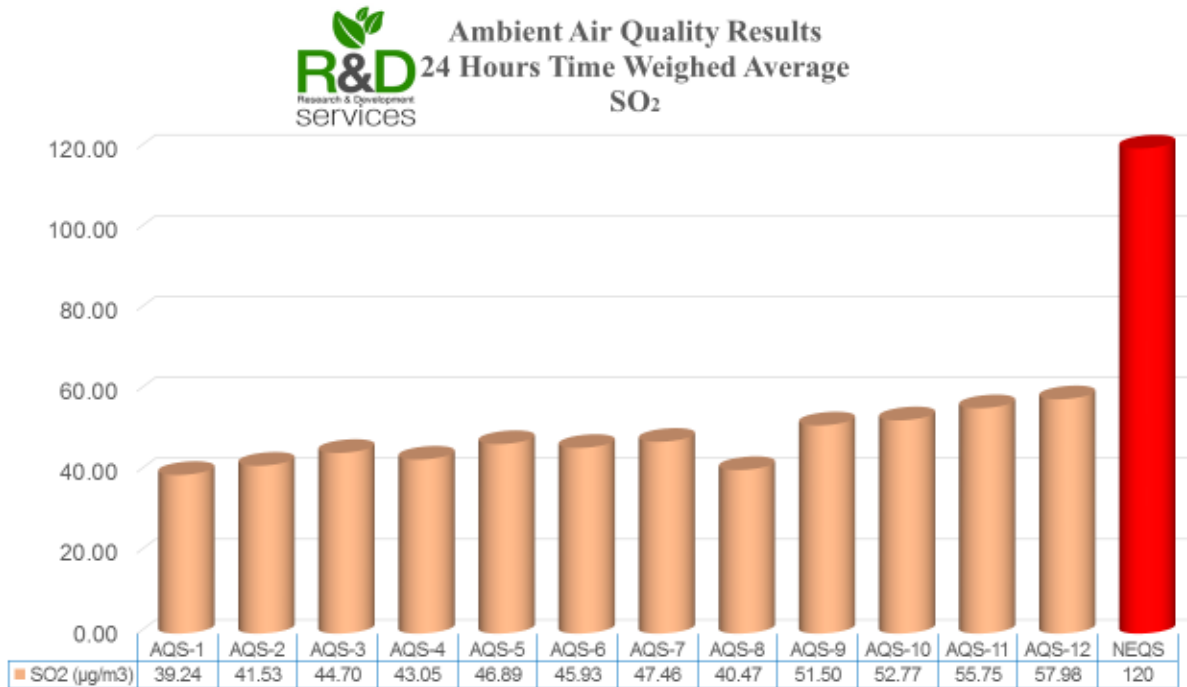


Figure 23: 24 hour weighted average concentration of SO2

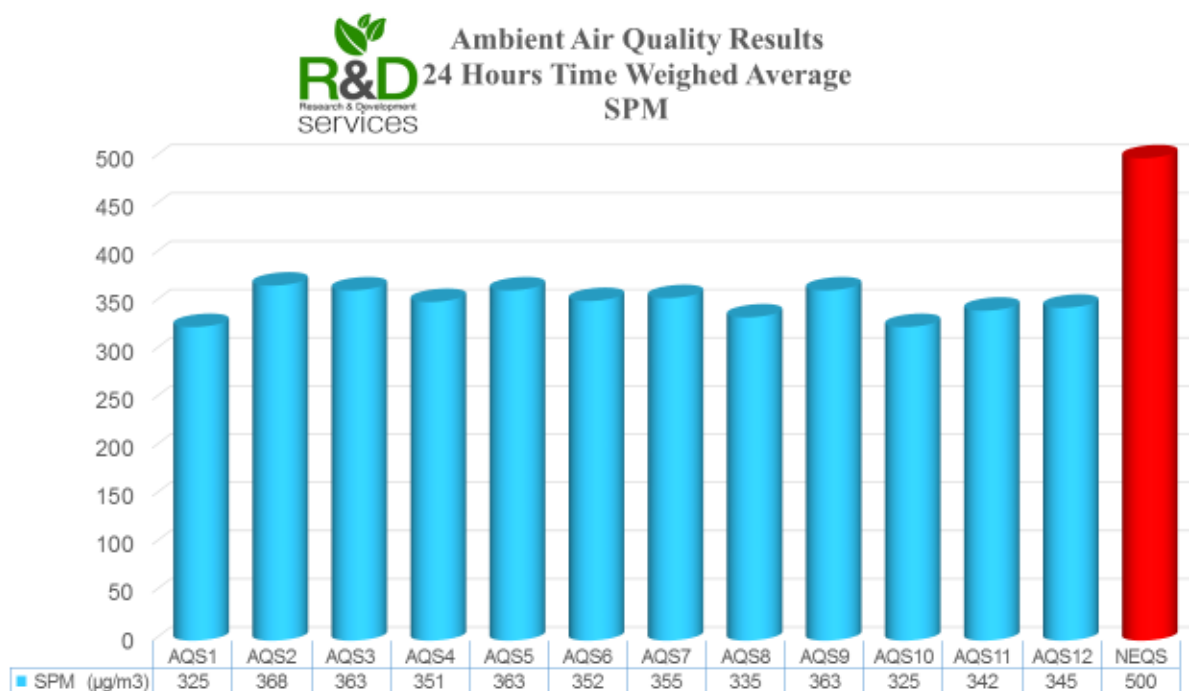


Figure 24: 24-hour weighted average concentration of SPM

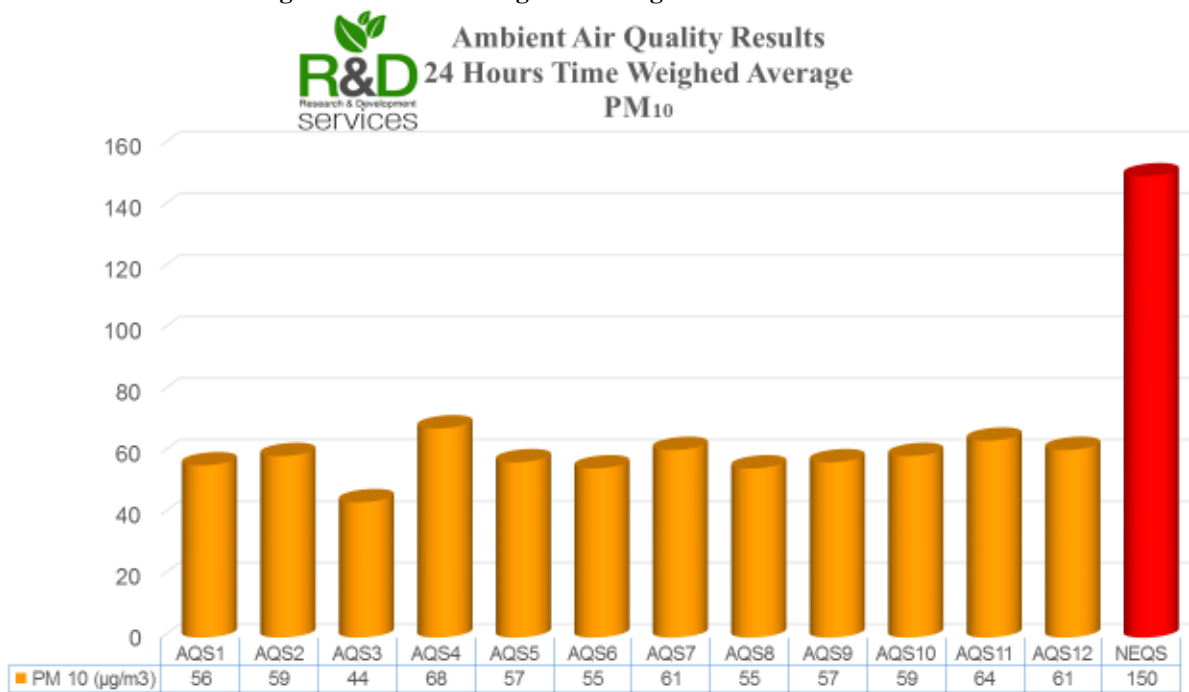


Figure 25: 24-hour weighted average concentration of PM10

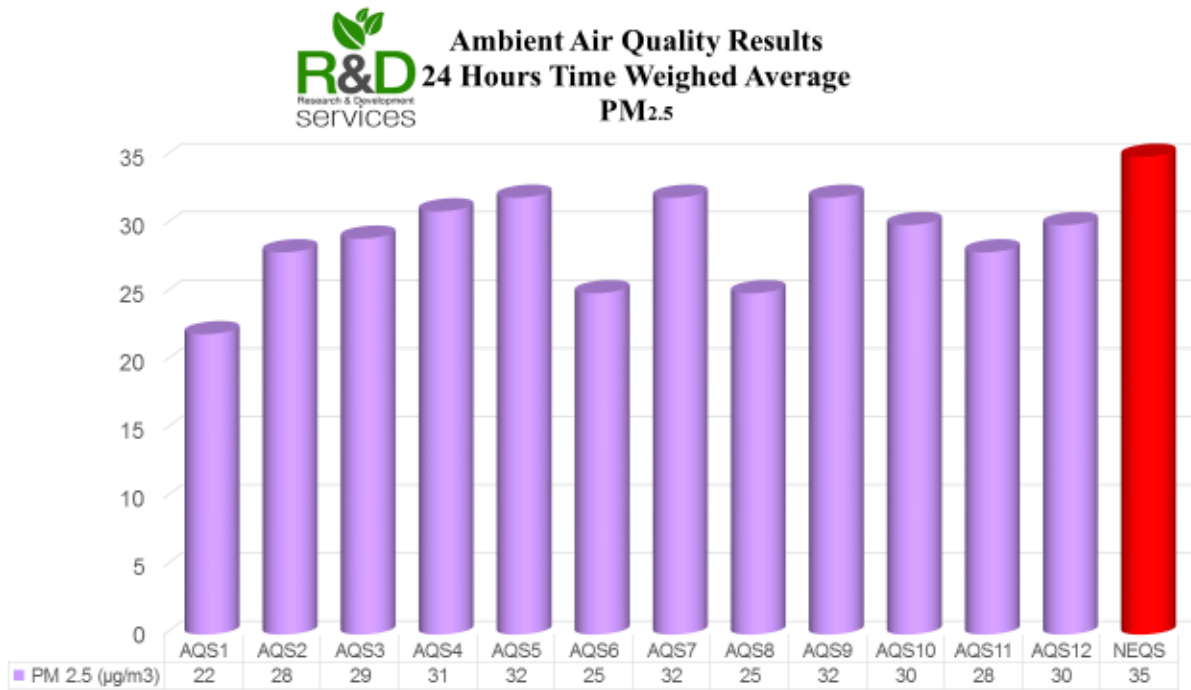


Figure 26: 24-hour weighted average concentration of PM_{2.5}

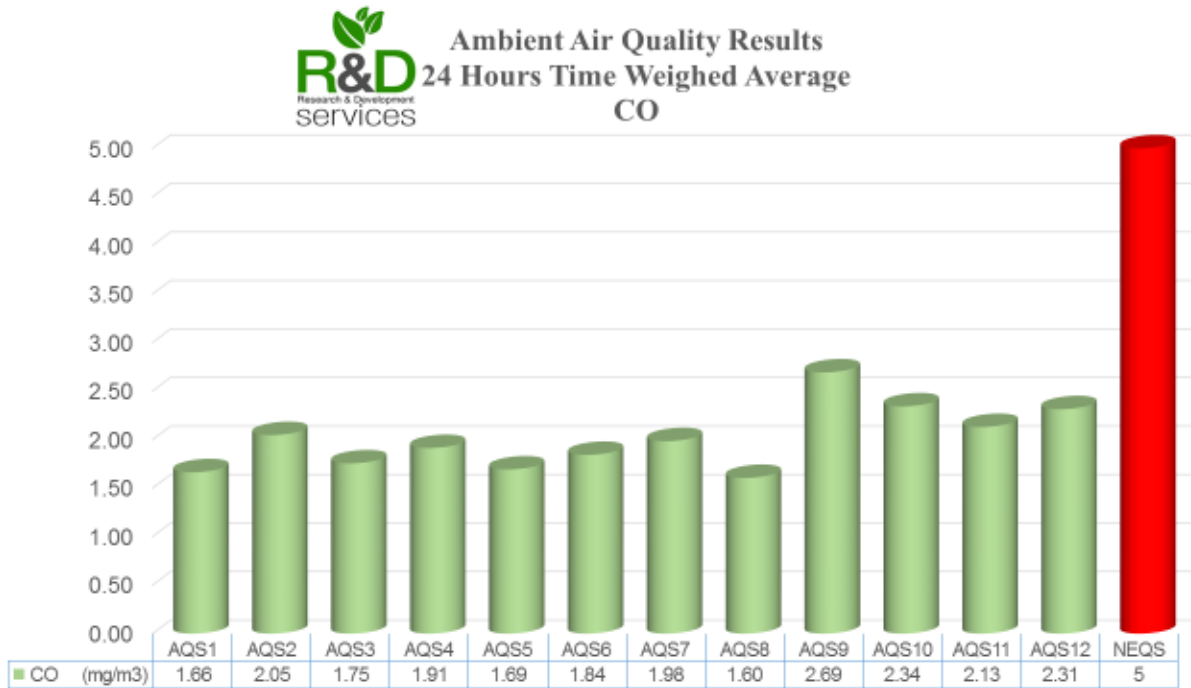


Figure 27: 24-hour weighted average concentration of CO

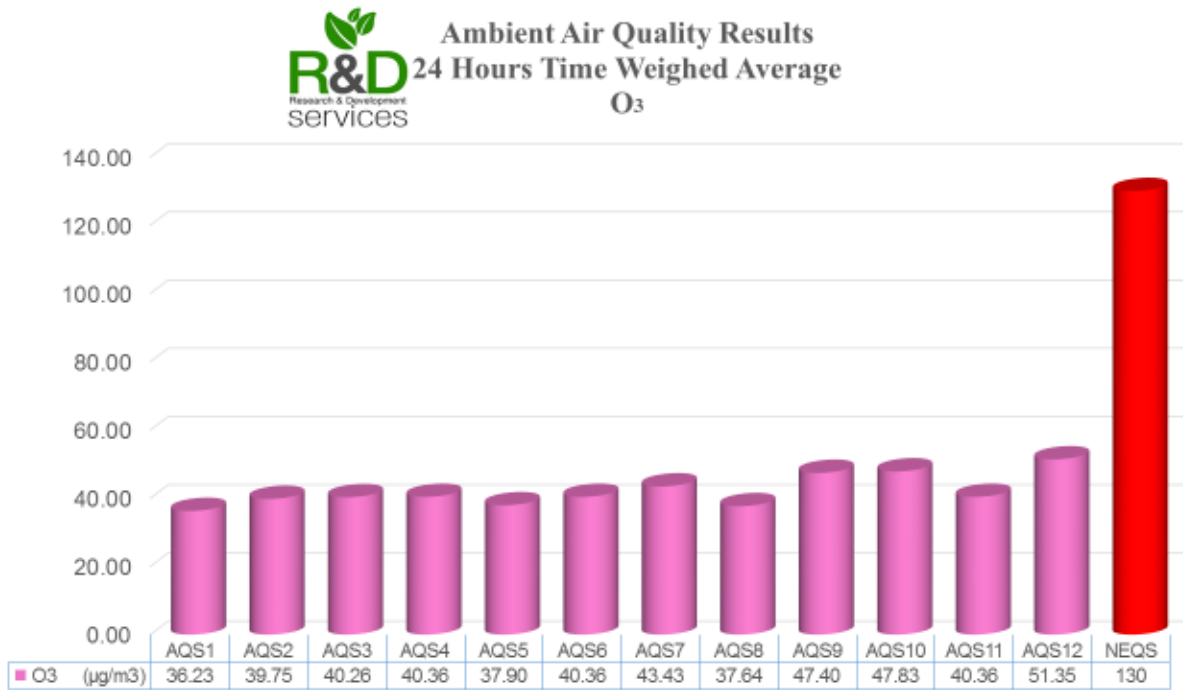


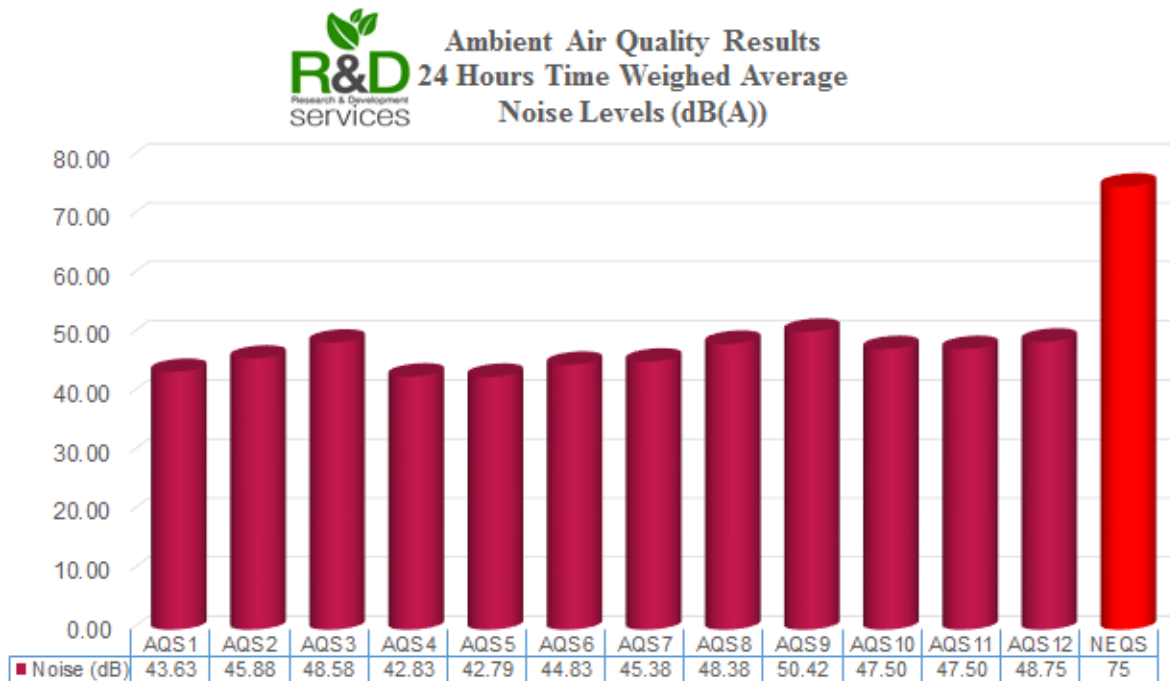
Figure 28: 24-hour weighted average concentration of Ozone

Ambient air quality was monitored at site and results were as follows:

Sr. No	Parameters	Unit	Concentration
1	CO	ppm	0.6
2	SO ₂	µg/m ³	5.2
3	NO ₂	µg/m ³	20.6
4	PM ₁₀	µg/m ³	41
5	PM _{2.5}	µg/m ³	12
6	SPM	µg/m ³	58
7	O ₃	Ppm	4

16.3.4 NOISE

The measured minimum, maximum and mean noise levels in nearby areas of project site were 42.7 dB (A), 50.2 dB (A) and 42.7 dB (A) respectively. These noise levels were well within prescribed limits of national and international standards. The ambient noise levels in the nearby areas of the proposed Project site are shown in **Figure**



Noise level observed at project site was 66.9 dB(A) which is within PEQs limits.

16.4 BIOLOGICAL ENVIRONMENT

16.4.1 Flora



Amongst trees, the most important are Kikar (*Acacia Arabica*) Shisham or Tahli (*Delbergia sissoo*), Beri (*Zizyphus jujube*), Toot (*Morus alba*), Sharin (*Albizia lebbek*), Dherek (*Melia azedarach*), Phulai (*Acacia modesta*), Pipal (*Ficus religiosa*) and Bohr (*Ficus bengalensis*) are planted for shade. The growth in Rakhs is composed mainly of three kind of trees, Jand (*Prosopis spicigera*), Karir (*Capparis aphylla*), and Wan (*Salvadora oleoides*). Occasionally Rero (*Acacia ieucophloea*) and Farash (*Tamarix articulata*) are also found. Pilchhi (*Tamarix dioica*) is found on moist sandy soil along the river and is used for wicker work, basket making etc. There is wild growth of Mesquite bushes and some Eucalyptus trees in the areas along the canals, roads and barren land but natural forest cover has been significantly reduced in the past. The fruit trees of project area include citrus fruits, mango, guava and date palm.



The main crops during Rabi are wheat, gram, rape, mustard, barley and oil seeds. In Kharif, cotton, jawar, sugarcane, bajra, maize and rice are grown. In addition, there are subsidiary crops known as Zaid Rabi like Kharbooza, tobacco and potatoes and Zaid Kharif like potatoes and chilies. The main fruits grown are mangoes, date palm, Malta, orange, water and musk



melon, guava, citrus, falsa, jaman and pomegranate. In the beginning of the cultivation era the inhabitants used to eat Pilu and Bair, the only wild fruits that grows intermittently. With the introduction of canal irrigation Date palm and other fruits are being grown on commercial basis. Wheat, cotton, sugarcane and rice are the major crops, whereas mango and citrus are the major fruits of the area. As per cropping pattern, wheat, cotton and sugarcane are the highest grown crops in the area. The vegetables are grown in abundance as the water and soils are suitable for cultivation. Potato, carrot, lady finger, chilies, onion and cauliflowers are grown. Bitter gourd, turmeric and garlic are grown to meet the public demand. Other vegetables i.e. Radish, Tinda (apple gourd), Bringal is also grown.



Reference: Dispersal of Power from 747 MW Power Plant at Guddu to Muzaffargarh




Table below provides the detail of various floral species present in project area. The ecological linkages of each species are also provided.



Name of Species		Ecological Linkages	Photograph
Local	Scientific		
Babul	<i>Acacia nilotica</i>	It is a roosting and nesting tree for doves, crows, black drongo, shrikes, bulbuls, flycatchers and so many other passerine birds. Woodpeckers hunt bark insects from its trunk. Garden lizard is commonly seen on it. Wasps and black ants also occupy this tree. Some spiders weave their webs in its foliage. Its gum is used by humans. Its wood is used to make coal on commercial scale. Its hard wood is used to make agricultural tools and household furniture.	
Jand / Kandi	<i>Prosopis cineraria</i>	It was seen growing in hamlets and on the sides of fields and paths. It fixes nitrogen in the soil. Its pods are rich in nutrients and are eaten by domestic livestock. Other ecological linkages are almost the same as that of <i>Acacia nilotica</i> .	



Name of Species		Ecological Linkages	Photograph
Local	Scientific		
Date Palm, Khajoor, Khaji	<i>Phoenix dactylifera</i>	The fruit is eaten by Palm squirrel and fruit eating birds such as Parakeets and Mynas. Human communities get commercial benefits from its fruits, annually.	
Shareen, Siris	<i>Albizia lebbeck</i>	It is a fodder tree. It fixes nitrogen in the soil and stabilizes the soil. Many birds roost in it and some also nest in it. It is of medicinal value for humans.	




Name of Species		Ecological Linkages	Photograph
Local	Scientific		
Neem	<i>Azadirachta indica</i>	Its ripe fruits are eaten by many birds. Honey bees are attracted to its fragrant flowers. It has great medicinal value. Its oil is used as pest control.	
Mango	<i>Mangifera indica</i>	Its fruits ripe unripe fruits are eaten by parakeets and palm squirrels. Mango mealy bug is its major pest.	



Name of Species		Ecological Linkages	Photograph
Local	Scientific		
Shesham; Talli	<i>Dalbergia sissoo</i>	Its pods are eaten by parakeets and palm squirrels. Palm squirrel and many birds nest on this tree. It has great timber value.	
Chota Kaloora	<i>Cyperus difformis</i>	It is eaten by domestic livestock; it has nutritive and economic potentialities, as it has high amounts of sucrose (22.80 mg/g dry wt.), polysaccharides (294.69 mg/g dry wt.) and total carbohydrates (379.66 mg/g dry wt.). The plant normally grows in flooded or in very moist soils. It grows best in rich, fertile soils, but can grow in poorer sandy or clay soils as well. It was sampled at the edge of crop field. Sometimes it is also used as fodder as it is the weed found on rice and other crop fields.	



Name of Species		Ecological Linkages	Photograph
Local	Scientific		
Lumb	<i>Aristida adscensionis</i>	It is a common pioneering species on disturbed soil, waste land and rocky places. It is unpalatable to livestock; It provides little ground cover during the dry season. It was sampled at the edge of wheat field.	
Khawai	<i>Cymbopogon jwarancusa</i>	It is an important medicinal herb for the treatment for various diseases, of the blood and skin. Ethnically it is useful in treating vomiting, abdominal tumors, unconsciousness and fever. It is of low forage value for the livestock. Some grasshoppers were disturbed from the cluster of this plant.	
Cut-leaved medick	<i>Medicago laciniata</i>	This plant was growing at the edge of agricultural field. This plant forms symbiotic relationship with the bacterium: Sinorhizobium meliloti, which is capable of nitrogen fixation. So it increases fertility of the soil. This plant is also used as food by the larvae of some butterflies.	

Name of Species		Ecological Linkages	Photograph
Local	Scientific		
Crowfoot grass	<i>Dactyloctenium aegyptium</i>	This grass is also used as fuel, fodder and it stabilizes soil in natural woodland and plantations.	
Kana	<i>Saccharum bengalense</i>	This is a roosting plant for flycatchers and chats. Babblers look for insects in the thickets of this plant.	

Name of Species		Ecological Linkages	Photograph
Local	Scientific		
Thistle Weed	<i>Carthamus oxyacantha</i>	It is, to some extent eaten by some invertebrates. However, it is also used as poison against rodents and insect pest of the crops. It is to some extent host of harmful organism. It is agricultural weed.	
Bladder campion	<i>Convolvulus arvensis</i>	It produces attractive flowers that attract insects. However, it is a nuisance weed due to its rapid growth and choking of cultivated plants. Its dense mats invade agricultural fields and reduce crop yields. It competes with other species for sunlight, moisture and nutrients. It poses threats to restoration efforts and riparian corridors by choking out grasses and forbs. It can decrease habitat biodiversity. It is mildly toxic to grazing animals	

Name of Species		Ecological Linkages	Photograph
Local	Scientific		
Khabbar	<i>Cynodon dactylon</i>	It is a perennial lawn grass. It spreads with underground rhizomes and the stems are arising. It is well adapted to all habitats. It is nutritious fodder grass. It is eaten by herbivore invertebrates. Dry grass straws are used by birds as nest material. It protects soil from erosion.	
Nara	<i>Arundo donax</i>	Where it grows thickly It provides secure roosting site for small birds.	
Dhraman, Dhaman	<i>Cenchrus setigerus</i>	It is adapted to arid and semi-arid climates with a long dry season and responds very quickly to light rains. It is very tolerant of drought and will grow in areas of low rainfall, making it excellent for improvement of low rainfall grazing land. It grows on wider range of soils. However prefers fine textured soils. It can stand heavy grazing. It survives frost. It is quite palatable and readily accepted by livestock. It is grazed in preference to Cynodon.	



Name of Species		Ecological Linkages	Photograph
Local	Scientific		
Kahi	<i>Saccharum spontaneum</i>	Where it grows thickly, it provides secure roosting site for sand martins, pipits, wagtails, ruby throat, bluethroat, Baya, black stalling, bank myna, and flocks of young house sparrow. The droppings of these birds provide fertility to the soil or water on which Typha is growing. This plant plays important role in boosting aquatic food chain. For humans it is cottage industry resource.	
Akk	<i>Calotropis procera</i>	It is an upright shrub, considered as a weed that grows successfully in dry areas. It is drought resistant. It forms dense thickets, which compete with other local plant species. Its milky sap is toxic to humans and sometimes also to livestock. It can also hinder pastoralists' by reducing the productivity of rangeland pastures.	



Name of Species		Ecological Linkages	Photograph
Local	Scientific		
Kundir	<i>Typha domingensis</i>	It is secure roosting site for sand martins, pipits, wagtails, ruby throat, bluethroat, Baya, black starling. Bank myna and flocks of young house sparrow. The droppings of these birds provide fertility to the soil or water on which Typha is growing. This plant plays important role in boosting aquatic food chain. For humans it is cottage industry resource.	
Mesquet	<i>Prosopis juliflora</i>	It is an invasive species. It is soil binding and nitrogen fixing plant. Its thickets provide diurnal shelter to wild hare, foxes, jackals, and nocturnal shelter to Partridges, babblers, bee-eaters, mynas, and many passerine species. It also provides nesting for doves, babblers, bulbuls and finches. It has medicinal value.	




16.4.2 Fauna


There is no wildlife except jackals, dogs and snakes etc. Common species of birds found in the project area are sparrows, crows, pigeon, dove tiliar (starling), lal mena, parrot, quail, pintail, and humming bird etc. River Indus and Ghazi Ghat Seasonal Lake are the source of freshwater fishes in the project area. Some commercial fisheries operate in the project area.

Table below provides the detail of various fauna species present in the project area. The ecological linkages of each species are also provided.


Name of Species		Ecological Linkages	Photograph
Local	Scientific		
Fish			
Daula	<i>Channa punctate</i>	It is common in ponds and ditches of the project area. This is carnivorous fish, so it eats aquatic insect and their larvae, crustaceans, small fish, and tadpoles. Its young feed on zooplankton and macro invertebrates in the water. It is preyed upon by piscivorous birds.	
Glass fish, Sheesha Machhi	<i>Chanda nama</i>	It is common in ponds and ditches of the project area. This fish eats small aquatic insects and crustacean larvae. When mosquito larvae become abundant in rainy season, it controls them significantly as its population also increases in this season. Rains connect the ponds and ditches with water; its dispersal also takes place to new water storages. It is then abundantly available to egrets and other piscivorous birds.	

Name of Species		Ecological Linkages	Photograph
Local	Scientific		
Bari Kanghi Machhi	<i>Colisa fasciata</i>	It is common in ponds and ditches of the project area. This fish eats small aquatic insects, particularly mosquito larvae and crustacean larvae. When mosquito larvae become abundant in rainy season, it controls them significantly as its population also increases in this season and it is usually found also in shallow water small storages. Rains connect the ponds and ditches with water; its dispersal also takes place to new water storages. It is then abundantly available to egrets and other piscivorous birds.	
Chotti Kanghi Machhi	<i>Colisa lalia</i>	It more frequently occurs in small storages of shallow water. This fish eats small aquatic insects, particularly mosquito larvae and crustacean larvae. When mosquito larvae become abundant in rainy season, it controls them significantly as its population also increases in this season and it is usually found also in shallow water small storages. Rains connect the ponds and ditches with water; its dispersal also takes place to new water storages. It is then abundantly available to egrets and other piscivorous birds.	



Amphibians			
Indus Valley Toad	<i>Bufo stomatcus</i>	Mainly nocturnal; during day time hides in crevices, among stones, holes and also in houses under household articles; several toads aggregate at damp places in dry seasons; often cross paths and tracks; it is common that unofficially it is considered national amphibian of Pakistan; Hibernates during winters. Insectivorous, consume large number of nocturnal insects, particularly insects gathered under artificial lights. It is eaten by Monitor lizard, rat snake, viper snake, krait snake, shrew, hedgehog, cattle egret, kestrel, spotted owl. If there is a water pond it also become a victim of giant water bug which grabs and sucks body juices of the toads by piercing their proboscis.	
Ant Frog	<i>Microhyla ornata</i>	The project site is well drained, apparently with no long lasting ponds or pools of water. However, this location is within the range of occurrence of the Ant Frog. During the mid monsoon period, if the ponds / water pools are formed in the project area, loud calls of this small size frog are heard; Hibernates during winters. Tadpoles are microphagus in deeper water, but soon appear closer to the surface or the edge of water perhaps to escape predation. Tadpoles are eaten by snakes and egrets. Metamorphosis is completed faster. However tiny frogs are then victims of many predators.	
Skittering Frog, Mendak, Dadoo, dad	<i>Euphlyctis cyanophlyctis</i>	It is found in pools, marshes, waterlogged land depressions and flooded paddy fields. It come out of water at night to feed in grassy area or crop fields. It is voracious feeder during the summers. It feeds mainly on aquatic insects and tadpoles in the water. At night it feeds on nocturnal insects. It is in turn preyed upon by egrets, kingfishers, black-winged kite, during the day and at night it is hunted by spotted owl, shrew, hedgehog and nocturnal snakes. Giant water bug also grabs it in the water and sucks its body fluids.	





Bull Frog, Basanti or peela maindak / dadoo	<i>Hoplobatrachus tigerinus</i>	It is a largest frog of Pakistan. It calls loudly during the summer rainy season. It lives in ponds, but comes out on land at night to feed. It feeds on insects, mostly at night on ground. Its tadpoles are carnivorous. These also prey on other tadpoles. The tadpoles are eaten by water snakes and some birds. The adult frogs are preyed upon by water snakes. When on land at night these are vulnerable to snakes, hedgehog, shrew and spotted owl.	
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Reptiles – Turtles




Mud Turtle, Moonji Kachhwa, Kachhu Kumma	<i>lissemys punctata</i>	It has widespread range of occurrence in Pakistan and India. It lives on trees and tall shrubs, and is abundant in the project area. Mortality in males often occurs when during the breeding season males looking for new territories cross the roads slowly, although they can run very fast. These hibernate during winters. These arboreal and need trees and hedges growing close for their shelter and feeding on insects. Females need soft ground to bury their eggs for incubation. Birds of prey are their natural enemies.	
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Reptiles – Lizards




Common Tree Lizard / "Girgit"	<i>Calotes versicolor</i>	It has widespread range of occurrence in Pakistan and India. It lives on trees and tall shrubs, and is abundant in the project area. Mortality in males often occurs when during the breeding season males looking for new territories cross the roads slowly, although they can run very fast. These hibernate during winters. These arboreal and need trees and hedges growing close for their shelter and feeding on insects. Females need soft ground to bury their eggs for incubation. Birds of prey are their natural enemies.	
Spotted Barn Gecko	<i>Hemidactylus brooki</i>	It is nocturnal, usually coming out soon after sunset. During day time it hides under fallen trees or litter of leaves or holes and crevices. Hibernates during winters. Seeks shelter in litter areas, crevices and holes; avoids living in buildings where house gecko lives, however, may be found in uninhabited old huts. Eats soft bodied insects. Also feeds before sunset from under the fallen leaves in a moist warm place.	





Common House Gecko	<i>Hemidactylus flaviviridis</i>	It occurs in the scattered village houses in the project area. It is nocturnal, feeding on insects found on the walls and roofs of the houses. Hibernates during winters. Seek shelter in the roofs, ventilators and crevices in rooms of houses. At night feeds on insects attracted to light.	
Rugose Speckled Lacerta	<i>Ophisops jerdonii</i>	It is diurnal lizard, found under dense growth. Its colour blends with the habitat; it often moves from one shelter to another. It creeps with ease under stones; Hibernates during winters. Mainly hides under leaves litter and stones; feeds on soft bodied crustacean and insects. Mongoose and birds of prey are its predators.	
Bengal Monitor Lizard / "Goh"	<i>Varanus bengalensis</i>	It is a large lizard, which also visits cultivates areas, sometimes entering the houses in search of rodents and poultry, particularly the young chicks. It climbs up trees in search of eggs and nestlings of birds from their nest. It lives in burrows; Hibernates during winters. It occupies a variety of habitats such as barren with sparse growth and areas of thick vegetation or even cultivated areas with bushes nearby. It is carnivorous, eating insect, rodents, etc.	
Reptiles – Snakes There are two categories of land snakes in Pakistan: venomous snakes; and, non-venomous snakes. The venomous snakes include: cobras; vipers; and, krait. Cobras and Krait are neurotoxic while the vipers are haemotoxic. However, none of these are aggressive.			
Striped Keelback	<i>Amphiesma stolatum</i>	It is non-venomous and gentle snake. It is nocturnal. Hibernates during winters. It prefers moist grassy areas with moderate vegetation. It also likes cultivations. Its food is toads, frogs, young frogs, tadpoles, fish, rodents and insects. Hedgehog is its main enemy.	





Common Cat Snake	<i>Boiga trigonata</i>	It is non-venomous; lives on trees and tall thick bushes; is nocturnal, however during rainy season it may be seen during day time as well; In winter it hibernates under stones, in crevices or in rodent holes; Hibernates during winters. It loves thick vegetation areas with trees and tall bushes; It eats lizards from trees & bushes; also eats rodents and large size insects.	
Banded Kukri Snake	<i>Oligodon omensis</i>	It is non-venomous; nocturnal; climbs tree to eat eggs of birds; also eats eggs of other reptiles; Hibernates during winters. Likes tree and bush growth; also hides in crevices and rodent holes or in stones or piles of wood.	
Sand Snake	<i>Psammophis condanarus</i>	It is non-venomous; Diurnal; Very agile and fast running; Feeds mainly on lizards by freezing and surprise attack; Hibernates during winters. Likes grassy and bushy habitats; It is attacked by diurnal birds of prey and mongoose.	
Dhaman	<i>Pities mucosus</i>	It is non-venomous; It is a nocturnal snake; It likes closeness of water and would readily go into water and swim to catch toads, frogs and sometimes small fish; prefers damp grassy areas; cultivations and gardens where it may climb up trees to look for nestlings of birds or catch lizards; enter houses in search of rodents; Hibernates during winters. Streams, ponds, damp grassy areas, gardens, and houses are linked to its food availability. Hedgehog is its one of the predators.	




Blotched Diadem	<i>Spalerosophis diadema</i>	It is non-venomous; It is a nocturnal snake; It likes closeness of water, so it is found along the streams; In rocky areas hides under stones; in rural deserted houses it lives in rodent burrows; Climbs reed roofs to look for bird nestlings; If cornered it gives painful bites. It hibernates during winters. Closeness of streams; stone piles and loose rocks; scrub vegetation; open fields; frogs, rats, small birds, nestlings, eggs and lizards are included in its food; hedgehog is its predator.	
Common Krait	<i>Bungarus caeruleus</i>	It is most deadly venomous snake; nocturnal; It hides in marginal vegetation along the fields; enters rural huts, also climbs and hides in reed roofs. It hibernates during winters. During day time hides in holes, crevices, piles of vegetation debris, loose stones and straw roofs of huts; rodents, small birds, their eggs and nestlings are its food; Hedgehog is its main predator.	
Saw-scale Viper	<i>Echis carinatus</i>	Venomous snake; nocturnal; sits in wait of its prey; kills by biting and injecting venom; climbs branches of shrubs; viviparous, give birth to 6 to 28 young. Hibernates in winter. Adapted to variable habitats such as rocky land, sandy land, scrub land, grassland, xeric vegetation; food includes frogs, toads, lizards, small snakes, small birds and their nestlings, rodents. Hedgehogs are its predators.	
Birds The project site has following categories of birds: a) Sedentary species / local birds that are found throughout the year; b) winter visitors, which are migrants from northern latitudes or they arrive from Himalayan heights; c) summer breeders, which usually come from south; and, d) Transit migrants, which pass through this area in spring and again in autumn.			
Dabchick, Little Grebe, Pandubi	<i>Tachybaptus ruficollis</i>	Lives in the pond area and breeds as well. Dives frequently for about less than a minute. Eats submerged soft vegetation, macroinvertebrates and tiny fish. It is preyed upon by Marsh harrier.	




Indian Pond Heron or Paddy bird, Bagla	<i>Ardeola grayii</i>	It is resident in the general area and visits the project area when the riparian area has some water. Eats aquatic invertebrates, small fish and amphibians.	
Cattle egret, Bagla	<i>Bubulcus ibis</i>	Resident in irrigated areas of plains and lower hills, lakes, ponds and rivers; Visits the area in and after summer monsoons. It eats grasshoppers. Its flock commonly remains with grazing livestock to catch grasshoppers dislodged by the hooves of the livestock.	
Little Egret, Safaid Bagla	<i>Egretta garzetta</i>	It is a common resident bird. It likes to feed at the edges of ponds, ditches, waterlogged land, grassy land and paddy fields. It feeds on mainly insects, tadpoles, and sometimes small lizards.	
Black-shouldered or Black-winged Kite	<i>Elanus caeruleus</i>	This bird visits the area any time of the year to look for rodents. This bird catches small rodents, lizards, frogs & toads and larger insects like large grasshoppers. It sits on trees or pauses during hunting.	




Indian Kite or Pariah Kite	<i>Milvus migrans</i>	It is seen usually soaring the sky in the general project area. It is common scavenger and has closer association with man.	
Eurasian Sparrow Hawk	<i>Accipiter nisus</i>	It is a winter visitor in the area. It is a predator of smaller birds.	
Desert Buzzard	<i>Buteo buteo</i>	It is a winter visitor in the area. It is a predator of mainly rodents and lizards. Small birds may also be caught by it.	
Bonnelli's Eagle	<i>Hieraetus fasciatus</i>	It is a resident of the general project area. It is a predator of mainly rodents and lizards. Small birds may also be caught by it.	





Eurasian Kestrel	<i>Falco tinnunculus</i>	It is a winter visitor. It is a predator of mainly rodents and lizards.	
Red-wattled Lapwing	<i>Hoplopterus indicus</i>	This bird is common and resident of the ponds and ditches edges, waterlogged land and paddy fields. This bird eats ground insects.	
Common moorhen, Jhalmurghi	<i>Gallinula chloropus</i>	It is resident of pond with thick vegetation cover. This bird eats soft aquatic vegetation.	
Black-winged Stilt	<i>Himantopus himantopus</i>	It is a year round visitor, mainly during rainy season and winter to the waterlogged area and paddy fields of project area. This bird eats aquatic and moist soil macroinvertebrates.	




Little Ringed Plover	<i>Chradrius dubius</i>	Winter visitor to pond edges and waterlogged land. This bird eats aquatic and moist soil macroinvertebrates.	
Kentish Plover	<i>Chradrius alexandrinus</i>	This bird eats aquatic and moist soil macroinvertebrates.	
Little Stint	<i>Calidris minutes</i>	It is autumn and winter visitor to the waterlogged project area. This bird eats aquatic and moist soil macroinvertebrates.	
Redshank	<i>Tringa tetanus</i>	It is autumn and winter visitor to the waterlogged area of this project. This bird eats aquatic and moist soil macroinvertebrates.	




Greenshank	<i>Tringa nebularia</i>	It is autumn and winter visitor to the waterlogged area of this project. This bird eats aquatic and moist soil macroinvertebrates.	
Common Sandpiper	<i>Actitis hypoleucos</i>	It is autumn and winter visitor to the waterlogged area of this project. This bird eats aquatic and moist soil macroinvertebrates.	
Indian Ring Dove	<i>Streptopelia decaocto</i>	It is a resident bird of the area. It is a resident and grain eating bird and it is associated with agricultural and tree areas.	



Red Turtle Dove	<i>Streptopelia tranquebarica</i>	This dove is a summer visitor and breeds in this general area. It is grainivorous bird and prefers Acacia trees to breed.	
Little Brown Dove	<i>Streptopelia senegalensis</i>	It is a resident bird of the area. It is a resident and grain eating bird and it is associated with agricultural and tree areas.	
Rose-ringed Parakeet	<i>Psittacula krameri</i>	It is a resident bird. It is fructivorous bird and visits fruit trees, chili fields, etc. for feeding. It also eats Sisham tree pods. It breeds in holes in trees.	





Koel	<i>Eudynamys scolopaceus</i>	It is a summer breeder in Kohat district general area. It is a brood parasitic bird of House Crow. Prefers banian and papal trees to eat figs.	
Coucal, Jhalmurgh	<i>Centropus sinensis</i>	Resident of the ponds with thick marginal vegetation and marshes with vegetation growth. It is omnivorous. It eats eggs and nestlings of marsh birds.	
Spotted Owlet	<i>Athene brama</i>	It is a resident nocturnal bird. It is a nocturnal hunter of rodents and large size insects. It breeds in tree holes.	





White-breasted Kingfisher	<i>Halcyon smyrnensis</i>	It is common resident bird. This bird lives in the vicinity of wetlands and in sufficiently irrigated agricultural areas. It eats small fish, aquatic insects, small mice and small lizards. It is a cavity breeder.	
Little Green Bee-eater	<i>Merops orientalis</i>	Common resident of general area of Muzaffargarh district. It eats flying insects. It needs projecting branches of trees or electric wires to perch in wait of flying insects. It is cavity breeder.	
Indian Roller	<i>Coracias benghalensis</i>	Resident of agricultural areas. It is an Insectivorous bird and cavity breeder.	
Hoopoe	<i>Upupa epops</i>	It is a winter visitor to this area. It eats grubs by probing the grassy areas from soft and moist grounds.	








Golden-backed Woodpecker	<i>Dinopium benghalensis</i>	A year round visitor to Acacia trees. It eats insect borers and other small insects hiding under the bark of the trees by pecking strongly the tree trunks.	
Sindh Pied Woodpecker	<i>Dendrocopos assimilis</i>	A year round visitor to Acacia trees. It eats insect borers and other small insects hiding under the bark of the trees by pecking strongly the tree trunks.	
Crested Lark	<i>Galerida cristata</i>	Resident species of the project area. It eats insects and grains from ground.	

Collard Sand Martin	<i>Riparia riparia</i>	Year round visitor. This little bird occurs in small or large flocks and catches small flying insects close to the moist ground or a water-body surface.	
Barn or Common Swallow	<i>Hirundo rustica</i>	It is a year round visitor to the entire general area. This little bird occurs in small or large flocks and catches small flying insects close to the moist ground or a water-body surface.	
Tawny Pipit	<i>Anthus campestris</i>	It is a year round visitor to moist ground. It eats Insects from ground.	


Rufous-fronted Wren Warbler	<i>Prinia buchanani</i>	It is a resident bird. It feeds on tiny insects from tree.	
Desert Warbler;	<i>Sylvia nana</i>	These warblers are winter visitors. These warblers eat tiny insects from the trees and the bushes.	
Booted Warbler	<i>Hippolais caligata</i>		
Lesser Whitethroat	<i>Sylvia curruca</i>		
Common Whitethroat	<i>Sylvia communis</i>		
Grey-headed Flycatcher Warbler	<i>Seicercus xanthoschistos</i>		
Greenish Warbler or Dull Green Leaf Warbler	<i>Phylloscopus torchiloides</i>		
Yellow-browed or Hume's Leaf Warbler	<i>Phylloscopus inornatus</i>		
Sulphur-bellied Warbler	<i>Phylloscopus griseolus</i>		
Eurasian Chiffchaff or Brown Chiffchaff	<i>Phylloscopus collybita</i>		

White-browed Fantail Flycatcher	<i>Rhipidura aureola</i>	Year round visitors. These catch flying insects from projected branches of trees or tall shrubs. These remain on trees or tall bushes.	
Asian Paradise Flycatcher	<i>Terpsiphone paradisi</i>		
Jungle Babbler	<i>Turdoides striatus</i>	These are resident species. These roost in trees and on tall & thick Shrubs and hop on ground to look for insects. Their nesting is in thick shrubs.	
Common Babbler	<i>Turdoides caudatus</i>		
Purple Sunbird	<i>Nectarinia asiatica</i>	It is a summer breeder in the general area. It eats nectar from flowers. It nests in tall bushes.	
Golden Oriole	<i>Oriolus oriolus</i>	It is double passage migrant over the area. It is arboreal, eats berries and insects.	

Bay-backed Shrike	<i>Lanius vittatus</i>	These are resident species of the general area. These are insectivorous and arboreal birds. These usually sit on projected branches of trees and bushes to catch flying insects. These nest in trees.	
Rufous-backed Shrike	<i>Lanius schach</i>		
Great Grey Shrike	<i>Lanius excubitor</i>		
Black Drongo	<i>Dicrurus macrocercus</i>		
Indian Tree Pie	<i>Dendrocitta vagabunda</i>	It is a local bird. It is omnivorous and it is arboreal bird.	
House Crow	<i>Corvus splendens</i>	It is a resident bird and it is dependent on its human association. It communally roosts for the night on tall trees. It is scavenger bird and visits human habitations for food.	
Common Starling	<i>Sturnus vulgaris</i>	It is a winter visitor. It is a ground feeding bird for insects. Roosts communally roosts for the night on trees or in marginal vegetation of wetlands.	

Common Myana	<i>Acredothores tristis</i>	These are resident birds which live in association with man in open areas. Both these birds are getting closer association with man and more dependence on human agricultural and household activities. Common myna is omnivorous and more scavenger. Bank myna is insectivorous and scavenger to some extent. Common myna breeds in houses as well as trees. Bank myna breeds in holes. Both these mynas remain closer to the grazing livestock to catch grasshoppers in the fields and grasslands dislodged by the hooves of the livestock.	
Bank Myana	<i>Acridotheres ginningianus</i>		
House Sparrow	<i>Passer domesticus</i>	Most common resident bird. It is grainivorous and scavenger. It breeds commonly in houses. It feeds its nestlings on soft food including insect larvae. It has two to three broods per breeding season.	
Mammals			
Long-eared Hedgehog	<i>Hemichinus collaris</i>	This is nocturnal. This hibernates in winter. This is carnivore. This eats insects, and meat of lizards, snakes, rodents. During the day it lives in burrows.	
Jackal	<i>Canis aureus</i>	It is nocturnal animal. It is a scavenger. During day time hides in bushes or in dens, sometimes porcupine burrows.	
Hill Fox	<i>Vulpes vulpes</i>	It is nocturnal. It avoids areas where there are jackals. It kills rodents in the wild.	
Grey Mongoose	<i>Herpestes edwardsi</i>		
Small Indian Mongoose	<i>Herpestes javanicus</i>	It is diurnal. It is carnivore and kills day time active lizards, snakes and rodents, ground nesting birds eggs and chicks. It also eats larger size insects.	
Jungle Cat	<i>Felis chaus</i>	It is nocturnal. It is meat eater. It eats rodents, small birds and bird eggs from the nest on ground or on a tree.	
Palm squirrel	<i>Funambulus pennantii</i>	It is diurnal. Lives on trees and mainly feeds on trees. It eats fruits and pods.	
House Rat	<i>Rattus rattus</i>	These are nocturnal.	

House Mouse	<i>Mus musculus</i>	These live inside the dirty houses. These carry fleas.	
Field Mouse	<i>Mus booduga</i>		
Short-tailed Mole Rat	<i>Nesokia indica</i>	These are nocturnal. These are pest of agriculture and food of owls and foxes.	
Indian Gerbil	<i>Tatera indica</i>		

Arthropods			
Crickets		These were abundant in the moist soil. These are attracted to bright white light at night. These are food of ground feeding insect eating birds, owls, hedgehogs, shrews, lizards and snakes. These will be more abundant in grassy plots with moist soil.	

16.5 SOCIOECONOMIC ENVIRONMENT

Socio economic environment is represented by the human and economic development and quality of life values. For the study of socio-economic environment of the project area, field surveys were conducted and interviews were held with the general public and neighbors. The baseline conditions of the city are as follow:

16.5.1 DEMOGRAPHY

Average household size in the area is about six persons per household. Population density is 338 persons/ km². The estimated population of the project area by gender is shown in **Table**.

Table 15: Estimated population of project area by gender

Males		Females		Gender Ratio
Number	% of Total population	Number	% of Total population	
969	57.2	725	42.8	1.3 males for each female

The highest percentage of the total population is included in age group <18 (46.2%), with the second highest percentage being the age group of 19-40 years (40.6%). Similar trends in population distribution are also observed among male and female population. The percentage distribution of population by age group is shown in **Table**.

Table 16: percentage distribution of population by age group

Age Group	Total		Male (% of Total Male)		Female (% of Total Female)	
	Number	% of Total Population	Number	(% of Total Male)	Number	(% of Total Female)
<18	783	46.2	461	47.6	322	44.4
19-40	687	40.6	370	38.2	317	43.7
41-60	168	9.9	97	10	71	9.8
>60	56	3.3	41	4.2	15	2.07

16.5.2 HEALTH FACILITIES

Health facilities are not sufficient in project area. A Basic Health Unit (BHU) is located at Moza Budh. BHU Budh is currently working beyond its carrying capacity (i.e. the staff and facilities at BHU are far less than the community needs). People have to go to nearby health facilities at Kot Mehmood, Sanawan and Qasba Gujrat even in case of minor medical problems. In case of major medical issues, Muzaffargarh, Kot Addu and Multan are the nearest places. The health facilities available in nearby cities and towns of project area are shown in **Table**. Photographs of some of the health facilities in the project area are shown in **Figure**

Table 17: Health facilities in surrounding areas of project

Name of Health Facility	Location
Basic Health Unit (BHU)	Mehmood kot
Islamic Relief Hospital	Mehmood Kot
Small private Clinic	Mehmood Kot
Basic Health Unit (BHU)	Sanawan
Rural Health Centre (RHC)	Sanawan
Rural Health Centre (RHC)	Qasba Gujrat
Turk Hospital (Private)	Baseera
Tehsil Headquarter Hospital (THQ)	Kot Addu
District Headquarter Hospital (DHQ)	Muzaffargarh
Nishtar Hospital and DHQ	Multan



Health facilities present near project site are New Malik surgical hospital and Sultan Surgical and Gynae hospital.

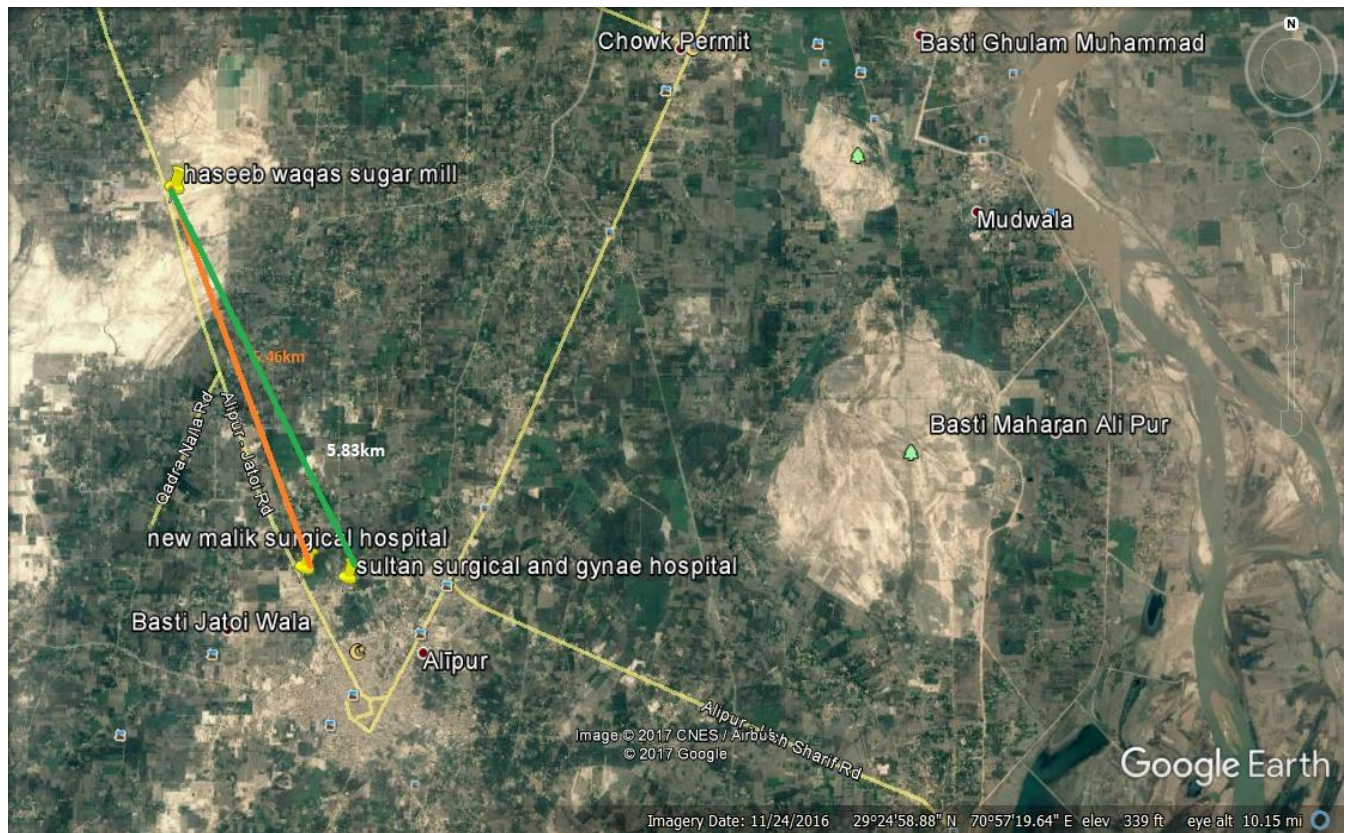


Figure 29: Nearest hospital & medical store

16.5.3 EDUCATIONAL FACILITIES

The education facilities in the project area are not sufficient to accommodate the entire population. Up to middle level (class 8th) educational facilities are available in the area. For high school and intermediate level studies, students go to nearby schools at Mehmood Kot, Sanawan, Qasba Gujrat and Kot Addu. The educational institutes in the study area are provided in **Table**

No.	Name of school	Location
1	Government Primary school (Girls)	Khaji Wala
2	Government Primary school (Boys)	Dheenga Wala
3	Government Primary school (Boys)	Budh
4	Government Middle school (boys)	Hamdani Wala
5	Government Middle school (Girls)	Hamdani Wala
6	Government Middle school (boys)	Budh
7	Government Middle school (Girls)	Kudna
8	Government Middle school (boys)	Kudna

Educational facilities present nearby project area are Al-Mubashir Public Secondary school, Govt. post graduate college alipur, High aims girls secondary school, the educators Punjab campus, allied school, the country school.

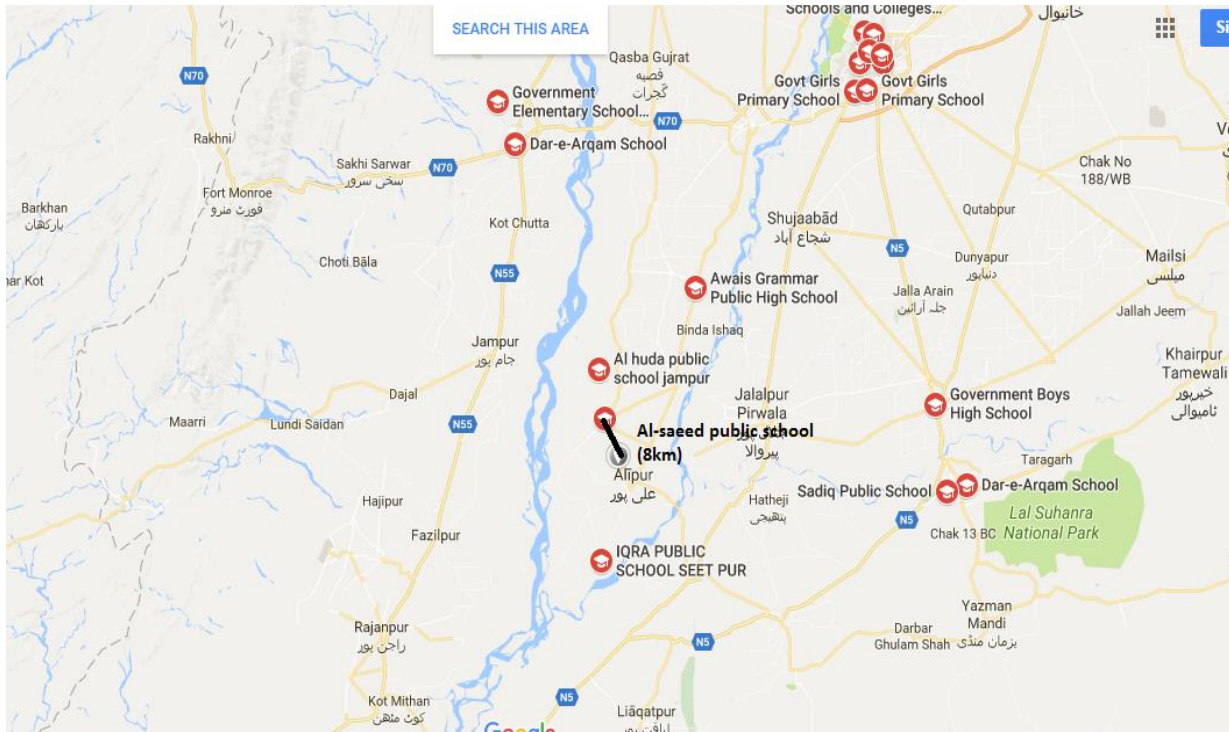




Figure 30: Nearest School

16.5.4 INDUSTRIES

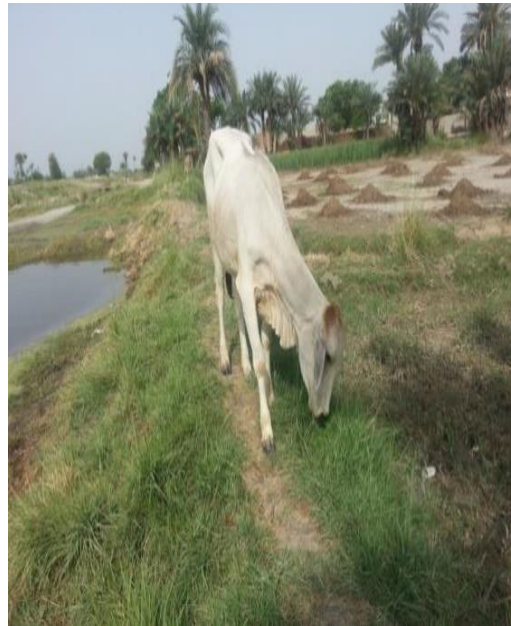
Major industries in district Muzaffargarh include: cotton ginning and pressing; flourmills; jute textile; oil mills; paper / paperboard articles; petroleum products; polypropylene bags; power generation; readymade garments; solvent extraction; sugar; textile composite; and, textile spinning.

Nearest industry (on google map) is shamim group of industries at a distance of 65 km approx from project site.



16.6 QUALITY OF LIFE VALUES

Most of the people in area are related to agricultural sector. The project area is an agriculture zone where wheat, cotton, rice and sugar cane are the main crops and mango and dates are the main fruits. Jawar, bajra (animal fodder), moong, mash, masoor, ground nut, maize, gram, guar seed and oil seed such as rape / mustard and sun flower are also grown in minor quantities in the area. Livestock rearing is quite common in the area. Almost every household involved in agricultural practices is also involved in livestock production. Livestock production is an important commercial activity of the farming communities in the area. Some families are very dependent on livestock production. Photographs of livestock in the project area are shown



Water logging in area has severely affected the crop growth and average yield otherwise; area has good agricultural potential. 100% of the population in project area is Muslim. Most of the people (98%) belong to Sunni school of thought. The remaining people are either “Shias” or “Ahl-e-Hadis” (locally called as “Wahabi”). Similar to rest of Southern Punjab, this area is also influenced by feudalism. Feudal are big property owners and politically influential people. Local people are mostly working on feudal agricultural lands for their livelihood and they have to obey them. Majority of people in project area (about 95%) speak “Saraiki” language. This is a dialect of Punjabi spoken in Southern Punjab. A small number of people also speaks other languages such as Punjabi and Urdu. Electricity is available in entire project area. Ground water is available in the area. Due to seepage from Muzaffargarh Canal, groundwater table is shallow. People have installed hand pumps and electric pumps for ground water extraction. Ground water has various quality issues, however only small numbers of people (about 8%) treat their drinking water before using. Boiling of drinking water prior to use is common water treatment method in the area. Government provided drinking water supply is not available in the area. A government provided sewerage system is not available in the project area. Therefore, people use self-constructed sewerage system. About 52% of households use pipe sewerage, 26% use septic tanks and 22% use open ventilated pit latrine for collection of waste water from toilets. Washing and bathing wastewater is openly released outside the houses. A photograph of a sewerage system adjacent to a house in the project area is shown



16.7 LAB REPORTS OF ENVIRONMENTAL ANALYSIS

Testing of different parameters was done from a certified laboratory to check the quality of different environmental parameters. The copy of the lab reports of these parameters (ambient air analysis, water quality analysis and noise) is given in annexure III.



Figure 31: Ambient Air Monitoring

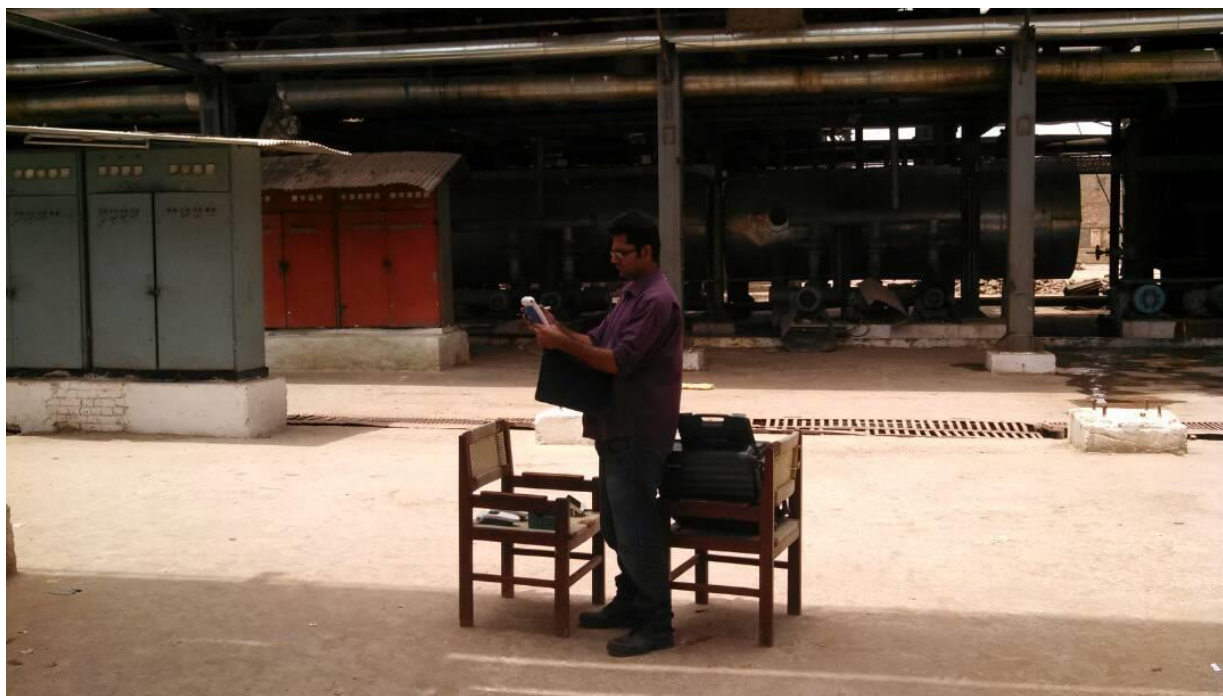


Figure 32: Noise Monitoring

CHAPTER 4: STAKEHOLDER CONSULTATION

17.1 GENERAL

Any person, group or organization with an interest in the project or who can be affected directly or indirectly, negatively or positively by the project activities is a project stakeholder. Because of their interests and concerns, it is very important to take stakeholders into confidence regarding the project need and impacts, and their management. Stakeholder consultation is a mean of involving the entire primary and secondary stakeholders in the project decision making process in order to address their concern, improve project design and give the project legitimacy. Stakeholder consultation, if conducted in a participatory and objective manner, is a mean of enhancing the project stability.

Community input (both of knowledge and values) on socioeconomic and environmental issues can greatly enhance the quality of decision making. Stakeholder consultation was therefore conducted in the project area, not only to satisfy legal requirement of EIA in Punjab but also to improve and enhance the social and environmental design of the project.

17.2 OBJECTIVE OF THE STAKEHOLDER CONSULTATION

Role of the public participation is very important in the design making process to achieve the goal of sustainable development. The major objectives of public consultation are as follows:

- Promote better understanding of the project, its objectives and its likely impacts and their management.
- Identify and address the concerns of all interested and affected parties of the project.
- Provide a mean to Identify and resolve issues before plans are finalized and development commences, thus avoiding public anger, resentment and potentially costly delays.
- Encourage transparency, and inculcate trust among various stakeholders to promote cooperation and partnership with the communities and local leadership.

17.3 CONSULTATION PROCESS

17.3.1 Consultation Methodology

The methodology adopted for consultations is summarized below.

17.3.1.1 Consultation Material

The main document for distribution to stakeholders during the consultations was Social Impact Assessment Interview Schedule. The filled Survey forms of stakeholders are annexed (Annexure VI).

17.3.1.2 Community Consultation Mechanism

The community consultations were conducted with the community members outside their settlements to encourage and facilitate their participation. Photographic record of the consultations with the men from the communities is presented below. Consultation was done for 3 days from 6th of June to 8th of June 2017. People were consulted and their views were recorded in form of survey forms and presented in table below:

The meetings progressed in the following manner:

- An overview of the Project and EIA process was provided to the community representatives.
- Members of the communities were given the opportunity to raise queries or concerns regarding the Project.
- Queries were responded to and concerns were documented.
- The consultation process was carried out in Urdu and Punjabi language.

17.4 STAKEHOLDERS CONSULTED

Names and CNIC of consulted stakeholders are given in table below:

Table 18: List of consulted stakeholders

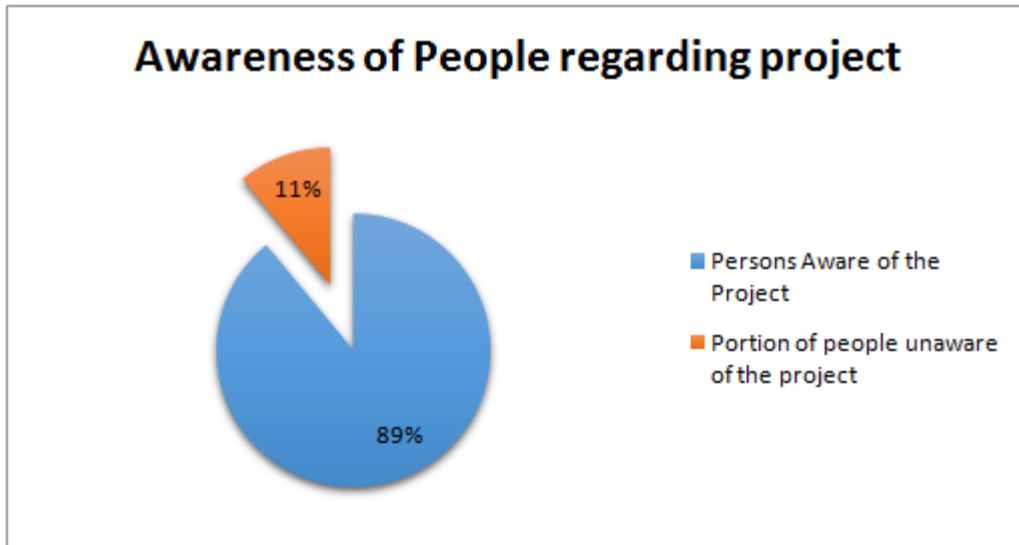
Sr. No	Stakeholder name	CNIC Number
1.	Muhammad Hakim	32301-0899669-5
2.	Abdulaziz	32302-8865076-7
3.	Asghar Ali	32301-6707794-1
4.	Kashif Ali	32301-1042443-9
5.	Parvez Hussain	31304-3641875-7
6.	Muhammad Naeem	32301-7769904-3
7.	Muhammad Zulfiqar	32302-1923668-3

8.	Muhammad Waqar	32301-2286586-7
9.	Muhammad Arif	32301-3560885-7
10.	Muhammad Javed	32301-2306631-7
11.	Muhammad Jalal	32301-3712974-7
12.	Muhammad Tofail	31301-1430910-3
13.	Syed Barat Hussain	32301-0911865-5
14.	Arif Khan	32302-9944089-5
15.	Basheer Hussain	32301-1072234-5
16.	Saddam Hussain	32302-6563777-9
17.	Muhammad Javed	32301-6984887-3
18.	Muhammad Aslam	32302-1531131-3
19.	Hameed Ahmad	32301-5823956-3
20.	Muhammad Zafar	32302-8161811-7
21.	Muhammad Maqsood	32301-6784699-1
22.	Muhammad Aslam	32301-8661151-9
23.	Muhammad Akram	32301-5319694-7
24.	Muhammad Aslam	32301-7149972-1
25.	Muhammad Arshad	32301-0750673-3
26.	Muhammad Amir	32302-4496559-7
27.	Muhammad Hashim	32301-0899299-1
28.	Muhammad Tariq	32302-4890073-5
29.	Muhammad Parvez	32301-4365044-1
30.	Syed Irfan Mehdi	32301-2072338-5
31.	Sajjad Ahmed	32302-4578228-1
32.	Muhammad Waqas	32303-1119009-9
33.	Hafeezullah	32301-0269175-5
34.	Bahadur Abbas	32301-9404522-9

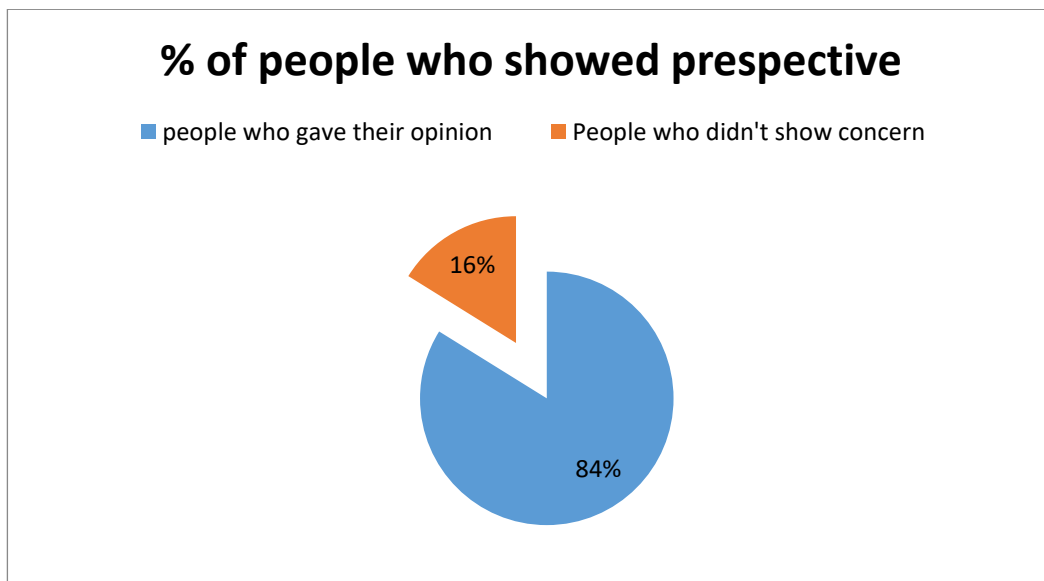
17.5 STAKEHOLDER CONCERNS AND RECOMMENDATIONS

The finding of the community consultation has been addressed in various sections of EIA. Mitigation plan has been incorporated into EMP.

Out of total respondents, 89% knew about the project whereas 11% were not aware of the project planning and implementation. All people were then briefed about the project.

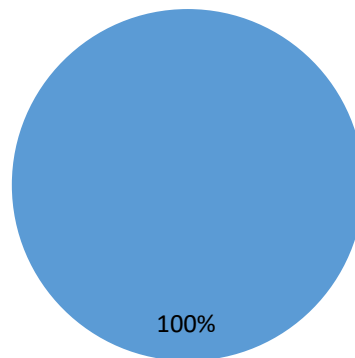


84% of interviewee commented their views about the project and 16% didn't respond.



100% people favored the project keeping in view its importance.

Project Acceptance



Concerns raised by public and recommendations provided by participants were as follows:

17.5.1 Concerns raised by the public

The positive concerns raised were:

- The project would encourage sugar cane farming in the region
- Sugar cane farmers will have a reliable outlet: they will grow and sell their cane through contract farming with HWSML. They will also earn income and raise their standard of living.
- There will be both direct and indirect employment for the people: the former will apply to workers who will be employed by HWSML and the later will apply to sugar cane farmers and those who will be employed in business that will spring up due to the presence of HWSML.
- New businesses will spring up and old ones will grow as a result of migration of people in the area.
- The local economy is likely to grow through backward and forward linkages and income and employment multiplier effects resulting from the project.
- Some by products from sugar processing will be used locally. Such by products will include ash which can be used to fertilize the soil.
- The establishment of sugar mill in the region will contribute to industrial development.

- The project will provide raw materials for other industrial Plants e.g., those manufacturing industrial spirits.
- The project will produce sugar for domestic use hence saving the foreign exchange that could be used for its importation.
- On many occasions children are employed on sugar cane farms. This is not only against the law but also denies children to attend school.
- The widespread use of fertilizers and herbicides on the sugar farms, there will be water pollution in the streams and rivers.
- Youth unemployment is high in the area.
- The cost of transporting sugar cane is borne by the farmer.
- Poor management of sugar factories. This leads to delayed and low payments to the farmers which may lower their morale.

17.5.2 Recommendations made by the participants

- Early maturing cane varieties should be introduced in the area. This will enable farmers to earn money early enough from sugar cane than presently is the case.
- Use of child labor on sugar cane farms should be banned.
- Farmers should be encouraged to use organic manure instead of industrial fertilizers on the farms.
- HWSML should give preference to the local unemployed youths when employing workers for the project.
- The cost of transporting cane to the factory should either be borne by both the farmer and HWSML or be charged at a flat rate irrespective of the distance from the farm to the factory.

The pictorial view of the public consultation is given below:



Figure 33: Consultation with community in Alipur



Figure 34: Consultation with people in Jatoi



Figure 35: Consultation with female community



Figure 36: Consultation with private doctor



Figure 37: Consultation with doctor in Sultan Surgical Hospital



Figure 38: Consultation with nurse



Figure 39: Consultation with female doctor



Figure 40: Consultation with teachers in school



Figure 41: Consultation with people outside mosque



Figure 42: Consultation with people on nearby road



Figure 43: Consultation with bank manager



Figure 44: consultation with Chairman municipal committee Alipur

CHAPTER 5: POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

18.1 GENERAL

This section discusses the project's potential environmental impact on the area's geomorphology, soil, water resources, air, biological resources and socioeconomic condition and, where applicable, identifies mitigation measures that will reduce, if not eliminate, its adverse impact. The assessment carried out in this section is based on potential impacts on overall environmental receptors within the project area.

18.2 OBJECTIVES

Objectives of screening all possible impacts and then providing their mitigation measures are:

- To find different alternatives and ways of doing the project activities.
- To enhance the environmental and social benefits of proposal.
- To avoid, minimize and remediate adverse impacts.
- To ensure that residual adverse impacts are kept in acceptable limits
- Anticipated Potential Environmental Impacts (Construction & Operation Phase)

Table 19: Impact Assessment (Construction Phase)

ENVIRONMENTAL STANDARDS						ECOLOGICAL IMPROTANCE		SOCIAL IMPORTANCE			
Surface and Ground Water Quality	Air Quality	Noise	Solid Waste	Smell & Smoke	Fire Hazards	Destruction of Habitat / Vegetation	Disturbance to local fauna	Disturbance to Other Services	Urban Congestion	Employment Opportunities	Health & Safety
-1	-1	-1	-1	0	-1	-2	-2	0	0	+2	-1

Table 20: Impact Assessment (Operational Phase)

ENVIRONMENTAL STANDARDS						ECOLOGICAL IMPROTANCE		SOCIAL IMPORTANCE			
Surface and Ground Water Quality	Air Quality	Noise	Solid Waste	Smell & Smoke	Fire Hazards	Destruction of Habitat / Vegetation	Disturbance to local fauna	Disturbance to Other Services	Urban Congestion	Employment Opportunities	Health & Safety
-2	-2	-1	-1	0	-2	0	0	0	0	+2	-2

Key : 1 = Minor Impacts are defined as Less significant adverse impacts that may be easily prevented or mitigated

2 = Moderate Impacts are considered as likely to have adverse environmental impacts

3 = Major Impacts are defined as significant, or irreversible adverse impact

0 = This category serves no impacts from project

18.3 Impacts Associated with Project Location

While citing a plant, care should be taken to minimize the adverse impact of the facility on immediate neighborhood as well as on the distant places. The application of good and sound citing criteria is often the best and first strategy to minimize the environmental and social impacts that can be caused by a cement manufacturing plant. The Proposed site is undisputed open land.

No human settlements, archeological/cultural resources and ecologically sensitive/declared protected area to be disturbed, dismantled or relocated in the proximity of the proposed site. The choice of the proposed site is justified because Muzaffargarh is endowed with suitable natural conditions for increased sugarcane production. Distances from all receptors are given in section 2.4.1.

18.4 Impacts Associated with Design

At the design phase, no considerable impact will occur on land, soil, topography, ground water, and people residing in the nearby area. However in pre-construction phase a management system should be provided so anticipated impacts can be reduced. Design of the proposed building will adhere to all standard technical requirements in order to avoid adverse impacts on socio-environmental aspect.

The design, if maintained and operated in sustainable manner, is expected to cast positive impact on the social environment and will impose adverse impact on the environment which can be mitigated or reduced upto acceptable level by adopting best management practices.

Mitigation Measures

The Proponent intends to construct the unit on modern lines with incorporation of latest technology which will not cause any significant impact on environment. Wastage of water will be avoided. All the waste material will be tried to use as raw material i-e baggase as fuel of boiler, wastewater in sugarcane fields etc. Moreover, the buildings will be designed by keeping in consideration all the technical standards to avoid adverse impacts on the environment and society.

18.5 Impacts Associated with Construction Phase

Project construction phase will be of two year whose activities will surely show effects on land environment, water, air, noise level, soil quality, socio-economic trend, etc. This activity will have a positive impact in case of socio-economic culture for the people in the nearby villages. They will have a chance for local employment in foundation, fabrication, brick masonry, painting and machinery erection works. Along with that tree plantation will be one of the activities. As local workers are involved in construction phase, impact at site will be negligible. The construction phase of proposed establishment of sugar plant will include activities associated with the site leveling, construction of civil structures, architectural works and building services. The construction phase would bring in immediate but short term changes on various components of environment near the project site.

18.5.1 Impact on Topography

The area of the proposed plant is more or less flat terrain. It is predominantly covered with fine to medium grained clay loam as top soil with underlying compacted dense sand. During the construction phase leveling would be required. Apart from the localized construction impacts confined to the plant site, no significant long term adverse impact on topography is envisaged.

18.5.2 Soil Contamination

The following practices will be adopted to minimize the risk of soil contamination:

- The proponent will be required to instruct and train their workforce in the storage and handling of materials that can potentially cause soil contamination.
- Solid waste generated during construction will be properly and safely disposed of as per practices of area.

18.5.3 Impact on Air Environment

The main source of air emission during the construction phase is dust. It will be generated due to movement of equipment at the site and during site leveling, earthwork, foundation work and other constructional activities. Dust emissions are expected to result in increased particulate matter thus affecting base line air quality, primarily in working area for a short duration. Following mitigation measures will be adopted:

- In order to reduce concentration of suspended dust particles, transport roads will be sprinkled with water on the regular basis

- Construction activities causing dust should not be carried out on excessively windy days
- Construction workers will be provided with masks for protection against the inhalation of dust and they should be trained for its use
- Vehicle speed should be controlled within the limit
- Emission of exhaust gases from vehicles used for construction should be controlled

18.5.4 Impact on Water Environment

The construction activities will be associated with mechanical fabrication, assembly and erection. These activities associated do not consume large quantities of water. Make shift sanitation facility shall be provided by contractors for disposal of sanitary sewage generated by the work force. There shall be no disposal of construction waste outlet. The overall impact on water environment during construction phase due to the proposed project is considered short term and insignificant.

18.5.5 Impact on Flora & Fauna

Project site is clear and no vegetation is present on-site. Since, no flora removal is involved; therefore no effect due to the project implementation is being envisaged. There will be no effect on fauna of the area, animals will not be allowed at project execution area. Proper fencing will be done during construction period to protect any damage to fauna (if any).

18.5.6 Impact on Noise Environment

The noise produced during construction phase may not have significant impact on the existing ambient noise levels. The activities like construction of foundation, infrastructure and plant are considered as the main source of noise generation. The major construction work will be carried out during the daytime. The construction equipment may generate high noise which can affect the personnel operating the machines. Use of proper personnel protective equipment will mitigate any adverse impact of noise on the working population. Noise from the site is expected to be reduced significantly before reaching nearby habitation.

Following mitigation measures will be adopted:

- Selection of up to date and well maintained plant or equipment with reduced noise levels ensured by suitable in built damping techniques or with appropriate muffling devices
- Confining noisy work to normal working hours in the day, wherever possible

- Providing the construction workers with suitable hearing protection like ear cap, or earmuffs and training them in its use
- Restricting construction vehicle movements during nighttime
- Use of low noise machinery, or machinery with noise shielding and absorption are the mitigation measures suggested for said project

18.5.7 Occupational Safety

During the construction there are chances of minor or major accidents at the site.

Mitigation:

All the workers will be provided with PEPs such as; helmets, goggles and safety instructions in the form of manuals and also first-aid will be made available. List of PPEs is given below:

▪ Safety shoes	16 No's
▪ Gloves	24 No's
▪ Helmets	12 No's
▪ Safety belts	06 No's
▪ Ear plugs	12 No's
▪ Safety Goggles	12 No's

18.6 IMPACTS DURING OPERATION PHASE

The plant operational activities will have impact on physical environment (air & water quality, noise level) and on socio-economic environment. No land/topography alteration is envisaged due to the operation of sugar plant.

18.6.1 Impact on Air Environment

Sources of air emissions in Proposed Sugar Mill are boilers and steam generators. The air environment gets polluted due to emission of suspended particulate matter.

Due to existing PUCCA roads & reduced distances for bullock carts, tractors & trucks to reach the mill site suspended particulate matter generation will be comparatively lesser. Use of captive Bagasse from cane crushing as a fuel will be a solution for its safe disposal. Complete combustion, wet scrubbers, ash collection system and effective ash handlings are the mitigation measures which will be adopted in said project. Mixing of collected ash with press mud to sell to farmers/brick producers (located near site) is another suggested mitigation measure to minimize the probable impacts of fuel handling & safe ash disposal. Ash will be generated at less than 1% of baggase used as fuel in boiler.

Vehicles used for transportation of sugar cane as well as finished product would be bullock cart, tractors and trucks and the utility vehicles used would be buses, jeeps, cars and ambulances. HWSML needs to regularly carry out checks of all motor driven vehicles and carry out regular servicing and maintenance of it in order to keep the environmental impact on account of their exhaust emissions to its minimum level. For reducing fugitive dust, regular water sprinkling on Kachha roads will be done. All trucks proposed to be used for transportation will be covered with tarpaulin, maintained and optimally loaded. Moreover, the garden development and tree plantation activities of HWSML during operational phase would ensure minimal impact of fugitive dust emissions.

18.6.2 Impact on Noise Environment

Noise, an unwanted sound, affects human being. Excessive exposure to noise produces varying degree of damage to hearing system. It leads to headache, fatigue etc. Road traffic will also result in rise in noise levels. Continuous exposure of increased level of noise will have an adverse impact on the health of workers as well as the people residing in surrounding area.

In the operation of Sugar mill following equipment shall be the sources of noise.

- Centrifugal Machine - 86-87 dB (A)
- Vacuum Release - 102-104 dB (A)
- Sugar dry units - 91-92 dB (A)
- Compressor for air supply - 90-92 dB (A)
- Milling - 88-91 dB(A)
- Mill Turbine - 92-94 dB(A)
- Juice clarification station - 88-89 dB(A)
- Juice evaporation station - 82-93 dB(A)
- Boilers - 83-109 dB(A)
- FD fans - 94-96 dB(A)
- Delivery pumps for sugar & molasses supply - 89-90.5 dB(A)

As the nearest residence is at a distance of 7.6km from site so no disturbance due to noise will be there on residents.

Proper encasement of noise generating sources will be done to control the noise levels within limits. The steam turbine generator will be provided with acoustic enclosures and silencers in the exhaust. The steam turbine will be housed in a closed building which will considerably

reducing the noise. In case of maintenance, the persons working near the steam turbine generator building will be provided with ear muffs.

A thick greenbelt will be developed all around the plant which will be acting as noise barrier.

In general the following methods will be adopted to control the noise pollution from the proposed units;

- The use of concrete and masonry walls & barriers keeping in view the benefits of stiffness weight & cavity construction & the need to provide well sealed sound attenuating doors & windows.
- The use of complete or partial enclosures.
- Attenuation by use of sound absorbents on walls and fixed or suspended ceilings
- Introduction of control and monitoring rooms having good sound insulation properties.
- The use of mufflers, sound attenuation and acoustic louvers in air flow paths, taking particular care to direct inlet and discharge an opening away from critical areas wherever possible, so as to take advantage of direct effects.
- All the workers will be provided with ear plugs, proper maintenance of blowers and pumps. All the transporters will be advised to carry out regular maintenance of their vehicles.

18.6.3 Solid waste management

The solid waste generated from the sugar unit is mainly ash, press mud and Bagasse. The ash will be generated from boiler. This solid waste in case dump on land will create soil degradation or underground water pollution.

Mitigation:

Press mud will be sold to farmers to use as biofertilizer or cow feed. Bagasse is the raw material in boilers. Ash generated during combustion in boiler will be sold to brick manufacturers or will be mixed with mud cakes and used in fields.

18.6.4 Impact on water environment

Wastewater generated will be treated in lagoons over an area of 4 acre. After treatment, wastewater will be discharged in sugarcane fields owned by proponent (these fields will be grown by proponent in future nearby project site).

18.6.5 Impact on Socioeconomic Environment

Like other sugar factories HWSML is also located in an isolated area. HWSML management thought that it would be advantageous to improve the living conditions of people in and around the plant site. It also proposes to employ local skilled and unskilled workers in the proposed project. It will therefore generate employment in the local area.

In turn local people can avoid uncertainty of jobs, raise their living standards, do supplementary jobs of cane & other farming, cattle, poultry, brick making unit etc. thus to stabilize & prosper in life. This will surely make a positive impact.

18.7 ENVIRONMENTAL ENHANCEMENT

Proposed project will be result in following benefits:

- Direct and indirect employment opportunities,
- Gains in the local and national economy,
- Industrial development in region
- Business spin-offs in the factory area,

Tree plantation will act as environmental enhancement measure. Approx 2 kanal area will be reserved for tree plantation. Trees including Kikar (Acacia Arabica) Shisham or Tahli (Delbergia sissoo), Beri (Zizyphus jujube), Toot (Morus alba), Sharin (Albizzia lebbek), Dherek (Melia azedarach), Phulai (Acacia modesta), Pipal (Ficus religiosa) and Bohr (Ficus bengalensis) are recommended trees. Trees will be planted at every 1m distance. Approx 800-1000 trees will be planted and 1-1.2million budget will be reserve for plantation and maintenance of trees/plants.

CHAPTER 6: ENVIRONMENTAL MANGEMENT AND MONITORING PLANS

19.1 GENERAL

This EIA provides the Environmental Management Plan (EMP) of the project to keep it environment benign as well as the monitoring plan to ensure the compliance of the established EMP.

Outline and key features of the EMP for operations phase is presented. As per the environmental legislation in Pakistan, the EMP for the operations phase, along with other documents, is to be submitted to the environmental protection agency to obtain confirmation for compliance and Environmental Approval for project operation.

Even after implementation of the suggested mitigation measures, the impact may remain significant, and require monitoring. This section also underlies the monitoring framework for both construction and operation phases to check compliance of the EMP and to take timely actions for correction in case any accident of significant criteria, requirements or goals are found.

19.2 OBJECTIVES OF ENVIRONMENTAL MANAGEMENT PLAN

The primary objectives of the EMP are to:

- Facilitate the implementation of the mitigation measures identified
- Define the responsibilities of the project proponent and contractor and provide a means of effective communication of environmental issues between them.
- Identify monitoring parameters in order to ensure the effectiveness of the mitigation measures
- Provide a mechanism for taking timely action in the face of unanticipated environmental situations.
- Identify training requirements at various levels.

19.3 MANAGEMENT APPROACH

The organizational roles and responsibilities of the key players are summarized below:

Proponent: The project proponent will undertake overall responsibility for compliance with the EMP. Concerned Departments will carry out verification checks to ensure that the contractors are effectively implementing their environmental and social requirements.

Contractors: The contractors will implement the majority of environmental and social mitigation measures. The contractors will carry out field activities as part of the project. The contractors are subject to certain liabilities under the environmental laws of the country, and under its contract with proponent.

19.4 COMPONENTS OF THE EMP

The EMP consists of the following:

- Management plan
- Monitoring Plan
- Communication and documentation
- Institutional capacity
- Environmental training

19.5 ENVIRONMENT MANAGEMENT PLAN

It lists all the mitigation measures identified in the EIA and the associated environmental or social aspect in line during operational phase with the administrative framework involving all the responsible implementing authorities who are required to take the planned actions/measures. It enhances project benefits by reducing its impacts and making it environmental friendly.

Table 21: Environmental Management Plan

Objective	Management Action	Responsibility	Time framework
Construction phase			
Employment Opportunities			
To promote the employment of local persons	Recruitment of local workers will be undertaken without discrimination and in accordance with HWSML recruitment policy by contractors involved in construction	HWSML/Contractor	On commencement of construction activities
To promote the use of local service providers	Local procurement of goods and services will be undertaken wherever possible and cost effective and where practicable to the project	HWSML/Contractor	On commencement of construction activities
Construction traffic management & safety			
To ensure safety in factory construction site	<ul style="list-style-type: none"> Safety signage will be put in relevant places within the construction site Construction drivers to be subjected to public safety awareness Reckless driving by construction workers will be prohibited and monitored and prohibited 	Contractor	On commencement of construction activities
Soil management			
To ensure the conservation of soil	<ul style="list-style-type: none"> Topsoil is to be stripped from the footprint area for the processing plant, and plant related infrastructure All excavation works must be properly backfilled and compacted to avoid soil erosion Rip compacted areas to reduce runoff and improve re-vegetation where required 	Contractor	Continued from planning phase
Construction waste management			
To prevent the contamination of soils and water resources due	<ul style="list-style-type: none"> The factory construction site will have litter bins for waste collection 	Contractor	Throughout construction stage

to inappropriate management and disposal of waste	<ul style="list-style-type: none"> Recycling or reuse of waste wherever possible. Application of a good strategy to collect, remove and safely dispose of waste on daily basis to ensure a clean environment in the factory site 		
Pollution control management			
To contain spillages	Proper maintenance of construction vehicles and equipment will be undertaken	Contractor	On-site establishment
To manage sewage	Portable toilets will be provided at site offices. The portable toilets are to be cleaned on a regular basis	Contractor	On commencement of construction
Protection of biodiversity			
To avoid unnecessary disturbance of and quick recovery of biodiversity in the factory site	<ul style="list-style-type: none"> Avoid destruction of biodiversity outside the designated factory construction site Minimize clearing of vegetation during construction Surface soil excavated during construction to be placed back on the sub-soil to fast vegetation recovery Prepare and implement an appropriate landscaping programme to help in re-vegetation of affected project areas after construction 	Contractor	Throughout construction phase
Air quality & dust management			
To minimize the dust entrainment during construction	<ul style="list-style-type: none"> Regular surface wetting will be implemented on dusty sections in the factory construction site Strict on-site speed controls are to be enforced for construction vehicles All trucks hauling soil, sand and other loose materials shall be covered 	Contractor	On commencement of construction activities
Noise & Vibration			

To minimize disturbance due to noise & vibration	<ul style="list-style-type: none"> Loading and unloading of materials must be done carefully to reduce noise disturbances to surrounding households Residences are at a safe distance from site so no disturbance will be envisaged. 		
Occupational health & safety			
To ensure healthy and secure environment in the factory construction site for all workers	<ul style="list-style-type: none"> Management must ensure that fire extinguishers are located in strategic and visible places All vehicles and construction equipment are under control of competent personnel Employees need will be informed on the necessary safety procedures and be competent in the work they are employed to do. Inspection of material and harmonization to the occupational health and safety standards. Adequate security for workers will be provided during construction Sensitize workers to operate in teams 	Contractor	Throughout construction phase
Operation phase			
Cane fire management			
To ensure prevention of cane fires	<ul style="list-style-type: none"> Sensitization of farmers on the environmental impacts of cane harvesting using the burning method Ensure that all the farmers avoid the use of cane harvesting using the burning method 	HWSML	Throughout project operation
Farm soil compaction			
Ensure cane loading outside the farm	<ul style="list-style-type: none"> To alleviate the deterioration of farm soil quality due to compaction by heavy tractors during cane harvesting and delivery to the factory 	HWSML	Throughout project operation
To avoid environmental pollution through improper	<ul style="list-style-type: none"> Provide solid waste handling facilities such as waste bins and skips in all sections of the sugar factory 	HWSML	Throughout project life cycle

solid waste management (SWM) in the sugar factory	<ul style="list-style-type: none"> • Ensure that solid waste generated is regularly disposed off appropriately • HWSML is planning to re-use the bagasse which is the residual woody fiber of the cane as fuel for boilers for steam generation. • The filter mud will be used for the production of dry filter cake to be used as a fertilizer or cattle feed. The filter cake will be distributed to the sugar cane farmers for recycling. • Non-biodegradable and recyclable matter, such as containers, waste papers, used materials, waste packaging materials, will be sold to local contractors for recycling or reuse purpose. 		
Wastewater	<ul style="list-style-type: none"> • Wastewater generated will be naturally treated in 5 lagoons over an area of 4 acre. Oil skimmer is also installed in the main drain for trapping of oil and grease. After treatment, wastewater will be discharged in sugarcane fields owned by proponent (these fields will be grown by proponent in future nearby project site). • Condensate water is used for imbibitions and sugar manufacturing process. • Boundary walls are made around the massecuite and molasses pumps to collect the leakage of sugar solution. In this way, leaky sugar solutions are reprocessed. 	HWSML	Throughout project life cycle
Air quality and dust management			
To minimize air pollution due to said project	<ul style="list-style-type: none"> • Use of captive Bagasse from cane crushing as a fuel • Complete combustion, wet scrubbers, ash collection system, effective ash handling is the mitigation 	HWSML	Throughout project life cycle

	<p>measures which will be adopted in said project.</p> <ul style="list-style-type: none"> • Mixing of collected ash with press mud to sell to farmers/ brick producers (available near site) is another suggested mitigation measure to minimize the probable impacts of fuel handling & safe ash disposal. • HWSML needs to regularly carry out checks of all motor driven vehicles and carry out regular servicing and maintenance of it in order to keep the environmental impact on account of their exhaust emissions to its minimum level. • For reducing fugitive dust, regular water sprinkling on Kachha roads will be done. • All trucks proposed to be used for transportation will be covered with tarpaulin, maintained and optimally loaded. • Moreover, the garden development and tree plantation activities of HWSML during operational phase would ensure minimal impact of fugitive dust emissions. • Regular monitoring of boilers stack. 		
Noise & vibration			
To minimize disturbance of communities due to noise and vibrations	<ul style="list-style-type: none"> • Proper encasement of noise generating sources will be done to control the noise levels within limits. • The steam turbine generator will be provided with acoustic enclosures and silencers in the exhaust. The steam turbine will be housed in a closed building which will considerably reduce the noise. In case of maintenance, the persons working near the steam turbine generator building will be provided with ear muffs. • A thick greenbelt will be developed all around the 	HWSML	Throughout project life cycle

	<p>plant which will be acting as noise barrier.</p> <ul style="list-style-type: none"> • The use of concrete and masonry walls & barriers keeping in view the benefits of stiffness weight & cavity construction & the need to provide well sealed sound attenuating doors & windows. • The use of complete or partial enclosures. • Attenuation by use of sound absorbents on walls and fixed or suspended ceilings • Introduction of control and monitoring rooms having good sound insulation properties. • The use of mufflers, sound attenuation and acoustic louvers in air flow paths, taking particular care to direct inlet and discharge an opening away from critical areas wherever possible, so as to take advantage of direct effects. • All the workers will be provided with ear plugs, proper maintenance of blowers and pumps. All the transporters will be advised to carry out regular maintenance of their vehicles. 		
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19.6 ENVIRONMENTAL MONITORING PLAN

Environmental monitoring is a vital component of the Environmental Management Plan. It is the mechanism through which the effectiveness of the environmental management Plan in protecting the environment is measured. The feedback provided by the environmental monitoring is instrumental in identifying any problem or lapse in the system under implementation and planning corrective actions.

Table 22: Environmental Monitoring Plan

Env. Components	Project Stage	Parameters	Instrument	Standards	Monitoring			Institutional Responsibility
					Location	Frequency	Duration	
Air	Construction	PM10, SO ₂ , NO ₂ , CO, SPM, O ₃	Air Quality Monitors/ Gadgets	PEQs	Project site	Twice during construction	As per approved testing method	Contractor through approved monitoring lab
	Operation	Stack emissions	Air Quality Monitors/ Gadgets	Category B of SMART rules	Boiler stack	Quarterly	As per approved testing method	HWSML through approved monitoring lab
Noise Levels	Construction	Noise levels on dB(A) scale	Digital Sound Meter	PEQs	Project site	Twice during construction	Reading to be taken at 15 seconds interval for 15 minutes every hour and then averaged	Contractor through approved monitoring lab

	Operation	Noise levels on dB(A) scale	Digital Sound Meter	PEQs	Project site	Quarterly	Reading to be taken at 15 seconds interval for 15 minutes every hour and then Averaged.	HWSML through approved monitoring lab
Waste water	Operation	Effluent flow, Temperature, COD, BOD, pH, TSS, Oil & grease	Lab equipments	Category B of SMART rules	Wastewater discharge point	Quarterly	As per approved standards method	HWSML through approved monitoring lab

19.7 INSTITUTIONAL CAPACITY OF THE UNIT

The institutional capacity for the Environment Management Plan is outlined below:

19.8 PRIMARY RESPONSIBILITIES

The primary responsibility for implementing different aspects of the EMP within the project lies with management of HWSML.

19.9 OPERATION MANAGEMENT & CONTROL

Conducting the operational activities in environmentally sound manner will be the responsibility of the concerned Manager; for which he will be trained.

19.10 SUPERVISION & MONITORING

Senior Supervisor will be responsible for all environmental issues and for the implementation of EMP.

19.11 COMMUNICATIONS AND DOCUMENTATION

An effective mechanism to store and communicate environmental information during the project is an essential requirement of an EMP.

19.12 ENVIRONMENTAL TRAINING

Environmental training will help ensure that the requirements of the IEE/EIA and EMP are clearly understood and followed by all project personnel in the course of the project

Table 23: Environmental training program

Target audience	Trainers	Contents	Schedule
Selected management staff	Consultants	HSE Management	After every five months
All personnel	Consultants	Fire Fighting (Training/drill)	Monthly

Technical Staff	Consultants	Occupational Health & Safety	
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19.13 EQUIPMENT MAINTENANCE DETAILS

Equipment with high efficiency, good condition and reliability will be purchased by the Proponent. The proposed plant machinery will be maintained by the proponent according to the design and as suggested by the contractor. Fire safety equipment such as; fire-extinguishers, smoke detection system, fire pumps, fire-fighting hoses, firefighting nozzles, fire and water monitors, fire trolleys, hooters and hydrants will need regular maintenance and check in order to eliminate hazards of associated risk of fire. Following is the maintenance details for the portable fire extinguisher:

Table 10: Maintenance Plan for Portable Fire Extinguisher

Task	Weekly	Monthly	Semi-Annually	Annually
Visual Inspection	✓			
Testing and Inspection		✓		
Check for Leakage		✓		
Recharging				✓
Fire Mains and Nozzles		✓		
Containers/Cylinders			✓	
Control and Section Valves			✓	

19.14 ENVIRONMENTAL BUDGET

Approximately PKR 2 million budget will be reserved for the Environment. 1-1.2million budget will be reserved for plantation and maintenance of trees/plants.

CHAPTER 7: CONCLUSION AND RECOMMENDATIONS

20.1 Conclusion

The findings of the EIA based on the disclosed project details and the baseline site assessment indicated that the project is desirable and will support the realization of national and county development goals. The proposed project is justified by the vision and mission of HWSML to encourage and promote industrialization in the county. The manpower required for the proposed sugar mill will be about 794 workers whose number will increase as the factory gains momentum. The sugar factory is expected to eventually benefit the livelihoods of more than 50,000 people comprising of farmers and their families, farm laborers, vehicle operators, traders which will support the overall economic development in County and the wider region.

The EIA findings showed that the project design is the most suitable based on the current state of environment and the available technology. The project is feasible and desirable within the perspective of environmental and social economic evaluation undertaken in this study. Therefore, the project is necessary, and should be implemented as soon as possible. The overall benefits of the proposed development are far higher than the potential cost of the marginal negative environmental changes which are likely to occur. The proposed project is desirable because it will improve the socio-economic status for the people in the area. It will create employment and deliver a wide range of other socioeconomic benefits.

The baseline environmental assessment of the proposed factory site indicated that the environment is already been under agricultural use and does not contain any sensitive environment or endangered species. The EIA established that the proposed project design is by far more suitable than the No project option. The stakeholder engagement and consultation process also established that the local people were unanimously in support of the proposed project.

20.2 Recommendation

In view of the findings of the EIA, the proposed project is considered as environmentally sound. On the basis of these findings it is recommended that the proposal for the construction of the proposed mill be approved based on the willingness by the proponent to implement the proposed project in strict adherence to the Environmental Management Plan (EMP) and

Environmental Monitoring Plan as provided in this report. On the basis of these findings, it is recommended that the proposed construction should be provided Environmental Approval.