Environmental and Social Management Plan for

Section (R7) Asphalt plant
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EXECUTIVE SUMMARY

Iraqi Ministry of Construction and Housing has already signed construction contracts with Terna S.A for the rehabilitation of the expressway NO.1 section R7 (Nasriya to Rumula) project. The project is funded by The World Bank.

Due to technical and logistical requirements, Terna S.A. has proposed to install an asphalt plant in Thi-Qar Governorate in order to meet the required demand of asphalt for road rehabilitation works. The land plot which is needed to allocate the asphalt plant is approximately 25,000 m² in area and is of 40 Km distance away from the city of Nasiriya. The closest populated town is SUQ AL SHUQE which is about 20 Km from the asphalt plant. The plot is about 1-2 meters below the expressway No.1 Road level.

This Environmental and social management plan report (ESMP) for the installation and operation of the proposed asphalt plant is prepared since the original ESIA for the expressway 1 has determined that asphalt will be transported to the site from existing asphalt plants to the rehabilitation sites. During the rehabilitation process, it was agreed with the Owner Engineer that transporting asphalt all this distance will degrade the asphalt quality and it is technically more appropriate to establish an onsite asphalt plant. Since this has not been covered in the Expressway 1 ESIA, The World Bank requested to prepare an ESMP for this new activity in compliance with the World Bank’s Operational Policy 4.01.
This ESMP presents the potential negative and positive environmental and social impacts of the installation and operation of the asphalt plant to meet the project requirements. Site survey and baseline information collection activities, review of plant specifications and characteristics, eco system surrounding analysis, expected pollutant effluent characterization and analysis, and expected negative impacts on the environmental as well as workers ‘occupational health and safety during plant installation and operation phases were conducted. The potential environmental impacts of the project activities were identified, assessed, and documented. A number of mitigation measure actions were also presented to reduce or eliminate any possible negative environmental impacts.

Both the Iraqi and World Bank's social safeguard policies and the Iraqi EIA legislations have been considered during the evaluation, assessment and proposed mitigation recommendations made in this study. The ESMP study has been carried out according to the requirements of the WB operation policy 4.01 on environmental assessment.

The analysis of the environmental impacts resulting from the construction and operation phases of the asphalt plant include:

- air pollutants in the form of particulate matters and gases
- noise pollution.
- solid waste and
- wastewater generation from the workers and operators of the plant.
The study reached to a conclusion that, the asphalt plant proposed installation location meets the environmental operation requirements and that it is located at a very far distance from any residential or population inhabited area which minimize any negative impacts that may result from the plant operation. The plant location is also served by several surrounding roads and expressway junctions that can benefit the process of raw material transportation and asphalt material delivery at minimum impacts and avoidance of any road safety hazards. The expected negative impacts of the asphalt plant installation and operation have been evaluated and assessed and found to be of low to moderate negative environmental impacts. With proper mitigation measures those negative identified impacts can be minimized to the minimum level.
1. Introduction

1.1 Background

TERNA S.A –Iraq was assigned by the Roads and Bridges Directorate–Iraq to execute the Rehabilitation of expressway No.1 Section (R7) project. This is a 145 Km project extending between Nasiriya and Rumaila in the southern part of Iraq. The expressway is 23 years of age and consists of a 3*3 Lane with a standing lane of approximate (15.5 m width). Figure (1.1) shows the expressway route.

Figure (1.1) Expressway No.1 Route
The project Maintenance / Rehabilitation activities of Section R7 (Nasiriya – Rumaila) which is assigned to TERNA S.A Iraq branch includes but not limited to:

- Road's marking
- Installation of guardrails between both sides and on sides where necessary
- Road shoulder.
- Installation of signs and road furniture
- Installation of a chain link fence on both sides of the road
- Rehabilitation of the asphalt as needed.

As part of the rehabilitation requirements, TERNA S.A – Iraq is planning to construct and operate an asphalt mixing plant along the expressway to meet the project needs. To meet and satisfy WB environmental protection policy and the Iraqi environmental protection laws and legislation, TERNA S.A-Iraq has assigned a specialized qualified team to carry out an environmental assessment for the proposed asphalt plant.

This report focuses on studying and analyzing the environmental impacts expected from the construction and operation of this plant and proposes the mitigations and actions that need to be taken and considered to protect the surrounding environment. The report also discusses the social impacts of the proposed to be constructed asphalt plant. An Environmental Monitoring plan and schedule are also placed to make sure that all types of expected pollutants coming from the plant’s operations are within the allowable limits and environmental standards.
The aim of the ESMP study is to comply with World Bank’s OP 4.01 and the Iraqi national legislations. Since the Expressway 1 ESIA, which was presented and approved by The World Bank, did not include an assessment for a new asphalt plant, therefore this ESMP covers this gap. Originally, asphalt was planned to be produced and transported to the rehabilitation site from already existing asphalt plants however this proved to be technically and practically not feasible. Therefore, it was agreed with the Owner and Engineer to establish an onsite asphalt plant. This ESMP addresses the impacts and mitigation measures of the construction and operation of the proposed asphalt plant.

The asphalt plant is not operation yet and still under the installation phase. The plant is expected to provide the needed amounts of asphalt for the rehabilitation of the expressway No.1 section R7 project. The commissioning and operation period is expected to be two and half years. The plant is designed to be disassembled at the end of the project and shifted to other projects. The current proposed location of the plant is a wide open area that was used as a storage location for construction materials by private local contractors of the region.

1.2 Objectives of the ESMP report

The main objectives of this ESMP report are:

- Ensuring that potential significant positive and adverse environmental and social impacts of the construction and operation of the asphalt plant are identified;

- Mitigate negative impacts of the asphalt plant and avoid serious and irreversible damage to the surrounding environment and people;
Place a monitoring plan for the proposed construction and operation of the plant to help ensure that the pollutants are within acceptable limits and environmental standards;

Comply with the World Bank OP4.01 and Iraqi national legislations.

1.3 Approach and Methodology

The approach of the study will be according to the following steps:

- Conduct several visits with the team of experts, to the site for carrying out site reconnaissance and baseline data collection;
- Assess the potential environmental and social impacts of the project in the study area by carrying out baseline surveys;
- Assess risks and hazards associated with the project activities;
- Compare the impacts in relation to relevant national and international requirements and guidelines;
- Develop screening criteria for acceptability of project intervention from environmental and social aspects;
- Develop an environmental and social management plan for the mitigation of the potentially negative impacts and for monitoring compliance with the relevant environmental laws.
2. Project Description

2.1 Background

The Government of the Republic of Iraq represented by the Ministry of Construction and Housing (MOCH) / State Commission for Roads & Bridges (SCRB) had approved a program to maintain and rehabilitate of Iraq expressway NO.1 section (7) and section (8). As part of this process an asphalt plant is a plant used for the manufacture of asphalt, macadam and other forms of coated road stone, sometimes collectively known as blacktop or asphalt concrete.

2.2 Project components

The asphalt plant will consist of different compounds. The plant will be used for mixing the dry warm aggregate, padding and asphalt for homogeneous mixture at the required temperature. Asphalt is widely used for the construction of highway, city roads and parking lots. Figure (1.2) shows the main components of a standard asphalt plant.

Figure (1.2) Typical components of asphalt plants
In general, there are two types of asphalt plants, batch heater and continuous. The type which will be used in this project is the “batch heater”. In batch heater type, the plant runs material from various cold feed hoppers into a heated drum, where the batch is then heated up to temperature. The hot aggregate is screened into numerous hot bins (depending on the various aggregate sizes). Each hot bin releases a certain amount of aggregate into a weigh hopper, then it is discharged into a mixing drum where (dry) filler and binder are added. The blend is mixed and discharged either directly into the delivery vehicles or into a small weighing and collecting hopper.

To increase throughput, the heater can be heating the next batch while the previous is being mixed. Capacity is usually of the order of tens of tons per hour. The batch heater plant is used where short production runs are common (a different recipe can be used in each mix) or where total volume is low. Mobile batch heaters are available. Meanwhile, in the asphalt drum mix plant (also called continuous asphalt plant) there is a set of machine that produces asphalt. The asphalt drum mix plant produces asphalt in a continuous way.

The Asphalt plant which will be used by Terna S.A Iraq for the road works of Section (R7) of expressway No.1 is a (AMMANN) German fabricated plant and site installed with 160 Ton / Hour capacity. The specifications and details of the asphalt components and its environmental control and prevention details include the following
• Control Room:
• Raw Materials Storage Hooper’s (5 NOS)
• Transform Belt (20 M Length)
• Dryer
• Hot Material Elevator
• Materials Screen
• Weighing Tanks
• Mixer
• Storage Silo (20 Ton)
• Weighing Dumber
• Asphalt storage tanks (5NOS)
• Polymer Storage tanks (2 NOS)
• Polymer Mix Machine.
• Electric Generators 630 KV (1 NOS)
• Electrical Generator 700 kV (1 NOS)
• Electrical Generator 65 kiva (1 NOS)
• Gas Fuel Tanks (2 NOS)
• Chemical Storage Containers (2 NOS)
• Spare Parts Storage Containers (2 NOS)
• Office Porte cabins (2 NOS)
• Air and Dust Filter System.

Figure (1.3) shows a sketch for the TERNA S.A asphalt plant layout and components. Meanwhile Figure (1.4) shows the different parts and compounds of the asphalt plant. Its benefit to clear that, the plant is under installation.
Figure (1.3) TERNA S. Asphalt plant Layout
Rehabilitation of Expressway No.1 Section (R7) Nasiriya –Rymaila Project
Environmental and Social Management Plan (ESMP) for Section R7 Asphalt plant

Administration and Management offices

Generators and Fuel Storage area

Raw Materials Loading Zone

Elevation Tower and Clio
Figure (4) Compounds of TERNA S.A Iraq R7 Asphalt plant
2.3 Plant Location

Selecting the plant location is a crucial process due to its significant social and environmental impact on the society. Choosing the plant location has gone through certain procedure in order to come up with the best sustainable and eco-environmentally location. The criteria followed in choosing the plant location was based on the following:

- The proximity to the R7 location;
- The proximity to fuel source;
- The proximity to raw materials (gravel, sand, Bitumen, etc.);
- The proximity to access roads and means of transportation;
- Avoiding construction on farm lands,
- Flat topography as a preferable condition for construction and operation,
- Available Land Area.
- To be preferably under the prevailing wind direction.

The asphalt plant is located 1 Km away from the right side of expressway No.1 (Basra – Baghdad) lane. The plot which is to allocate the asphalt plant is approximately 25,000 m$^2$ in area and is of 40 Km distance from the city of Nasiriya. The closest populated town is SUQ AL SHUQE which is about 20 KM from the asphalt plant. The plant plot is about 1-2 m below expressway No.1 Road level.
TERNA S.A-Iraq proposal to install this asphalt plant to meet the requirements for the maintenance / rehabilitation urgent demands of expressway No. 1 – Section R7. Providing asphalt mixes at different designs and specifications in large and continues quantities is an essential factor in road projects.

This plant will ensure that the asphalt needs for the project is delivered on time and in the required specifications. The project is at mobilization phase with some cleaning activities along the expressway and some activities for old post guard rail removal. No operation activity in regards to asphalt plant operation or mixing has been made at this current stage and installation and mobilization activities are ongoing.

The asphalt plant plot described above was selected for many reason such a:

- Its intermediate location between the 145 Km (R7) section. This locations will ensure minimum driving distance to asphalt delivery along the project length. This will ensure the lowest fuel burning and emission discharges from trucks and company vehicles.

- The location is close to a crossing bridge over expressway No.1. This crossing will ensure that loaded asphalt and raw materials trucks cross between the two sideways of the expressway in a safe manner and with avoidance to any road closure or obstacles.

- The location is far away from any populated or uses area and thus ensures prevention of pollution exposure to any residence.

- The site is linked with paved roads that can ensure ease of raw material deliveries. There is an approved raw material borrow pit of
about 300 km distance. This again will achieve minimum distance travel and lower emissions.

• The proposed plot for asphalt plant installation is an open wide desert area. The plot is owned by a local citizen and considered as a private property and was rented to Terna S.A upon a mutual rent agreement. The plot was previously used by the local land owner to stock and store some construction materials.

Figure (1.5) shows a satellite image of the proposed site plot location for the asphalt plant.

![Satellite image of the asphalt plant location](image)

**2.4 Water and Fuel supply**

No water is required for the process of asphalt plant operations. However there will be a need to supply water for the purpose of domestic consumption of the plant workers and for the purpose of sprinkling to stabilize soils and prevent dust emissions. The domestic water will be abstracted from an authorized network point near the city of Nasiriya and transported to the site using large
water tankers (size 10,000 Liters). Water will be stored in PVC tanks above the ground and is suitable for use for non-drinking purposes. Meanwhile, drinking water will be provided in the form of plastic disposable bottles.

The estimated quantity of water needed for domestic purposes is about 5,000 liters.

Bottled water for drinking will be provided to the site through suppliers (commercial drinking water bottles), Meanwhile domestic water for, washing, bathing, and other purposes is shifted through large water tankers (10,000 L ) to the site and the camp from a source of water supplier (The water tankers will bring the water from authorized taking points near the city of Nasiriyah and stored on site in special water tankers installed for this reason). The estimated daily consumption of domestic water is 5,000 L for about 20 workers.

The asphalt plant uses electricity as the main source of energy. The electricity will be generated from one diesel generators of 700KV capacity (A standby generator will also be available on site). Therefore fuel requirements for the plant (Diesel fuel for generators and operating plant equipment’s) will be brought from the nearest fuel station (Near Nasiriyah City) by fuel tankers and stored in fuel tanks at the plant. The fuel tanks will be surrounded by barriers to prevent any fuel spills in case of accidental leakage. Firefighting equipment's will be installed and safety measures will be placed and taken to reduce risk hazards and implement occupational safety measures. The estimated diesel fuel consumption for asphalt plant operation is 12 liters of diesel fuel per one ton of asphalt produced.

2.5 Raw Materials supplemental

The proposed asphalt plant will use raw construction materials for the production of the approved asphalt mix design. Those raw materials are shifted to the plant location from an approved commercial borrow pit that is located
around 300 km away from the plant location. Those brow pits provide document recites of the material supply which is all then subjected to laboratory tests to meet the resident engineer requirements. A full statement of the raw material approval site is provided at Appendix (1).

Below is the list of the raw materials needed for the asphalt plant operation:

- SPS polymer material (Italian Production- 20 kg bags). Will be procured and shifted to site and stored at proper stores with environmental and safety requirements.
- BITUMEN 40-50 from Governmental ALNASRIYA Bitumen Plant.
- Cement Filler from Governmental SAMAWA cement plant.
- Crushed aggregate 5-19 mm from commercial ALNIBAA borrows pit.
- Crushed aggregate 5-25 mm from JILAT commercial supply brow pit.
- Sand from JILAT commercial supply borrow pit.

Note / All the listed materials above are being sourced from existing, governmental and/or commercially operating and viable suppliers and no newly developed borrow pit or any other facilities have been established for the purpose of the use of this plant.

3. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK
This assessment has taken into consideration, both the potential Iraqi environmental valid laws and regulations and those policies and procedures of the World Bank related to the project. The World Bank Group General EHS Guidelines attached in Appendix (II) which are related to project activities will apply. These legal frameworks include:

### 3.1 Iraqi Environmental Laws and Regulations

The relevant environmental laws included in the Iraqi Environmental Protection Act are:

- **Environment Protection and Improvement Law (Law No.27), 2009.** This law outlines the responsibility in case of pollution of the environment, monitoring and assessments of impacts, and the restriction concerning any activities which can potentially cause pollution. Article 9 prescribes that all the development projects shall be implemented with the appropriate countermeasures and monitoring systems for the mitigation of environmental impacts. Article (No. 10) shows the contents to be included in the EIA and prescribes that an EIA has to be carried out in a feasibility study in all the development projects in spite of the category.

- **System No. (25) 1967 - Maintenance of rivers and public water from pollution.** This system contains instructions concerning the quantity of chemicals and material allowed to be discharged into a water body. However, in this project the sewage resulted from camp is collected in holding tanks and then shifted to an approved by municipality sewage treatment plant to be treated. Appendix (III)
Table (2-1):- Iraqi national wastewater discharge limits to sewerage network (3)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>WASTEWATER DISCHARGED SEWERAGE NET WORK</th>
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<td>Temperature, °C</td>
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</tr>
<tr>
<td>Suspended Solid</td>
<td>750</td>
</tr>
<tr>
<td>pH</td>
<td>6-9.5</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>-</td>
</tr>
<tr>
<td>BOD</td>
<td>1000</td>
</tr>
<tr>
<td>COD (CrO method)</td>
<td>-</td>
</tr>
<tr>
<td>Cyanide CN⁻</td>
<td>0.5</td>
</tr>
<tr>
<td>Fluoride F⁻</td>
<td>10</td>
</tr>
<tr>
<td>Free Chlorine</td>
<td>100</td>
</tr>
<tr>
<td>Chloride Cl⁻</td>
<td>*a) &lt;1%</td>
</tr>
<tr>
<td>Phenol, Ph</td>
<td>*b) 600 mg/L</td>
</tr>
<tr>
<td>Sulphate SO₄</td>
<td>**a) &lt;1%</td>
</tr>
<tr>
<td>Nitrate NO₃</td>
<td>**b) &lt;400 mg/L</td>
</tr>
<tr>
<td>Phosphate PO₄⁻</td>
<td>**c) 200 mg/L</td>
</tr>
<tr>
<td>Ammonium NH₄⁺</td>
<td>-</td>
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<tr>
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<tr>
<td>Arsenic</td>
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<tr>
<td>Copper</td>
<td>-</td>
</tr>
<tr>
<td>Nickel</td>
<td>0.01</td>
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<tr>
<td>Selenium</td>
<td>-</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.001</td>
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<tr>
<td>Cadmium</td>
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### Table of Chemical Concentrations

<table>
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<th>Element</th>
<th>Concentration</th>
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<tbody>
<tr>
<td>Zinc</td>
<td>0.1</td>
</tr>
<tr>
<td>Chromium</td>
<td>0.1</td>
</tr>
<tr>
<td>Aluminum</td>
<td>20</td>
</tr>
<tr>
<td>Barium</td>
<td>0.1</td>
</tr>
<tr>
<td>Boron</td>
<td>1.0</td>
</tr>
<tr>
<td>Cobalt</td>
<td>0.5</td>
</tr>
<tr>
<td>Iron</td>
<td>15</td>
</tr>
<tr>
<td>Manganese</td>
<td>-</td>
</tr>
<tr>
<td>Silver</td>
<td>0.1</td>
</tr>
<tr>
<td>Barium</td>
<td>4.0</td>
</tr>
<tr>
<td>Boron</td>
<td>1.0</td>
</tr>
<tr>
<td>Cobalt</td>
<td>0.5</td>
</tr>
<tr>
<td>Total Hydrocarbons and its compound</td>
<td>Note***</td>
</tr>
<tr>
<td>Sulphide S²⁻</td>
<td>3</td>
</tr>
<tr>
<td>Ammonia</td>
<td>10</td>
</tr>
<tr>
<td>Ammonia gas</td>
<td>6</td>
</tr>
<tr>
<td>Sulphur Dioxide</td>
<td>7</td>
</tr>
<tr>
<td>Petroleum Alcohol</td>
<td>-</td>
</tr>
<tr>
<td>Calcium Carbonate</td>
<td>-</td>
</tr>
<tr>
<td>Organic Solvent</td>
<td>-</td>
</tr>
<tr>
<td>Benzene</td>
<td>0.5</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>0.1</td>
</tr>
<tr>
<td>TNT</td>
<td>0.5</td>
</tr>
<tr>
<td>Bromine</td>
<td>3.1</td>
</tr>
</tbody>
</table>

**Notes:**

* Chloride Cl⁻

** sulphate SO₄²⁻

*a) When the ratio of the amount of the discharged water to the water source is (1:1000) or less

*b) When the ratio of the amount of the discharged water to the water source is more than (1:1000)
*c) When the ratio of the amount of the discharged water to the water source is less than 200 mg/L, then each case should be studied by responsible authority for executing this regulation.

***Total Hydrocarbons and their compounds:--It is allowed to discharge Hydrocarbons materials to the water source according to concentration limits shown below in condition that these concentrations must be measured before the point of mixing with water source.

- Standards of emissions for activities and projects (No. 3, 2012). The document includes national standards for air quality. These standards are listed in Tables (2.2 and 2.3).

**Table (2.2):** Iraqi national standards for emission air quality (maximum limit for fixed sources).\(^{(4)}\)

<table>
<thead>
<tr>
<th>AIR POLLUTANTS</th>
<th>SYMBOL</th>
<th>SOURCE OF EMISSION</th>
<th>MAX. LIMIT OF EMISSION MG/NM(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoke and visible contaminant emission</td>
<td></td>
<td>Combustion or burning source</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other sources</td>
<td>0.0</td>
</tr>
<tr>
<td>Opacity</td>
<td></td>
<td>All sources</td>
<td>20.0%</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>CO</td>
<td>All sources</td>
<td>500</td>
</tr>
<tr>
<td>Oxide of Nitrogen (measured as NO(_2))</td>
<td>NO(_x)</td>
<td>Combustion or burning source</td>
<td>70-500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Materials production</td>
<td>1000</td>
</tr>
<tr>
<td>Sulphur dioxide</td>
<td>SO(_2)</td>
<td>Combustion or burning source</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Materials production</td>
<td>2000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other sources</td>
<td>1000</td>
</tr>
<tr>
<td>Tri-sulphur oxide (including fog of sulphuric acid, measured as SO$_3$)</td>
<td>SO$_3$</td>
<td>Materials production</td>
<td>150</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>--------</td>
<td>----------------------</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other sources</td>
<td>50</td>
</tr>
<tr>
<td>Total suspended particulates</td>
<td>TSP</td>
<td>Combustion or burning source</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cement production</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cement production</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other sources</td>
<td></td>
</tr>
<tr>
<td>Ammonia and ammonium compounds</td>
<td></td>
<td>Materials production</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other sources</td>
<td>10</td>
</tr>
<tr>
<td>Benzene</td>
<td>C$_2$H$_2$</td>
<td>All sources</td>
<td>5</td>
</tr>
<tr>
<td>Iron</td>
<td>Fe</td>
<td>Iron and steel factory</td>
<td>100</td>
</tr>
<tr>
<td>Lead and lead complex</td>
<td>Pb</td>
<td>All sources</td>
<td>5</td>
</tr>
<tr>
<td>Antimony and Antimony complex</td>
<td>Sb</td>
<td>Materials production</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other sources</td>
<td>1</td>
</tr>
<tr>
<td>Arsine and Arsine complex</td>
<td>As</td>
<td>All sources</td>
<td>1</td>
</tr>
<tr>
<td>Cadmium and Cadmium complex</td>
<td>Cd</td>
<td>All sources</td>
<td>1</td>
</tr>
<tr>
<td>Mercury and Mercury complex</td>
<td>Hg</td>
<td>All sources</td>
<td>0.5</td>
</tr>
<tr>
<td>Chromium and chromium complex</td>
<td>Cr</td>
<td>All sources</td>
<td>5</td>
</tr>
<tr>
<td>Nickle and Nickle complex</td>
<td>Ni</td>
<td>All sources</td>
<td>1</td>
</tr>
<tr>
<td>Copper</td>
<td>Cu</td>
<td>All sources</td>
<td>5</td>
</tr>
<tr>
<td>Hydrogen sulphide</td>
<td>H$_2$S</td>
<td>Materials production</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other sources</td>
<td>5</td>
</tr>
<tr>
<td>Material</td>
<td>Source</td>
<td>Emission Source</td>
<td>Max. Limit</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------</td>
<td>-----------------</td>
<td>------------</td>
</tr>
<tr>
<td>Chloride (Cl)</td>
<td>Chloride production</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other sources</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Hydrogen fluoride (HF)</td>
<td>All sources</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Hydrogen chloride (HCl)</td>
<td>Chloride production</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other sources</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Silicon fluoride (SiF₄)</td>
<td>All sources</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Fluoride (include HF, SiF₄)</td>
<td>Aluminum smelter</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other sources</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Formaldehyde (CH₂O)</td>
<td>Materials production</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other sources</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Carbon (C)</td>
<td>Materials production</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other sources</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Volatile Organic Compounds (VOC)</td>
<td>All sources</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Dioxin and Furans</td>
<td>All sources</td>
<td>1 (ngTEQ/m³)</td>
<td></td>
</tr>
</tbody>
</table>

Notes:

1. Combustion or burning sources mean burners and boilers of oil and petro-chemical industries or manufacture and power station. Materials production means structural industries, chemical industries and dye industries.
2. The concentration of any materials in the second column emitted from any sources in the third column must not exceed the Max. limit specified in the fourth column at any point and before mixing with air, smoke, and other gases.
3. The limit of smoke and visible emission, must not use with water vapor, and not for starting or shut downing burning.
4. The allowable Max. limit of NOₓ for turbine unit working with gas that constructed before this law was adopted is 125 mg/Nm³.
5. Measuring TSP emitted from a burning source measured at 12% of CO₂ as a reference.
6. Standard cubic meter is cubic meter of gas at 25°C and 760 mm/Hg.
7. The Overall concentration of heavy metals (Pb, Cd, Cr, Ni, Hg, Cu, As, Sb) in any measurement must not exceed 5 mg/Nm³).
8. The limit of VOC is for unburned hydrocarbons.
9. The limit for all contaminants except Dioxin and Furans must be estimated for 24
hours as an average basis while for Dioxin and Furans it must be estimated for 6-8 hrs.

10. The concentration of any materials in the second column must be measured according to the standard methods of American Environmental Protection Agency (USEPA).

*TEQ: Toxic Equivalent.

### Table (2.3):- Iraqi national standard for ambient air quality

<table>
<thead>
<tr>
<th>POLLUTANTS</th>
<th>PERIOD OF MEASUREMENT</th>
<th>LIMITATION VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO(_2)</td>
<td>1 hr</td>
<td>0.1 ppm</td>
</tr>
<tr>
<td></td>
<td>24 hr</td>
<td>0.04 ppm</td>
</tr>
<tr>
<td></td>
<td>1 yr</td>
<td>0.018 ppm</td>
</tr>
<tr>
<td>CO</td>
<td>1 hr</td>
<td>35 ppm</td>
</tr>
<tr>
<td></td>
<td>8 hr</td>
<td>10 ppm</td>
</tr>
<tr>
<td>NO(_2)</td>
<td>1 hr</td>
<td>0.04 ppm</td>
</tr>
<tr>
<td></td>
<td>24 hr</td>
<td>0.05 ppm</td>
</tr>
<tr>
<td>O(_3)</td>
<td>1 hr</td>
<td>0.06 ppm</td>
</tr>
<tr>
<td>PM(_{10})</td>
<td>24 hr</td>
<td>150 µg/m(^3)</td>
</tr>
<tr>
<td>PM(_{2.5})</td>
<td>1 hr</td>
<td>15 µg/m(^3)</td>
</tr>
<tr>
<td></td>
<td>24 hr</td>
<td>65 µg/m(^3)</td>
</tr>
<tr>
<td>Total suspended solid (TSP)</td>
<td>1 hr</td>
<td>150 µg/m(^3)</td>
</tr>
<tr>
<td></td>
<td>24 hr</td>
<td>350 µg/m(^3)</td>
</tr>
<tr>
<td>Dusting falling</td>
<td>30 day</td>
<td>Residential area: 10 T/km(^2)/month</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Industrial area: 10 T/km(^2)/month</td>
</tr>
<tr>
<td>HC</td>
<td>3 hr</td>
<td>160 µg/m(^3)</td>
</tr>
<tr>
<td>Pb</td>
<td>24 hr</td>
<td>2 µg/m(^3)</td>
</tr>
<tr>
<td></td>
<td>3 month</td>
<td>1.5 µg/m(^3)</td>
</tr>
<tr>
<td></td>
<td>1 yr</td>
<td>1 µg/m(^3)</td>
</tr>
<tr>
<td>Gasoline</td>
<td>1 yr</td>
<td>0.03 µg/m(^3)</td>
</tr>
<tr>
<td>Dioxane</td>
<td>1 yr</td>
<td>0.6 p g/m(^3)</td>
</tr>
</tbody>
</table>
- Noise Control Law No. (41) for the year 2015. This law includes national standards for noise level. These standards are listed in Table (2.4).

**Table (2.4):** Iraqi national standard for noise level.\(^{(5)}\)

<table>
<thead>
<tr>
<th>RECEPTOR</th>
<th>MAXIMUM ALLOWABLE LOG EQUIVALENT IN DB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day (07:00 – 22:00 hr) Night (22:00 – 07:00 hr)</td>
</tr>
<tr>
<td>Industrial</td>
<td>70</td>
</tr>
</tbody>
</table>

- Environmental Standard Instructions for project construction and monitoring their correct application (NO.3, 2011). This legislation includes environmental instructions for Industrial, agricultural and service projects. The document includes an explanation of site determinations, environmental requirements, master plan outlines, classifications of pollution sources and activities.

According to this legislation, the asphalt factory classify as class (A) "Projects which may have a significant impact on the environment And thus require a complete environmental assessment" and subjected to article (No.18) shows the contents to be included in the EIA of asphalt which includes the following constraints:

1. Constructed it outside municipality boarder and population cities by (5) km as minimum and by (1 Km) m outside general road and in suitable places.

2. Achieve of treatment means for gases and particulate emission from according to national standard for air pollutants.
3.2 Other relevant Iraqi environmental laws:

- Law no. 2 for the year 2014: Protection of the Environment from Municipal Wastes.

3.3 World Bank Safeguard Policies

The objective of the World Bank's environmental and social safeguard policies is to prevent and mitigate undue harm to people and their environment in the development process. These policies provide guidelines for the bank and borrowers in the identification, preparation, and implementation of programs and projects. Safeguard policies have often provided a platform for the participation of stakeholders in project design, and have been an important instrument for building ownership among local populations.

The World Bank's environmental assessment policy and recommended processes are described in Operational Policy (OP) /Bank Procedure (BP) 4.01: Environmental Assessment. Its purpose is to improve decision making, to ensure that project options under consideration are sound and sustainable, and that potentially affected people have been properly consulted.

Environmental review begins with identifying the seriousness of the potential harm. The Bank screens all new projects and assigns each one of four categories based upon the character, dimension, and the sensitivity of the environmental issue. These categories are similar in Iraqi legislation (NO.3, 2011) which is:

**Category A:** Projects which may have a significant impact on the environment And thus require a complete environmental assessment.


**Category B:** Projects that may only have limited specific environmental effects which should be investigated, but do not necessarily require an in-depth environmental assessment.

**Category C:** Projects for which an environmental analysis is not normally necessary e.g. education; family planning; health; nutrition; institutional development; technical assistance; and human resource projects.

For those projects for which a full EIA is not required, but are in need of some environmental analysis (Category B), an Environmental Mitigation or Environmental Management Plan often will suffice (these are also prepared for category A projects as a part of the full EIA). The Bank’s requirement for mitigation plans includes: a description of all adverse environmental impacts; a description and technical details for each mitigation measure; the assignment of responsibilities for carrying out the mitigation measures; an implementation schedule for the mitigation measures; monitoring and reporting procedures; and; cost estimates.

This project, installation, operation and decommissioning of Batch Heat Asphalt Plant is identified as a Category B project, which requires the preparation of a site specific Environmental and Social Management Plan.

The World Bank (WB) has identified 10 environmental and social safeguard policies that should be considered in its financed projects. The proposed project is classified as Category B according to the World Bank. This mandates a site specific Environmental and Social Management Plan (ESMP).
World Bank Safeguard Operational Policies and
It’s applicability to the proposed project

<table>
<thead>
<tr>
<th>Safeguard Policy</th>
<th>Triggered</th>
<th>Justifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Assessment (OP/BP 4.01)</td>
<td>Yes</td>
<td>The project is classified as Category B which requires limited environmental assessment.</td>
</tr>
<tr>
<td>Natural Habitats (OP/BP 4.04)</td>
<td>No</td>
<td>Location of the project is in a desert environment which has no ecological importance or sensitive habitats.</td>
</tr>
<tr>
<td>Forests (OP/BP 4.36)</td>
<td>No</td>
<td>Proposed project areas contain No forests.</td>
</tr>
<tr>
<td>Pest Management (OP 4.09)</td>
<td>No</td>
<td>The proposed project will not involve purchasing or using Pesticides.</td>
</tr>
<tr>
<td>Physical Cultural Resources (OP/BP 4.11)</td>
<td>No</td>
<td>No physical or cultural resources are present in or near the project site.</td>
</tr>
<tr>
<td>Indigenous Peoples (OP/BP 4.10)</td>
<td>No</td>
<td>No indigenous people are identified in or near the project site.</td>
</tr>
<tr>
<td>Involuntary Resettlement (OP/BP 4.12)</td>
<td>No</td>
<td>The land chosen for erecting the asphalt plant is state owned and free of any occupants. The site is non-occupied desert land with no sign of prior use. No livelihoods are affected due to absence of any economic activities within or near the project site. No population will be affected by the erection or operation of the asphalt plant.</td>
</tr>
<tr>
<td>Safety of Dams (OP/BP 4.37)</td>
<td>No</td>
<td>Not relevant to the proposed project</td>
</tr>
<tr>
<td>Projects on International Waterways (OP/BP 7.50)</td>
<td>No</td>
<td>Not relevant to the proposed project</td>
</tr>
<tr>
<td>Projects in Disputed Areas (OP/BP 7.60)</td>
<td>No</td>
<td>Not relevant to the proposed project</td>
</tr>
</tbody>
</table>

**OP 4.01 – Environmental Assessment**

According to the World Bank Operational Policy OP 4.01, the erection and operation of the temporary asphalt plant are classified as a category B project which is likely to have limited adverse environmental impacts. The environmental impacts that are likely to be caused by the project shall be analyzed in this study. Mitigation measures shall be identified for all expected negative impacts in addition to outlining specific environmental monitoring activities.

**3.4 World Bank Emission Levels**

Unless the Iraqi regulations are more stringent, World Bank emission levels will prevail.
3.4.1 Atmospheric Emissions

In addition to the Iraqi limitations for ambient air; the World Bank and International Finance Corporation (IFC) for Ambient Air Quality Objective limitations are recommended by ESIA team; Table (2.5).

**Table (2.5):- Ambient air quality.**

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>GUIDELINE VALUE (µG/M³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO₂</td>
<td>Maximum 24-hour average</td>
</tr>
<tr>
<td></td>
<td>Interim target 1: 125</td>
</tr>
<tr>
<td></td>
<td>Interim target 2: 50</td>
</tr>
<tr>
<td></td>
<td>Guideline: 20</td>
</tr>
<tr>
<td></td>
<td>10 minutes average</td>
</tr>
<tr>
<td></td>
<td>500</td>
</tr>
<tr>
<td>NO₂</td>
<td>1-Year average</td>
</tr>
<tr>
<td></td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>1-hour average</td>
</tr>
<tr>
<td></td>
<td>200</td>
</tr>
<tr>
<td>PM₁₀</td>
<td>1-year average</td>
</tr>
<tr>
<td></td>
<td>Interim target 1: 70</td>
</tr>
<tr>
<td></td>
<td>Interim target 2: 50</td>
</tr>
<tr>
<td></td>
<td>Interim target 3: 30</td>
</tr>
<tr>
<td></td>
<td>Guideline: 20</td>
</tr>
<tr>
<td></td>
<td>24-hour average</td>
</tr>
<tr>
<td></td>
<td>Interim target 1: 150</td>
</tr>
<tr>
<td></td>
<td>Interim target 2: 100</td>
</tr>
<tr>
<td></td>
<td>Interim target 3: 75</td>
</tr>
<tr>
<td></td>
<td>Guideline: 50</td>
</tr>
<tr>
<td>PM₂₅</td>
<td>2-year average</td>
</tr>
<tr>
<td></td>
<td>Interim target 1: 35</td>
</tr>
<tr>
<td></td>
<td>Interim target 2: 25</td>
</tr>
<tr>
<td></td>
<td>Interim target 3: 15</td>
</tr>
<tr>
<td></td>
<td>Guideline: 10</td>
</tr>
<tr>
<td></td>
<td>24-hour average</td>
</tr>
<tr>
<td></td>
<td>Interim target 1: 75</td>
</tr>
<tr>
<td></td>
<td>Interim target 2: 50</td>
</tr>
<tr>
<td></td>
<td>Interim target 3: 37.5</td>
</tr>
<tr>
<td></td>
<td>Guideline: 25</td>
</tr>
<tr>
<td>Ozone</td>
<td>8-hour daily maximum</td>
</tr>
<tr>
<td></td>
<td>Interim target: 160</td>
</tr>
<tr>
<td></td>
<td>Interim target: 100</td>
</tr>
</tbody>
</table>

Notes:
- World Health Organization (WHO). Air Quality Guideline Global Update, 2005. PM 24-hr value is the 99th percentile.
- Interim target is provided in recognition of the need for a staged approach to achieve the recommended guidelines.

3.4.2 Noise
Since there is no near residential area and the region around the asphalt plant is industrial with petroleum oil production as a dominant activity, so the limits for ambient noise which is considered as maximum allowable limits in the present study is 70 dB(A) as specified by WB, WHO and Iraqi local standards for industrial noise pollution at outdoor regions during day time as in Table (2.6).

**Table (2.6):- Ambient Noise Levels Standards**

<table>
<thead>
<tr>
<th>RECEPTOR</th>
<th>MAXIMUM ALLOWABLE LOG EQUIVALENT IN DB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day (07:00 – 22:00 hr)</td>
</tr>
<tr>
<td>Industrial</td>
<td>70</td>
</tr>
</tbody>
</table>

**3.4.3 Solid Wastes**

Because the Iraqi Environmental Protection Act does not provide strict guidelines for waste in general, World Bank standards are used.

**3.4.4 Sewage**

Two sections of the IFC general HSE guidelines, namely section 1.3 ‘Wastewater and Ambient Water Quality’ and section 1.4 ‘Water Conservation’ have been considered for this project.
Table (2-7):- Indicative Values for treated Sanitary Sewage Discharge

<table>
<thead>
<tr>
<th>Pollutants</th>
<th>Units</th>
<th>Guideline Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>pH</td>
<td>6 – 9</td>
</tr>
<tr>
<td>BOD</td>
<td>mg/l</td>
<td>30</td>
</tr>
<tr>
<td>COD</td>
<td>mg/l</td>
<td>125</td>
</tr>
<tr>
<td>Total nitrogen</td>
<td>mg/l</td>
<td>10</td>
</tr>
<tr>
<td>Total phosphorus</td>
<td>mg/l</td>
<td>2</td>
</tr>
<tr>
<td>Oil and grease</td>
<td>mg/l</td>
<td>10</td>
</tr>
<tr>
<td>Total suspended solids</td>
<td>mg/l</td>
<td>50</td>
</tr>
<tr>
<td>Total coliform bacteria</td>
<td>MPN / 100 ml</td>
<td>400a</td>
</tr>
</tbody>
</table>

Notes:
  a. Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation.
  b. MPN = Most Probable Number

3.5 Emission Thresholds Limits

The current ESIA presents the Iraqi and World Bank emission thresholds limits and standards. The more strict thresholds limits of any of the expected pollutant emissions will be applied in the assessment, monitoring and mitigation actions followed through. However, for wastewater which is limited to domestic uses, as mentioned before it will be collected in a holding tank then transferred regularly to AL NASRIYA city sewage treatment plant where Terna S.A had obtained a written approval from the local municipality to dispose of the collected sewage waters from its facilities.
3.6 Multilateral Environmental Agreements

International Environmental Agreements already ratified by the Federal Government of Iraq, which are relevant to the project, are:

- Kyoto Protocol (Green House Gases Emissions) on Climate Change, 1997.

3.7 Related Institutions and Legal Bodies

The related institutions related to the installation of an asphalt plant are listed as below:

- Ministry of Health and Environment.
- Ministry of Planning.
- NASRIYA Local Authority.

According to those laws an environmental register is to be established for this project. This register will document all the environmental impacts and aspects that the project poses during construction and operation phases. This document should contain the following information:

- Type and amount of releasing pollutants from the project activities and the allowable limits.
- Project activity's description and the expected pollutants potentials from those activities.
- Details of mitigation actions that is required for environment and personal protection.
• Environmental monitoring plan and schedule.
  Periodic test and analysis results for pollution measurements with specific timings and sampling location identification.

• Names of personals and staff responsible for environmental and personal protection.
  In the case of any environmental violation or pollution break proper reporting should be made to the authorized bodies in the form of an official registered letter. The letter should explain the contamination case, source, effects and the mitigations taken to reduce its negative impacts on the environment. This environmental monitoring register is to be available at site management and can be reviewed and inspected by the authorized officials at any time.

  In addition a sign board is to be prepared and hanged at the project facility containing the maximum allowable limits of all expected pollutants and contaminates resulting from project activities.

3.8 Gap analysis for key environmental concerns: Iraqi laws and WB Policies

Tables below summarized the comparison between Iraqi and WB standards for different parameters that related to the present project. Its benefit to mention that, the strictest limits will be applied.

Table (2.8): Air Quality

<table>
<thead>
<tr>
<th>Requirements of Iraqi legislation</th>
<th>Requirements of WB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reference</strong></td>
<td><strong>Inflections</strong></td>
</tr>
<tr>
<td>Article No. 4 for the year 2012</td>
<td>Ambient Air Protection from Pollution</td>
</tr>
<tr>
<td></td>
<td>IFC GENERAL EHS GUIDELINES</td>
</tr>
<tr>
<td>Environmental Determinates for projects constructions, No.3, 2011</td>
<td>States that it is not allowed using the Asphalt mixing units at a distance less than 1000 m away</td>
</tr>
</tbody>
</table>
Table (2.9): Max. Emission allowable limit for Asphalt mix units (mg/m³)

<table>
<thead>
<tr>
<th>Total VOCs</th>
<th>CO</th>
<th>Total particulate matters</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>250</td>
<td>150</td>
</tr>
</tbody>
</table>

Table (2.10): Indicative limits for air quality

<table>
<thead>
<tr>
<th></th>
<th>Iraqi legislations µg/m³</th>
<th>WB Requirements µg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ambient air parameters</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposure period</td>
<td>Ambient air pollutants threshold</td>
<td>IFC Ambient air pollutants threshold (based on WHO limits)</td>
</tr>
<tr>
<td></td>
<td>1 hr</td>
<td>8 hr</td>
</tr>
<tr>
<td>Carbon monoxide CO µg/m³</td>
<td>43200</td>
<td>12300</td>
</tr>
<tr>
<td>Sulfur dioxide SO₂ µg/m³</td>
<td>282</td>
<td>N/A</td>
</tr>
<tr>
<td>Nitrogen oxides NOₓ µg/m³</td>
<td>81</td>
<td>N/A</td>
</tr>
<tr>
<td>Particulates PM₁₀ µg/m³</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Particulates PM₂.₅ µg/m³</td>
<td>15</td>
<td>N/A</td>
</tr>
<tr>
<td>TSP µg/m³</td>
<td>150</td>
<td>N/A</td>
</tr>
<tr>
<td>Ozone</td>
<td>127</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table (2.11): Water Quality

<table>
<thead>
<tr>
<th>Requirements of Iraqi legislations</th>
<th>Requirements of WB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reference</strong></td>
<td>Inflections</td>
</tr>
<tr>
<td>Standard Specification No. (417) drinking water</td>
<td>Concerning Drinking Water and Standard Methods for Testing and Analysis.</td>
</tr>
<tr>
<td>Water Conservation System No. 2 of 2001</td>
<td>Maximum limits for draining the processed liquid industrial wastes into freshwater bodies and groundwater reservoirs</td>
</tr>
<tr>
<td>Maintenance of rivers and public water from pollution, No. 25/1967</td>
<td>Controlling the discharge of wastewater into the sewage system and public network</td>
</tr>
</tbody>
</table>
### Table (2.12): Indicative Limits for discharge of liquid effluent into sewer systems

<table>
<thead>
<tr>
<th>Parameters/pollutant</th>
<th>Effluent threshold (Iraqi requirements)</th>
<th>Effluent pollutants threshold (WB requirements)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6-9.5</td>
<td>6 – 9 pH</td>
</tr>
<tr>
<td>BOD mg/l</td>
<td>1000</td>
<td>30</td>
</tr>
<tr>
<td>COD mg/l</td>
<td>-</td>
<td>125</td>
</tr>
<tr>
<td>Total nitrogen mg/l</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>Total phosphorus mg/l</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Oil and grease mg/l</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>Total suspended solids mg/l</td>
<td>750</td>
<td>50</td>
</tr>
<tr>
<td>Total coliform bacteria (Most Probable Number/100 ml)</td>
<td>-</td>
<td>400</td>
</tr>
</tbody>
</table>
Table (2.13): Noise requirements

<table>
<thead>
<tr>
<th>Article</th>
<th>Inflections</th>
<th>Reference</th>
<th>Inflections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise Control Act No. 41 of 2015</td>
<td>Maximum allowable limits for ambient noise intensity</td>
<td>OP 4.01</td>
<td>Ensure the environmental sustainability of investment projects</td>
</tr>
<tr>
<td></td>
<td>Maximum exposure duration</td>
<td>IFC GENERAL EHS GUIDELINES</td>
<td>Maximum increase in background nearest receptor location off-site. Noise limits for different working environments are provided</td>
</tr>
</tbody>
</table>

Table (2.14): Standards and Limits for Ambient Noise

<table>
<thead>
<tr>
<th>Iraqi Law 41/2015 Requirements</th>
<th>Permissible limit for noise intensity (decibel)</th>
<th>Requirements of WB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Area</td>
<td>DAY 7 a.m. to 10 p.m.</td>
<td>NIGHT 10 p.m. to 7 a.m.</td>
</tr>
<tr>
<td>Sensitive Areas (schools- hospitals- public parks- rural areas)</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>Residential areas within the city</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>Residential areas outside the city</td>
<td>55</td>
<td>45</td>
</tr>
<tr>
<td>Residential areas within the industrial zones and vice versa</td>
<td>60</td>
<td>45</td>
</tr>
<tr>
<td>Schools, kindergartens, universities and institutes</td>
<td>55</td>
<td>45</td>
</tr>
<tr>
<td>Industrial zones and public buildings</td>
<td>70</td>
<td>65</td>
</tr>
<tr>
<td>Service and commercial areas</td>
<td>65</td>
<td>60</td>
</tr>
<tr>
<td>Protected cultural and urban areas</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>Recreation areas</td>
<td>60</td>
<td>50</td>
</tr>
</tbody>
</table>
**Table (2.15): Standards and Limits for Noise Levels in the Work Environment**

<table>
<thead>
<tr>
<th>Iraqi Law 41/2015 Requirements</th>
<th>WB Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TYPE OF PLACE AND ACTIVITY</strong></td>
<td><strong>MAXIMUM PERMISSIBLE NOISE [level equivalent to decibel (A)] day-night</strong></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Work place with up to 8 hour shifts and aiming to limit noise hazards on sense of hearing*</td>
<td>85</td>
</tr>
<tr>
<td><strong>Hotels</strong></td>
<td>50-40</td>
</tr>
<tr>
<td><strong>Offices and commercial buildings and services</strong></td>
<td>60-55</td>
</tr>
<tr>
<td><strong>Hospitals, schools and kindergartens</strong></td>
<td>50-35</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*At the workplace, exposure time (8 hours) is halved for every additional 3 dBA over the maximum allowable limit.

Above the maximum limit (85dBA for 8-hour shifts), wearing proper ear muffs is a must.

- Noise level at any time at the work place shall not exceed 135 dBA
- Noise shall be measured inside working environment in LAeq unit in accordance with ISO 9612/ ISO 1996 or Iraqi standards
4. Environmental and Social Baseline

4.1 Demography

The Proposed asphalt plant is located within the boundaries of Thi Qar province. The population of this province is approximately 2,000,000 citizens with an average growth rate of 2.7%. The total unemployment percentage in the province is as high as 31%. The Proposed asphalt plant is expected to provide a lot of job opportunities to the area citizens. Many skilled and unskilled workers and operators will be employed from the local area in addition to many truck drivers and suppliers. There are no major buildings such as schools, governmental offices or facilities near the asphalt plant proposed plot. The nearest civilized complex to the plant plot is an under development industrial city which is of about 25 km distance from the north direction of the plot. The plot itself is a modified natural desert land that is privately owned and has been used before for construction material storage.

4.2 Water Sources

The main water source available in Thi Qar province where the asphalt plant is located is the surface Euphrates River. Yet the river is about 55 km away from the proposed site. Thus there are no surface water sources within the area of influence of the site and activities. Ground water levels are very deep and therefore are not considered as an economically feasible alternative for fresh water sources.
4.3 Electricity Sources

Although the proposed asphalt plant location is not far away (2KM) from a main 32 KV transport line. However, to reduce the load onto the national electricity grid, the electrical demands which are required for plant operations will be supplied using two 700 KV diesel electricity generators. The generators will ensure 24 /7 electricity demands for the site.

Fuel storage tanks will be supplied and surrounded by barriers to prevent fuel and oil spillage and reduction of noise. The generators are also equipped with sound silencers and equipment’s for pollution and emission control.

4.4 Climate and Weather Considerations

4.4.1 General Climate description

The average temperatures in Iraq and in Nasiriya province range from higher than 48 degree °C in July and August to below freezing in January. A majority of the rainfall occurs from December through April. The summer months are marked by two kinds of wind phenomena: the southern and southeasterly "sharqi, a dry, dusty wind with occasional gusts to eighty kilometers an hour, occurs from April to early June and again from late September through November; "the shamal", a steady wind from the north and northwest, prevails from mid-June to mid-September. Very dry air, which accompanies the shamal permits intensive sun heating of the land surface, but also provides some cooling effect. Dust storms accompany these winds and may rise to a height of several thousand meters, causing hazardous flying and driving conditions.
Extremes of temperatures and humidity, coupled with the scarcity of water, will affect both men and equipment. During the dry season, clouds of dust caused by vehicle movement will increase detection capabilities in desert regions. Flash flooding in Wadis and across roads will hinder traffic ability and resupply efforts during the rainy season.

Clear, cloudless skies make air superiority a prerequisite to successful offensive operations throughout Iraq. Air operations may be reduced during the windy season. The climate in this region also receives brief violent rainstorms in the winter that usually total about 10 centimeters (cm). Most nights are clear in the summer, and about one third of the nights are cloudy in the winter.

**4.4.2 Ambient Temperature**

Temperature is undoubtedly the most important climatic element. The temperature of an area is dependent upon latitude or the distribution of incoming and outgoing radiation, the nature of the surface (land water), the altitude, and the prevailing winds. The air temperature normally used in climatology is that recorded at the surface. In the study area, temperature is considered a more dominate factor which has a direct effect on the other climatic factors, especially evaporation and wind speed. The average monthly temperatures in the region where the asphalt plant is to be located are shown in Figure (7). Meanwhile the annual average of the mean temperature is (25 °C).
Figures (4.1 and 4.2) show the yearly average temperatures and rainfall patterns along the year for the area. Meanwhile, the wind rose of the area is represented, though Figure (4.3).

Figure (4.1) The Average Temperature variations in the Proposed Asphalt site along the year for the period's between 2009-2014.
4.4.3 Precipitation (Rainfall)

Rainfall varies monthly and yearly and it usually begins in October and reaches the maximum level in January and then rains little in May, where the months from October to May considered as a rainy month. The rainy months, the maximum monthly averages is (58.34 mm) in Nov. and the minimum is (0.02 mm) in Jun., total rainfall annual average is (180.46 mm) as shown in Figure (4.2).

Figure (4.2) Average Rain falls around Asphalt plant area along the year
4.4.4 Wind

The maximum monthly average of the wind speed is 4.7 m/sec in June and the minimum is 2.3 m/sec in January in the area where the asphalt plant is proposed to be installed. The annual average is about 3.3 m/sec. The analyses of wind direction data of the latest thirty years (1980-2010) showed (in a percentage of contribution) that the prevailing direction along the year is NW with 74.1%, W direction (15.3%), N direction (5.26%), SE direction (4.05%), and S direction (1.16%), as seen in Figure (4.3).

Figure (4.3) Wind rose patterns in proposed Asphalt plant site area
4.5 Ecological Conditions

4.5.1 Site Topography

The area surrounding the road section represents an extension of the flat plateau areas that stretches from the middle of Iraq till the mid-southern parts of the country. No specific terrains or natural land is present in the project area. All surrounded areas adjacent to the road are flat with wide open areas.

4.5.2 Geology

Nasiriya city and its suburban area are situated in the basin of the lower reaches of the Euphrates River. The alluvial soil is dominant in this region. The underlying rocks are silt-clay strata. No Seismic activities have been recorded for more than 25 years.

4.5.3 Land use

The land of the area surrounding the road alignment is used primarily for oil investigations where there is several gas and oil fields such as Siba, Artwee, El-Lahees and others. In additions, there are some farms scattered on both sides of the road. It is worth mentioning that, all the earth around the road belongs to the state and that farm and some commercial activities are overrun by some people on these lands. The proposed plot itself is a private property to locals and was used for raw construction material storage.
4.5.4 Biodiversity

The project area is located in the Arabian Desert and Saharo-Arabian xeric shrub lands ecoregion. The wildlife of the project area is scarce. Protected or endangered species are not recorded along the road alignment. The proposed plot for the asphalt plant was previously used for storage of construction materials by the private owners of the plot therefore the habitat quality of the site had been modified.

4.5.5 Heritage Environment

The road alignment does not pass through any historical or cultural sites. There are no sites of historical or cultural importance in the area. The nearest historical place is OOR ancient city, which is about 25 km to the north of asphalt plant towards direction of Baghdad city.

4.5.6 Surface and groundwater

The road alignment passes parallel to the Euphrates River which is situated north of the road section at a distance of 55 km. Flooding of the road has not been reported in the past 40 years. The depth of ground water in the area ranges from 50-75m, and is brackish. The flow of the groundwater is from the south-west to north-east of the project according to the hydraulic gradient. The groundwater in the project area is used for irrigation to some farm scattered around the road as mentioned before.
5. Potential Environmental Impacts and mitigations

5.1 Introduction

As in many construction development projects, several environmental pollution sources are expected with the construction and operations of the proposed asphalt plant. The environmental pollutants are a result of the operation activities of the asphalt plant described above. The expected type, sources and effects of pollutants coming from the construction and operation phase of the asphalt plant are discussed her within. Also, the recommended mitigation measures and actions to reduce environmental impacts are discussed and illustrated.

The potential ecological impacts identified in the operation of the asphalt plant are:

(i) Ground water pollution related to disposal of domestic solid wastes generated by the personnel and domestic wastewater generated by the personnel,

(ii) Ground water pollution from oil type wastes and/or spills used for the maintenance of equipment

(iii) Noise pollution resulting from the operation of turbines and other equipment

(iv) Air pollution resulting from the emissions and dust blows.
All those wastes with potential impacts on the environment will be treated with most recent technology available in accordance with the relevant national and international legal framework.

The positive impacts that will be benefited from the project are basically the development of the road systems in the region and the country. This will surely improve the nation’s economy and transport. The impact of will improves infrastructural conditions for further investments, basically related to the tourism sector, in the area. Accordingly, this will enable increased employment opportunities to the youth in the area and hence help to improve the social wellbeing also with improved life standards.

5.2 Environmental Impacts and Mitigations during Asphalt Plant Construction Phase

5.2.1 Potential Pollutants

A- Air emissions:

The following table shows the expected types of air emissions and the sources of these emissions.

Table (5.1): Type and sources of air emissions.

<table>
<thead>
<tr>
<th>Type of Emission</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfur Dioxide (SO₂)</td>
<td>Trucks and Vehicles transporting raw materials and Personals.</td>
</tr>
<tr>
<td>Carbon Monoxide (CO)</td>
<td>Trucks and Vehicles transporting raw materials and Personals</td>
</tr>
<tr>
<td>Dust and Total Suspended Particles (PM₁₀ &amp; TSP)</td>
<td>Trucks and Vehicles transporting raw materials and Personal sand moving on</td>
</tr>
</tbody>
</table>
Since the construction equipment will be new, the air emissions are expected to be within the permissible limits. However, if all machinery is operating simultaneously within a small area, it is expected that the emissions will exceed the limits especially the PM$_{10}$ and TSP. The sensitive receptors identified are the construction workers onsite. Since the construction process has a limited period, the impacts will be short term, localized and reversible. Therefore, the impacts of air emissions during construction are considered of low significance.

**B- Noise**: Truck and machinery moving and equipment operations. The general noise levels expected from the machinery working at the site are listed in Table (5.2).

**Table (5.2) Reference Sound levels of construction Machinery**

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>REFERENCE SOUND LEVEL (DBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy Truck</td>
<td>96</td>
</tr>
<tr>
<td>Off-route Truck</td>
<td>86</td>
</tr>
<tr>
<td>Excavator</td>
<td>97</td>
</tr>
<tr>
<td>Pile Driver</td>
<td>101</td>
</tr>
<tr>
<td>Concrete Mixer</td>
<td>88</td>
</tr>
<tr>
<td>Crane</td>
<td>89</td>
</tr>
<tr>
<td>Roller Truck</td>
<td>89</td>
</tr>
</tbody>
</table>
Note: The noise levels for the machinery listed above are all above the threshold limits of Iraqi Law and World Bank limits. The main noise impacts will be upon the workers who use these machines or work very close to them. No other receptors exist in or around the site. The impacts are temporary, localized and reversible however if exposed workers are not wearing PPEs then the noise impacts will be considered of low significance.

C- Solid and Hazardous Waste

1- Municipal waste (Garbage, wood, plastics)

Source: Workers and Personals dinning, Tolls packing’s, Materials cover cardboards. The solid waste generated by the plant will be only domestic solid waste which must be properly disposed of in designated landfills as required by the national regulations. The amount of solid waste generated in the operation phase is estimated based on the daily generation rate of 1 kg/person/day. Accordingly, the amount of solid waste generated can be estimated as:

\[
\text{Amount of daily Solid Waste} = \text{No. of Cap.} \times 1 \text{ kg/cap/day}
\]

The local municipality of the region has its own authorized waste landfills. Coordination and approvals from the local municipality will be made to manage waste related issues from plant installation and operation phases for both municipal and hazardous waste management as attached in Appendix (IV).

It is expected that the number of workers during construction will not exceed 15 workers. Therefore, the total estimated amount of domestic waste generated is about 15 kg which is a small quantity. However, if these wastes are not properly disposed of, it will result in polluting soils and create public health problems.
If waste management practices are not in place then the impacts are considered of low significance since the quantity of wastes generated is small and will be only during construction.

2- Industrial Hazardous Wastes (Oil filters, empty Oil barrels)

Source: Equipment and machinery maintenance.

During construction, equipment and machinery may need quick or urgent maintenance as well as refueling. Used oil filters and empt oil/fuel barrels are considered hazardous and need to be handled in a careful manner otherwise they may pollute the soils. Since the expected quantities of generated hazardous wastes are expected to be low, the impacts of these wastes are considered of low significance.

D- Liquid Waste

1- Sewage.
Source: Workers and Personals W.C and lavatories. The construction site will be equipped with a site office and worker rest area where restrooms and sinks will be available. If the raw sewage is disposed of directly to the soil, this will result in soil contamination and possible pollution of ground water. The construction activities are temporary, impacts are localized and will not likely reach the ground water level at 75 meters’ depth. Therefore, the impacts of domestic sewage is considered Low.

2- Industrial waste Water
Source: Oils from Machinery and Equipment’s. In case of accidental spillage or improper disposal of used oil, soils will be polluted. The impacts are short term, localized, of minor quantities but hardly reversible. The impact is considered Low.

E- Fauna and Flora
The site was already used as a storage yard for construction material without any sign of existing fauna or flora. The site is also located in a desert environment and adjacent to the expressway. No impacts on any ecological systems are expected.

**E-Soil Erosion**

**Source:** - Site clearing and preparation/Equipment's operation and movements/ Truck movements and transportation activities.

The site has already been modified to be used as a storage site for construction materials. No plants are existing on site therefore there are no impacts expected on soil erosion.

**G-Traffic**

**Transport of raw materials/movement of construction machineries.**

**Source:** Tippers shifting raw materials to the plant/ Tippers shifting asphalt materials to the work site/ Movement and operation of construction equipment’s will increase the traffic on the expressway. However, the site location is adjacent to the expressway and the number of trucks transporting material to the site is incomparably low with the existing traffic flow. Therefore, the impact on traffic is negligible.

### 5.2.2 Summary of the Potential Environmental Impacts during Construction

The potential environmental impacts of the asphalt plant and the significant ( Negligible, Low, Moderate, High ) of those impacts are listed below:

- Effect on Ecology (Impacts on Flora and Fauna). "**Negligible**"
- Risk of Soil Erosion-Through the removal of plants. "**No impact**"
- Noise and Vibration "**Low**"
- Dust Emission "**Low**"
5.2.3 Mitigation Measures

As seen in site image in Figure (5.1) and after site inspection and data collection it is seen that the site is open wide. There is no plant or vegetation that can be effected in the area. Not much sensitive environment exists near the location that can be effected.

![Figure (5.1)](image)

TERNA S.A Asphalt Plant site location and surroundings

The main mitigation measures that are taken **during the construction phase** were:

1- **Risk of Soil erosion.** The site soil is sandy with no vegetation cover and water spray is used to prevent soil erosion.

2- **Noise and Vibration.** The site is very far away from any populated or habitation areas, therefore noise and vibration coming from moving construction trucks will not be of much of a risk nor of an important impact on the surrounding environment. Their impact is limited to
workers, who should be provided with ear muffs and other protective means.

3- **Traffic Implications.** The site is wide open with several access points. It is linked with the main highways. Traffic signals and sign boards are used in entry and exist points indicating that large, heavy machinery is of use in the area.

4- **Dust Emissions:** Water sprinklers will be used to spray raw materials and site grounds to reduce the effects of dust emissions. The plant is very far from any residential area. Dust Masks will be provided for construction workers.

5- **Public Nuisance:** It is pointed out that the plant is located in a faraway location from any populated area and there are no effects of noise and vibration to residence. Construction workers working near noisy, loud machines are to wear protective ears gear kits and to have a routine schedule to minimize noise exposure.

6- **Waste Generation:** Waste generated during the construction phase will be temporarily stored in barrels and containers. The wastes are to be lifted every weekend by a licensed contractor to transfer wastes to dumping locations as designated by the local municipality. After construction phase the site will be cleaned and tidy up and all accessible materials will be shifted to proper final destinations.

7- **Hazardous Waste Generation:** Appropriate storage, handling and treatment/disposal of hazardous wastes will be taken inline with the EHS Guidelines (Appendix VII) and requirements under Iraqi national law.
Table (5.3) summarized the potential environmental impacts and mitigation measures undertaken during the construction phase of the TERNA S.A asphalt plant.
### Table (5.3) Summary of the Environmental Impacts and Mitigation Measures during the Construction Phase of Section R7 Asphalt Plant

<table>
<thead>
<tr>
<th>Possible Impacts</th>
<th>Sources or Causes</th>
<th>Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecology</td>
<td>- Pollution of Ground Water</td>
<td>- The site is not environmentally sensitive and no vegetation is present No measures are required.</td>
</tr>
<tr>
<td></td>
<td>- Destruction of Vegetation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Soil Erosion</td>
<td></td>
</tr>
<tr>
<td>Noise Pollution</td>
<td>- Transport of Materials by Trucks during Construction Activities</td>
<td>- The plant is far away from any residential or populated area</td>
</tr>
<tr>
<td></td>
<td>- Constructed machinery</td>
<td>- Avoid work shaft more than 8hrs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Providing ear muffs for workers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Periodic maintenance of machineries</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Replacement of noisy machinery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Use of noise suppressors or mufflers for heavy equipment</td>
</tr>
<tr>
<td>Traffic congestion</td>
<td>- Transport of Raw Materials</td>
<td>- Transport during off peak hours</td>
</tr>
<tr>
<td></td>
<td>- Transport of Asphalt Plant Parts</td>
<td></td>
</tr>
<tr>
<td>Dust</td>
<td>- Raw Materials Transportation</td>
<td>- Water Sprinkling</td>
</tr>
<tr>
<td></td>
<td>- Raw materials storing</td>
<td>- Covering of Trucks carrying raw materials</td>
</tr>
<tr>
<td></td>
<td>- Construction activities</td>
<td>- Covering stored raw materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Providing safety mean for workers, including masks.</td>
</tr>
<tr>
<td>Public Nuisance</td>
<td>- Due to Dust</td>
<td>The Plant is far away from any residential gathering (20Km) and 1 Km from the Expressway</td>
</tr>
<tr>
<td></td>
<td>- Due to Noise</td>
<td></td>
</tr>
<tr>
<td>Solid Waste</td>
<td>Due to Access Materials and Packaging</td>
<td>Collection and Storage of waste in Proper area and shifting on a weekly bases to authorized landfills</td>
</tr>
</tbody>
</table>
5.3 Environmental Impacts, Mitigations During Asphalt plant Operation

Phase and assessment of impacts

The Operation Phase of the asphalt plant is the most important phase regarding the assessment of environmental impacts. The installation and Operation of the asphalt plant will impact the environmental receptors. However, mitigation measures will be incorporated in the designs, installation and during the operation to minimize those impacts. The following paragraphs will present the potential pollutants, sources, possible impacts and recommended mitigations during the asphalt plant operation.

5.3.1 Potential Pollutants, Sources, Impacts and Recommended Mitigation Measures

5.3.1.1 Dust Emissions

Sources: The main source of stack dust is from raw materials (sand, gravel) which are used for the production of asphalt. The stack dust is generated from the following activities:

- Loading and Unloading of aggregate stockpiles.
- Sand and gravel Transportation.
- Feeding the loaders with sand and gravel.

Potential Impacts: The small particle size of the dust particles generated by the aggregates (sand and gravel) during the asphalt plant operations casus a potential health threat (Small size dust particles can get deep into the lungs some may even reach to blood streams). Exposure to those dust particles can affect lungs and the
heart. The main impacts are expected to be on the workers onsite since there are no nearby residential areas.

**Mitigation Measures:** Dust emissions from asphalt plant operations occur at the first stage of the production (Especially during the drying process). Other stages of particle dust emissions include raw materials transportation, storage, cold feed unit, filter silos and the elevators. Therefore, the main initiative of the dust problem will be to reduce the dust emissions created in the first place. This should be achieved throughout the following mitigation measures:

- The asphalt plant which will be used by TERNA S.A in the rehabilitation of section R7 of expressway No.1 is modern and equipped with the latest technology in terms of pollution control. For dust control the plant is equipped with grab filters and dust collectors, Those filters entrap the dust particles efficiently. The maximum emission of particulate according to asphalt plant specification is 20 µg/m³. The settled collected dust particles are then disposed of without any harmful environmental impacts.
- Raw materials will be covered during transportation and storage to prevent dust emission.
- Access roads and material stocks will be water sprinkled with water to prevent soil erosion and dust emissions.

**Assessment of impacts:** According to mitigation measures undertaken and the dust collector's technique; the impact of dust expected to be low.
5.3.1.2 Gasses and odor emissions

**Sources:** According to the specification; no gases emissions will result from asphalt plant operation itself. However, the effect of some expected emission gases from asphalt plant operations and electric generators will be discussed:

- Sulfur Dioxide (SO₂) from the fuel burning processes.
- Nitrogen Oxides (NOₓ) from the dry burner processes, and fuel burning.
- Volatile Organic Compounds (VOC’s) which are hydrocarbons with the molecular structure of a combination of carbon and hydrogen atoms. When measuring those compounds from asphalt plant operations, they are usually referred to as Total Organic Carbons. Those compounds come from fuel emissions and they take the form of vapor or reaction products. The most important source of hydrocarbons is the incomplete combustion of fuel.
- Carbon Monoxide (CO) from the combustion process of the asphalt plant dryer and fuel combustion from generators and vehicles.

**Potential Impacts:** The Impacts of NOₓ and CO emissions on human health depend basically on the degree of exposure to those gases. Localized pains, nausea, muscle weakness, tremors, palpitation, indigestion, dizziness, eye irritation, nervousness and anxiety all have been correlated with exposure to such gases.
Meanwhile, the impacts of those gases on the environment are characterized by the acidification of the atmosphere and it’s built up concentrations in the atmosphere. On the other hand SO₂ emissions are influenced by the Sulfur content of the fuel used in the asphalt plant operations and the rate of adsorption in the alkaline dust layer formed by the filter. SO₂ emissions from asphalt plant operations will be minimum and do not pose any environmental threat.

**Mitigation Measures:** As noted above the asphalt plant purchased by Terna S.A –Iraq is of a modern technology and in very good condition and is equipped with modern pollution control equipment. Therefore, there will not be any severe negative impacts on the air quality. Still the following mitigation measures will be implemented to reduce the negative impacts of gases.

- Using fuel with lower Sulfur content. This fuel could be brought from existing fuel station dealing with improved fuel.

- Continues maintenance of the generators to ensure proper air to fuel mixtures and the appropriate retention time to ensure complete combustion and reduction of CO emissions.

- Insuring proper operation conditions such as sufficient flame volume, clean combustion to ensure lowers VOC’s are produced.

- Provide the workers with all safety measures; including masks, ear muff, gloves and other safety means and periodic medical testing.

- Periodic maintenance and replacement of filters of the asphalt plant and generator wherever this possible.
Assessment of impacts: In addition to mitigation measures undertaken, the plant environment is considered as open area and this will increase the possibility of gases dispersion and dilution in case on any emissions. According to, the impact is expected to be low.

5.3.1.3 Noise Emissions

Sources: Noise occurs at different places in the operation process of an asphalt plant and generators. The convertor belts, dryer and mixer drums, internal and external traffic all are types of noise sources in the plant. It is estimated that the noise level in the plant to be around 90-100 dBA (Leq) within few meters from the plant equipment and operating parts.

Potential Impacts: The increase of noise generated as a result of asphalt plant operations will not affect the neighborhood since no residential development is anywhere near the plant within a distance of not less than 10 Km and therefore no noise will be heard from the plant operations. However, workers within the plant surroundings will be affected by the noise generated.

Mitigation Measures: For staff and persons whom will be working within noisy zone they will be supplied with personal protective equipment (PPE) in order not to impair on their health as a result of over exposed to noise. It is expected that all the noise generated during asphalt plant operations to be within the required norms. Moreover, the plant generators are all fitted with noise reduction equipment. The placement of a noise breaker screen at the site will also be further investigated if needed.
Assessment of impacts: In addition to mitigation measures undertaken, the plant environment is considered as open area and this will decrease the effects of noise pollution. According to, the impact is expected to be low.

5.3.1.4 Traffic Implications

Sources: The transportation of the raw materials that are needed to produce the asphalt mix such as aggregate and bitumen and other chemicals and parts. Those materials are brought from borrow bits and factory through moving trucks and tippers. Moreover, the company trucks that will carry the final produced asphalt mixture to the expressway will cause traffic implications. The capacity of the trucks used for carrying and transporting those materials will be 15-30 Ton. Since the peak production of the plant is estimated to be 500 Ton/day then it is expected that at least 20 Lorries will be utilized for the plant operation activities.

Potential Impacts: The increase of traffic movement within the site parameters will cause soil erosions and dust emissions. Moreover, the load on the expressway will also be affected. Gas emissions from the moving and operating trucks and vehicles will also effect on air quality.

Mitigation Measures: The following mitigation measures will be taken to overcome the negative impacts occurring from traffic implications.

- Utilizing non-peak hours for raw material transportation.
- Good maintenance for trucks and lorries used to reduce gas emissions.
- Water sprinkling to access roads and site to prevent dust emissions.
- Covering of raw materials transported by trucks to minimize dust emissions.

**Assessment of impacts:** The volume of traffic on the expressway is not expected to increase significantly by adding the expected number of trucks. Therefore, the impacts are assessed to be low.

### 5.3.1.5 Solid Waste Generation

- **Sources:** Domestic waste and sludge’s will continue to be produced during the operation phase of the asphalt plant. It is estimated that, for each employee present at the site a total amount of 1 kg of solid waste will be produced per day. Other solid waste such as empty drums and equipment packaging will be found. Sludge from asphalt production will also be generated.

- **Potential Impacts:** Not much negative environmental impacts are expected from the generation of solid wastes during asphalt production. The domestic wastes will be transported and disposed of in an authorized dumping site. The generated sludge will be reused and processed in the asphalt mixing process.

- **Mitigation Measures:** For the sludge waste, it's dealt with the asphalt plant manager to use it to pave some surfaces to reduce the dust emission, or it can be reused and utilized through recycling it back into the asphalt. Meanwhile, domestic wastes will be collected and stored in bins and then shifted periodically to proper authorized final sanitary landfills where it's far
by about 20 km as shown in Fig. (5.2). Moreover, good housekeeping will be implemented on the plant premises which will ensure that the location is tidy at all times. The services of a specialized cleaning company will be a possible alternative for waste management.

Operation of the plant can produce several hazardous materials, including diesel fuel, bitumen/tar and polymers. The Storage of fuel, oils, polymers, bitumen and other chemicals will be made in proper stores supplied and equipped with all proper safety measures. The materials stored will be labeled and the material hazardous sheet will be established for each of those materials to give a full description of how to deal with those materials. Risks and impacts from improper handling and/or operation of the facility as in case of spills and/or soil and potentially ground water contamination will be addressed for each of the hazardous identified materials at site. Fixed loading and dislodging points will be placed for fuel and bitumen materials and proper clean up and oil spill removal procedures will be applied in case of any accidental spills.

**Assessment of impacts:** low effect due to small amount of waste generated.
5.3.1.6 Wastewaters

- **Sources:** In asphalt plant, only domestic waste water will be generated while the plant doesn't produce any process wastewater. This domestic wastewater will be generated by the staff and persons working at the asphalt plant. It is estimated that around 10 persons will be present during operations.

- **Potential Impacts:** Minor negative environmental impacts are expected from the generation of domestic wastewater if no mitigation measures are implemented. The impacts will be potential pollution of soil and ground water.
**Mitigation Measures:** The domestic wastewater generated by the working staff at the asphalt plant will be disposed of in a septic tank which is acting as a holding tank with sealed bottom and walls and drained from time to time to wastewater treatment plants (called the Indian wastewater treatment plant) which is about 40 km away from the asphalt plant. An official permit from the municipality will be gained by the contractor to dispose this waste. Wastewater from wash basins (Gray water) will be collected separately where there will be two separated sewage networks and used for irrigation and water sprinkling activities.

**Assessment of impacts:** low effect due to small quantity of wastewater generated.

**5.3.1.7 Impacts on Land use**

As already discussed in paragraphs above that the site for the asphalt plant is located in an area far away from any populated human activities. The site is wide open and closes to paved road access and there is no vegetation on the site. Therefore, the site is highly suitable for the asphalt production activities. Furthermore, the setting up of the asphalt mixing plant region is ecologically favored due to the fact that comparable activities are concentrated within the region forming a cluster, thereby limiting the environmental impacts of several disposed individual activities.

The setting up of the plant will not have any permanent impact on the proposed site since it can be shifted at any time to another location without having and residual impact on the land form.
5.3.1.8 Impacts on Humans

There are several health related issues concerning the operations of an asphalt plant. The fumes coming out from the plant can cause whizzing, caught, headache and skin irritation problems. Asphalt plants are also considered to be noise pollution sources. Yet the emissions coming from the plant are within standard allowable limits as such there is no risk of any health hazards to the air quality of the workers at the plant. Moreover, several mitigation measures will be taken and monitored to make sure that those pollutants stay within control limits.

Asphalt plants can be very dangerous and accidents may occur from time to time. Hence, it is very important to have a proper policy for health and safety issues. The following measures will be adopted in order to ensure the effectiveness of safety within the premises.

- To prevent Bitumen burns it will be compulsory for the workers handling hot bitumen to wear full – body protection.

- All transportation, handling and storage of bitumen will be handled by experienced personals.

- The dust from the manufacturing processes may pose respiratory hazards, hence protective air masks will be provided to the operators of the loading and unloading of the aggregates.

- Ear-Muffs will be provided to those working at the plant.

- First aid kit will be available on site for the workers in case of an emergency.

- The material and data sheets (MSDS) for each chemical will be accessible on the site and display.
Safety signs will be posted throughout the site and entry and exit will be marked clearly.

Regular health checks will be conducted for employees and staff working at the asphalt plant.

5.3.1.9 Socio–Economic Impacts

The operation of the asphalt plant will have limited effects on the demographic conditions since the number of workers in the operation phase will be around 10-15 people. There will be no permanent living quarters associated with this asphalt plant. Hence, there will be no increased demand on local infrastructure, such as utilities, housing, medical facilities, schools, water, and food. The project will not cause any displacement of individuals whose livelihood depends on the land that will be occupied by the Project.

The labor force for the operation of the plant will be supplied also from Nasiriya city, which will result in increased disposable income of plant employees. The operation of the plant will provide many job opportunities to the locals such as the service suppliers, truck drivers, mechanics and others carriers. Hence, it will positively impact the social economic environment for service sectors.

5.3.1.10 Occupational Health and safety

Occupational health and safety means preventing accidents and work related ill health. Improved health and safety management can bring significant benefits to the business. It reduces individual and human costs of accidents and ill health, direct and indirect cost to the business, improves customer perception and company profile and workers’ morale. Under occupational health hazards, one can group several categories of working conditions impairing the health conditions of
workers, though this impairment is slow. Safety relates more to health hazards that results from accidents and can cause instantaneous impairment of the workers’ health. IFC Environmental, Health and Safety Guidelines For such kind of projects are shown in Table (5.4).

(5.4): General Requirements for Health and safety

<table>
<thead>
<tr>
<th>ISSUES</th>
<th>REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Health and Hygiene</strong></td>
<td>● Cleanliness</td>
</tr>
<tr>
<td></td>
<td>● Ventilation and temperature</td>
</tr>
<tr>
<td></td>
<td>● Dust and fumes</td>
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<tr>
<td></td>
<td>● Disposal of wastes and effluents</td>
</tr>
<tr>
<td></td>
<td>● Overcrowding</td>
</tr>
<tr>
<td></td>
<td>● Illumination</td>
</tr>
<tr>
<td></td>
<td>● Latrines and urinals</td>
</tr>
<tr>
<td></td>
<td>● Spittoons and dustbins</td>
</tr>
<tr>
<td><strong>Safety</strong></td>
<td>● Safety for building and equipment</td>
</tr>
<tr>
<td></td>
<td>● Precautions in case of fire</td>
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<tr>
<td></td>
<td>● Fencing of machinery</td>
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<tr>
<td></td>
<td>● Floor, stair and passage way</td>
</tr>
<tr>
<td></td>
<td>● Work on or near machinery in motion</td>
</tr>
<tr>
<td></td>
<td>● Carrying of excessive weights</td>
</tr>
<tr>
<td><strong>Compensation for accidents at work</strong></td>
<td>● Owner’s responsibility for compensation</td>
</tr>
<tr>
<td></td>
<td>● Amount of compensation</td>
</tr>
<tr>
<td></td>
<td>● Report on fatal accident and treatment</td>
</tr>
<tr>
<td></td>
<td>● Compensation on contract and contract registration</td>
</tr>
<tr>
<td></td>
<td>● Appeal</td>
</tr>
<tr>
<td><strong>Dust and Fumes</strong></td>
<td>● Any dust or fumes or other impurities likely to be injurious to the workers, effective measures shall be taken to prevent its accumulation and its inhalation by workers</td>
</tr>
<tr>
<td><strong>Overcrowding</strong></td>
<td>● No work room in any factory shall be overcrowded</td>
</tr>
<tr>
<td></td>
<td>● At least five hundred cubic feet of space shall be provided for every worker employed in a work room</td>
</tr>
<tr>
<td><strong>Latrines and urinals</strong></td>
<td>● Sufficient latrines and urinals shall be provided</td>
</tr>
<tr>
<td></td>
<td>● Shall be maintained in clean and sanitary condition</td>
</tr>
<tr>
<td></td>
<td>● Shall be adequately lighted and ventilated</td>
</tr>
<tr>
<td><strong>Precautions in case of fire</strong></td>
<td>● Shall be provided with a means of escape in case of fire</td>
</tr>
<tr>
<td></td>
<td>● Effective measures shall be taken to ensure that all the workers are familiar with the means of escape</td>
</tr>
<tr>
<td></td>
<td>● Firefighting apparatus should provide and maintained</td>
</tr>
<tr>
<td><strong>First aid</strong></td>
<td>● Provided and maintained first aid facility</td>
</tr>
<tr>
<td>Section</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
</tbody>
</table>
| Disposal of wastes and effluents | ● Provide with proper disposal system for solid waste and effluents.  
● In case of a factory where no public sewerage system exists, prior approval of the arrangements should be made for the disposal of wastes and effluents. |
| Occupational and poisoning diseases | ● Sixteen occupational diseases modifiable to the Chief Inspector of Factories:  
1. lead poisoning  
2. lead tetraethyl poisoning  
3. phosphorous poisoning  
4. mercury poisoning  
5. manganese poisoning  
6. arsenic poisoning  
7. poisoning by nitrous fume  
8. carbon di sulfide poisoning  
9. benzene poisoning  
10. chrome ulceration  
11. Anthrax  
12. silicosis  
13. poisoning by halogens  
14. primary epitheliomatous cancer of the skin  
15. toxic anemia  
16. pathological manifestation due to radium or x-rays |
| Compensation | ● If personal injury is caused to workmen by accident arising in the course of employment, employer shall be liable to pay compensation  
● 36 occupational diseases for compensation payable  
● Monthly payment as compensation for temporary disablement are  
1. Compensation should be paid for the period of disablement or for one year whichever period is shorter  
2. Such compensation shall be paid at the rate of full monthly wages for the first two months  
3. Two thirds of the monthly wages for the next two months and at the rate of the half of the monthly wages for the subsequent months  
4. In case of chronic occupational diseases, half of the monthly wages during the period of disablement for a maximum period of two years shall be paid |
5.3.1.11 Health

To minimize the hazards arising from the activities at different phases of plant construction and operation, the following measures should be taken:

- Employees should be informed of the potential health impacts they are facing.
- The employer should inform his employees of these potential hazards, arrange a proper medical examination prior to and during employment, as well as tests and analyses necessary for the detection of diseases.
- Works with volatile toxic chemicals should be undertaken in a well-ventilated place.
- Laborers handling offensive toxic chemicals should be provided with and forced to use protective clothing.
- Workers exposed to an excessive amount of noise should be provided with protective gear and be relieved frequently from their post.
- Workers exposed to large amounts of dust should be provided with adequate protective gear.
- Frequent spraying of water should be undertaken to minimize dust pollution.
- Persons undertaking construction and installation works should have access to amenities for their welfare and personal hygiene needs such as sanitary toilets, potable drinking water, washing facilities, shelter sheds etc.
- Proper disposal of waste and sludge should be arranged.
- Health education and information on hygiene should be provided to the workers.
- Regular checks on food quality should be arranged within the work site.
5.3.1.12 Safety

Safety implies the reduction of risk of accidents at the work site. Accident prevention is more valuable than any migratory or compensatory measures. This may be achieved through strict rules and procedures for the execution of specific tasks, enforcement of the rules, and discipline amongst workers, maintenance of machineries used and by providing all necessary gear or equipment that may enhance the safety of the workers. The following guidelines should be followed to maintain the safety of the workers:

- Workers have to be informed about the possible damage or hazards related to their respective jobs.
- If pedestrian, traffic or plant movements at or near the site are affected by construction works, the person with control of the construction project must ensure that these movements are safely managed so as to eliminate or otherwise to control any associated health and safety risks.
- Must ensure sufficient lighting in the area where a person performs construction work or may be required to pass through, including access ways and emergency exit or passage without risk to health and safety.
- Construction site needs to provide safe access to and egress from all places where they may be required to work or pass through. This includes the provision of emergency access and egress route that must be free from obstructions.
- Adequate perimeter fencing should be installed on the site before construction work commences and that should be maintained during the construction work and signs should be placed which is clearly visible from outside the site including emergency telephone numbers.
• Must ensure that electrical installations materials, equipment and apparatus are designed, installed, used, maintained and tested to eliminate the risk of electrical shock, burns, fire or explosion.
• Construction site should be kept orderly and tidy. Access ways should be kept clear of materials and debris and maintained in a non-slippery condition. Materials should be stored in an orderly manner so that it does not pose any risk to the health or safety of any person.
• Arrangements of first aid facility should me made accessible when construction work is being undertaken.

5.3.1.13 working in Confined spaces

In the operational phase of the plant, the work will mainly be limited in confined spaces. In this phase, noise pollution may pose risk to health. It has been observed that the measured noise level near the generators and turbines ranged from 90 dBA to 110 dBA. This level of noise limits the continuous exposure to the workers from 2 to 4 hrs., beyond which hearing impairment may be caused. If the installation of generators and turbines are within a confined space and monitored through glass windows, it will not pose any serious threat. However, precautions should be undertaken during routine inspections and maintenance works.

Supervisors, inspectors and related personnel should wear noise protectors like ear plugs or ear muffs. Wearer should be given a choice between ear muffs and plugs as muffs are easy to use, but may be a nuisance in a confined workspace and be uncomfortable in hot environment. Whereas ear plugs don’t get in the way in confined spaces but may provide little protection if not used carefully.
As the employees will work in confined spaces, the air pollution may not pose a health risk. However, the ambient temperature may be high due to plant operation and measures should be taken to keep the temperature within a comfortable limit.

Adequate care should be taken to minimize stress and ergonomic design should be improved to minimize health hazards. First aid facilities should be available and evacuation plans for emergency situations should be in place with adequate drills, instructions and signs. Adequate fire-fighting arrangements should be installed and maintained on a regular basis. Appropriate strict work procedure and guidelines are to be defined for different jobs and be informed to the relevant staff. Regular medical examination should be arranged for the staff exposed to occupational health hazards. Areas where people may be exposed to excessive noise should be sign posted as “Hearing Protection Areas” and their boundaries should be clearly defined. No person should enter this area unless wearing personal hearing protectors.

5.3.1.14 Hazardous Material Handling

During plant construction and operation, commercially available chemicals (paints, thinners, etc.) will be used and stored in the construction area. Hence, small amount of unused or spent chemicals (used paints, motor oils) will be generated. Hazardous wastes likely to be generated during routine project operations include oily water, spent catalyst, lubricants and cleaning solvents. Operation and maintenance of the plant also generate some hazardous wastes. These include waste oil, and lubricating oils etc.
The following set of storage guidelines should be adopted:

- The storage place must be sheltered from rain and other water sources and if possible, away from heat sources
- The storage place must have a ground cover
- The storage place must have an exhaust ventilation system.
- The storage place must have a restricted access and be identified as a hazardous material storing place.

The facility staff should be trained and equipped with personal protective gear such as rubber gloves, boots, hard hats, apron or splash suit and a face shield with safety glasses or goggles.

### 5.3.1.15 Risk assessment and Management

The problem of protecting human health and the environment may best be defined as the management of risk. The failure to manage risk effectively and to establish priorities rationally translates ultimately into a failure to protect the health, safety, and the environment. Through the use of risk assessment, concerned authorities can estimate the relative level of risks posed by different substances, products and activities and can establish priorities in determining whether, and how, to regulate.

The risk assessment should constitute an organization’s best effort to employ advanced scientific and technical methods to predict accurately the sizes of the risks. Once the relevant risks are estimated accurately and objectively through the risk assessment process, it can then be decided how best that risks could be addressed in the risk management phase.
Risk assessment is the technical process for estimating the level of risks posed by operational processes or products, i.e. the probability that a given harm will occur as a result of the processes or products. Risk assessment is applied to a substance, proceeds in four major steps:

- **Hazard identification**: determining what kinds of adverse health effects a substance, product or activity can cause.
- **Dose – response assessment**: predicting the degree of adverse effects at a given exposure level.
- **Exposure assessment**: estimating the amount of exposure, and
- **Risk characterization**: combining the foregoing into a numerical range of predicted deaths or injuries associated with actual exposure event.

Risk management options are then evaluated in a proposed solution to provide reduction of risk to the exposed population. Specific actions that are identified and selected may include consideration of engineering constraints as well as regulatory, social, political and economic issues related to the exposure.

Table (5.5) summarized the potential environmental impacts and mitigation measures will be taken during the operation phase of the asphalt plant at Section R7 – Expressway No.1 Rehabilitation Project.
### Potential Impacts of Environmental Issues and Mitigation Measures

<table>
<thead>
<tr>
<th>Potential Impacts</th>
<th>Sources and Causes</th>
<th>Mitigation Measures</th>
<th>Allowable Emissions WB</th>
<th>Predicted Emissions by Asphalt Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damage To Nature</td>
<td>- Pollution to surface or ground water due to oil spillage</td>
<td>- Placing barriers around fuel storage tanks</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td>- Damage to Flora and Fauna due to gas emissions and formation of acid rains</td>
<td>- The asphalt plant is equipped with pollution control devices</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Planting of plant's surround</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise Pollution</td>
<td>- Raw Materials Transport - Asphalt transportation - Asphalt plant operation</td>
<td>- Location of site is far away from any residential compounds - Using Ear – Muffs by workers - Periodic maintenance of equipment's - use of noise suppressors or mufflers for heavy equipment - Periodic measuring of noise level</td>
<td>70 dB(A)</td>
<td>&lt;60dB(A)</td>
</tr>
<tr>
<td>Traffic Implementations</td>
<td>- Raw Materials transport - Asphalt transport</td>
<td>- Shifting raw materials during non-peak hours - Site is located at a cross roadjunctions which prevent any road blockings</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table (5.5)** Summary of the Environmental Impacts, Mitigation Measures and Monitoring plan during the Operation Phase and...
<table>
<thead>
<tr>
<th>Potential Impacts</th>
<th>Sources and Causes</th>
<th>Mitigation Measures</th>
<th>Allowable Emissions World Bank (WB)</th>
<th>Predicted Emissions by Asphalt Plant</th>
</tr>
</thead>
</table>
| Dust Emissions PM$_{10}$ | - Raw Materials Transport  
- Asphalt plant operation | - Use of water sprinklers  
- Asphalt plant is equipped with | PM$_{10}$  
=(50-20)µg/m$^3$ | PM$_{10}$                  |
## Environmental and Social Management Plan (ESMP) for Section R7 Asphalt Plant

### Potential Impacts

<table>
<thead>
<tr>
<th>Potential Impacts</th>
<th>Sources and Causes</th>
<th>Mitigation Measures</th>
<th>Allowable Emissions World Bank (WB)</th>
<th>Predicted Emissions by Asphalt Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid Generation</td>
<td>Waste Generation</td>
<td>- Waste sludge from asphalt production</td>
<td>- Recycle of waste sludge - Disposal of waste sludge</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>grab filters that reduce and prevent dust emissions - Covering vehicles carrying raw materials - Periodic measurement of particulate matter</td>
<td>PM$_{2.5}$ = (25-10) μg/m$^3$ (Average 24-hour Concentration-Average annual concentration)</td>
<td>PM$<em>{2.5}$ &lt; 20 μg /m$^3$ PM$</em>{2.5}$ &lt;10 μg /m$^3$</td>
</tr>
</tbody>
</table>
### Environmental and Social Management Plan (ESMP) for Section R7 Asphalt plant

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Standards</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic waste</td>
<td>- Domestic waste from workers at the plant</td>
<td>proper landfills</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Collection and disposal of domestic wastes in proper landfills</td>
<td>- Using of special containers for each type of solid waste</td>
<td></td>
</tr>
<tr>
<td>Gaseous Pollution</td>
<td>- Sulfur Dioxide SO₂</td>
<td>- Periodic maintenance and replacement of filter.</td>
<td>SO₂=500-20 µg/m³ (Average 10 minute-Average annual concentration)</td>
</tr>
<tr>
<td></td>
<td>- Nitrogen Oxides NOx</td>
<td>- Periodic maintenance of burner and flame</td>
<td>NO₂=200-40 µg/m³ (Average 24-hour concentration)</td>
</tr>
<tr>
<td></td>
<td>- Carbon Monoxide CO</td>
<td>- Correction of air-fuel mixture</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Volatile Organic Carbons VOCs</td>
<td>- Proper operating conditions: sufficient flame volume, clean combustion</td>
<td></td>
</tr>
<tr>
<td>Waste Water Generation</td>
<td>- Domestic wastewater produced by workers at the plant</td>
<td>- Disposed in septic tanks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Use of gray water for water sprinkling and irrigation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Waste Water Generation

- Domestic wastewater produced by workers at the plant
- Disposed in septic tanks
- Use of gray water for water sprinkling and irrigation
6. Analysis of the alternatives

The purpose of the analysis of alternatives as part of the EIA process is to select the best among all possible project options. The assessments and recommendations made by the EIA Team are presented below.

6.1 Site location

The key criteria used in the evaluation of the selected site were as follows:

- **Economic factors:**
  - The proximity of access roads and means of transportations;
  - The land has already been identified and is free of conflict.
  - The location centers the Section R7 expressway line where all the works will be done and therefore, minimum transport distance will be achieved.
  - The location is suitable for shifting and storing raw materials needed for asphalt production.

- **non-economic factors:**
  - Potential environmental impacts;
  - Site development;
  - Avoiding construction on farm lands;
  - Flat topography as a preferable condition for construction and operation; and
  - To be preferably under the prevailing wind direction.

6.2 Selection of the Proposed Technology

The asphalt plant adopts a modern technology that takes environmental protection measures into consideration. The plant is equipped with dust prevention filters and many other health and safety incorporated tools and equipment’s which makes it a suitable option in terms of environmental protection.
7. Environmental Management and Monitoring Plan

In order to achieve a proper environmental management for the asphalt plant, an environmental monitoring plan (EMP) is needed. The EMP is a systematic method for meeting environmental outcomes, approval conditions and ways to be compliant with the standards.

Tables (7.1 and 7.2) show the proposed environmental monitoring plan for the proposed asphalt plant during construction and operation phases respectively. Both plans are important to achieve:

- Comparison between predicted and actual environmental impacts.
- Analysis of the accuracy of the impacts.
- Assessment of the activity of the mitigation measures proposed.
- Weakness of the system.
- Degree of compliance with the regulatory standards.

8.1 Monitoring devices, frequencies and report structure

In order to apply the environmental monitoring plan, a group of environmental pollutant measurement devices (gases, particulate matters and noise) has been purchased. Those devises include:

1- Sound level meter DB 200.
2- Aeroqual series 500, with the following sensors:
   - Carbone dioxide, CO₂ with the range from 0-5000 ppm.
   - Carbon monoxide, CO with the range from 0-1000 ppm.
   - Sulfur dioxide, SO₂ with range from 0-100 ppm.
   - Nitrogen Oxide, NO₂ with the range from 0-1 ppm.
- Volatile organic carbon, VOC with the range from 0-2000 ppm.

3- **Enviro dust particulates monitor.** A true laser particle counter, count individual particles; PM$_{10}$ and PM$_{2.5}$.

The devices will be frequently calibrated and used to measure the pollutants resulting from the asphalt plant operations and other project activities. All the monitoring actions ad mitigations measures will be achieved under the supervision of TEAM int. Environmental and safety specialists.
### Table (7.1) Environmental Management and Monitoring plan during the Construction Phase of Asphalt Plant

<table>
<thead>
<tr>
<th>Item</th>
<th>Activities</th>
<th>Monitoring Details</th>
<th>Monitoring apparatus</th>
<th>Schedule</th>
<th>Monitoring location</th>
<th>Responsibilities</th>
<th>Cost [USD] for environmental monitoring activities only (incl. specialists and equipment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise, $L_{eq}$</td>
<td>Excavation Parts installation</td>
<td>Decibel</td>
<td>Noise Meter Safety Checks</td>
<td>During activities</td>
<td>Around the asphalt plant and a different distances</td>
<td>Contractor (TERNA)</td>
<td></td>
</tr>
<tr>
<td>Dust PM$<em>{10}$, PM$</em>{2.5}$</td>
<td>Raw Materials Transport Loading and unloading of materials Construction equipment’s</td>
<td>Dust emission level and health and safety checks</td>
<td>Visual observation</td>
<td>During activities</td>
<td>Around the asphalt plant and different distances</td>
<td>TERNA</td>
<td></td>
</tr>
<tr>
<td>Traffic congestion</td>
<td>Raw Materials transport Equipment transportation</td>
<td>Monitoring of additional traffic due to construction</td>
<td>Visual observation</td>
<td>On a weekly base</td>
<td>At Intersection of SUQ AL SHUQE, Telleham and at paths of material transporter trucks</td>
<td>TERNA in coordination with the traffic administration</td>
<td>Cost of full time environmental engineering Specialist during construction period: 6,000 Cost of vehicle, fuel and camera: 10,000 Cost of devices (noise+particulate matters+ gases): 15000</td>
</tr>
<tr>
<td>Solid and Hazardous Waste (domestic, construction, industrial, oils and lubricates)</td>
<td>Solid waste during construction</td>
<td>Amount of waste generated</td>
<td>Visual observation and regular checks</td>
<td>On a weekly base</td>
<td>At asphalt plant and at dumping site*</td>
<td>TERNA in coordination with the local municipality/department of sanitary landfill</td>
<td></td>
</tr>
<tr>
<td>Waste water pH, BOD$_5$, COD</td>
<td>Waste water generated during construction</td>
<td>Level of waste water in the temporary facilities</td>
<td>Visual observation and regular checks</td>
<td>On a weekly base</td>
<td>At asphalt plant and at wastewater treatment plant*</td>
<td>TERNA in coordination with the local municipality/directory of water and sewage</td>
<td></td>
</tr>
<tr>
<td>Health and Safety (PPE)</td>
<td>During work operations and plant installation</td>
<td>Check of health and safety requirements</td>
<td>Visual observation and regular checks</td>
<td>On a weekly bases</td>
<td>At asphalt plant</td>
<td>TERNA</td>
<td></td>
</tr>
</tbody>
</table>

Total estimated monitoring costs [USD] for asphalt plant activities only: 31,000
### Table (7.2) Environmental Management and Monitoring plan during the Operation Phase of asphalt Plant

<table>
<thead>
<tr>
<th>Item</th>
<th>Activities</th>
<th>Monitoring Details</th>
<th>Monitoring apparatus</th>
<th>Schedule</th>
<th>Monitoring location</th>
<th>Responsibilities</th>
<th>Cost [USD] for asphalt activities only (incl. specialists and equipment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise, ( L_{eq} )</td>
<td>During operation of plant Loading and unloading of materials</td>
<td>Safety, vibrations, noise emission levels to receptors</td>
<td>Noise Meter Safety Checks</td>
<td>During activities</td>
<td>Around the asphalt plant and at different distances from noise sources</td>
<td>Terna</td>
<td></td>
</tr>
<tr>
<td>Dust, ( \text{PM}<em>{10}, \text{PM}</em>{2.5} )</td>
<td>Raw Materials Transport Loading and unloading of materials and asphalt production</td>
<td>Dust emission level and health and safety checks</td>
<td>Visual observations Air sniffer</td>
<td>During activities</td>
<td>Around the asphalt plant and at different distances from dust sources</td>
<td>Terna</td>
<td>Cost of full time environmental engineering Specialist during operation period: 24,000 Cost of vehicle, fuel and camera: 15,000 Cost of devices (noise+particulate matters+ gases):15000</td>
</tr>
<tr>
<td>Traffic Conjunction</td>
<td>Raw Materials transport Asphalt transport</td>
<td>Monitoring of additional traffic flow</td>
<td>Visual observation</td>
<td>During activities</td>
<td>At Intersection of SUQ AL SHUQE, Telleham and at paths of material transporter trucks</td>
<td>Terna in coordination with the traffic administration</td>
<td></td>
</tr>
<tr>
<td>Solid Waste (domestic, construction, industrial, oils and lubricates)</td>
<td>Solid waste during operation (sludge and domestic waste)</td>
<td>Amount of waste generated Visual observation and regular checks</td>
<td>On a daily basis</td>
<td>At asphalt plant and at dumping site*</td>
<td>Terna in coordination with the local municipality/ department of sanitary landfill</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waste water</td>
<td>Waste water generation due to</td>
<td>Level of waste water in the Visual observation</td>
<td>On a weekly</td>
<td>At asphalt plant and at wastewater</td>
<td>Terna in coordination</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>domestic use</td>
<td>wastewater septic tanks and regular checks</td>
<td>basis</td>
<td>treatment plant*</td>
<td>with the local municipality/ directory of water and sewage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health and safety</td>
<td>During plant operations</td>
<td>Check of health and safety requirements</td>
<td>Visual observation and regular checks</td>
<td>On a daily bases</td>
<td>At asphalt plant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire Hazards</td>
<td>During operation of plant</td>
<td>Check of health and safety requirements</td>
<td>Visual observations</td>
<td>Every month</td>
<td>At asphalt plant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air Quality (SO₂, NO₂, CO)</td>
<td>During operation of the plant</td>
<td>Check standard levels and predicted levels in EIA</td>
<td>Air analysis for SO₂, CO, NOₓ and VOCs</td>
<td>On a weekly basis</td>
<td>Around the asphalt plant and at different distances from gases sources</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total estimated monitoring costs [USD] for asphalt plant activities only :** 54,000

* TERNA has gotten a permit from local municipality to dump and disposal their solid waste and wastewater resulted from different activities. **Appendix III** contain a copy of these permissions.
7.2 Implementation Arrangements

In order to implement the placed mitigation measures to reduce and minimize the potential negative environmental impacts expected from the asphalt plant during both the installation and operation phases a number of implementation arrangements are to be taken including:

- Activation of the ESMP of the project.
- Continues environmental monitoring and documentation.
- Daily, weekly and monthly visits to all stores, offices, sites and project facilities.
- Material control plan. This includes inspection and control to all entered and exist materials from the plant.
- Proper supplement and use for PPE to workers combined with proper HSE induction courses.
- Placement of risk assessment and emergency plans.
- Visual and mechanical inspection on all machinery, tools, pumps and equipment's at site.
- Coordination with local municipality and environmental agencies.
8. Conclusions and Recommendations

From the study findings, it has been concluded that, the impacts of the plant can be mitigated. The developer is strongly advised to implement the recommendations made by the ESIA Team. The asphalt plant will have positive social and economic impacts to the local community. Also the plant will provide the required asphalt mix that is necessary to rehabilitate and maintain the expressway section R7 which is of great importance to the community in terms of development. The application of the monitoring system suggested in this study minimum negative impacts are expected in the environment. A number of mitigation measures are recommended against the adverse activities during the construction and operation phases of the project. Measures recommended during the construction phase include control of noise pollutions from heavy equipment and vehicles through proper inspection and maintenance, and use of noise suppressors or mufflers for heavy equipment, control of air pollution from construction works and movement of vehicles through proper inspection and maintenance to reduce exhaust emissions, watering of unpaved roads, control of adverse impacts from construction debris by proper handling and immediate removal, control of water pollution through proper storage and handling of oil wastes and treatment of wastewaters at site, control of solid wastes through sanitary storage and frequent collection for sanitary disposal. Quality of air and water will be monitored on a regular basis where noise will be measured periodically. In both construction and operation phases of the asphalt plant occupational health and safety will be carefully considered and controlled through continuous inspection to prevent disease and accidents, and workers will undergo an environmental and safety briefing on safety, sanitation measures, and
emergency rescue procedures before development begins. Adequate sanitary facilities, potable water, and garbage bins will be provided.

After completion of rehabilitation activities, the asphalt plant will be dismantled and be ready for re-erection in other potential road rehabilitation projects. In case the contractor is not awarded another contract, the asphalt plant will be sold to a local contractor.
9. References

1. Ministry of Environment (MOE), 2011, in process of approval from information of MOE.


5. NYSDEC, Assessing and Mitigating Noise Impacts. Program Policy DEP-00 1, 200.


8. NYSDEC, Assessing and Mitigating Noise Impacts. Program Policy DEP-00 1, 200.


Appendix (I)

Asphalt Plant Approved Raw Materials

Sources and Origins
<table>
<thead>
<tr>
<th>Type of Product</th>
<th>Quantity (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt Plant</td>
<td></td>
</tr>
</tbody>
</table>

**Environmental and Social Management Plan (ESMP) for Section R7 Asphalt plant**

Consultant for R7 & R8

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**Rehabilitation of Expressway No.1 Section (R7) Nasiriya – Rymaila Project**

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**TERNA S.A.**

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**SCRB**

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**TEAM INTERNATIONAL Engineering & Management Consultants**

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**Consultant For R7 & R8**

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Rehabilitation of Expressway No.1 Section (R7) Nasiriya – Rymaila Project
Environmental and Social Management Plan (ESMP) for Section R7 Asphalt plant
Rehabilitation of Expressway No.1 Section (R7) Nasiriya – Rymaila Project
Environmental and Social Management Plan (ESMP) for Section R7 Asphalt plant
Rehabilitation of Expressway No.1 Section (R7) Nasiriya – Rymaila Project
Environmental and Social Management Plan (ESMP) for Section R7 Asphalt plant
<table>
<thead>
<tr>
<th>Section</th>
<th>Length (M)</th>
<th>Width (M)</th>
<th>Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>R7</td>
<td>240</td>
<td>20</td>
<td>1.5</td>
<td>300</td>
</tr>
<tr>
<td>R8</td>
<td>180</td>
<td>20</td>
<td>1.5</td>
<td>240</td>
</tr>
</tbody>
</table>

**Note:** The table above provides a summary of the asphalt plant requirements for Sections R7 and R8 of the Nasiriya – Rymaila Project.
Consultancy Services for the Construction Supervision and Related Services for Rehabilitation Of Expressway No.1, Section R7 & R8

Number: TI-BS-STL-16-046
Date: 28/04/2016

To: Terna S.A. GEK Terna Group
Subject: Rehabilitation of Expressway No.1-Section R7 (Nasiria - Rumaila) Polymer / SBS

Dear Sir,

According to the construction supervision and related services for rehabilitation of Expressway No.1-R7&R8 contract No. TCP.CON.QCBS.R7&R8 dated 06/03/2016, refer to your letter No. TM1q/R7/030416/2 at 03/04/2016, concerning the submitted material SBS; According to Item No. 2.2 from the Bill of Quantity, and 3503 from the special specification; After checking the material specification submitted with your above letter, we found it is related to SBR (STYRENE – BUTADIENE – Rubber), and not to the material for Modified Bitumen SBS.

So we request to resubmit the intended SBS (STYRENE – BUTADIENE – STYRENE) material specification.

Best Regards,

Mazin A. Ahmed

Copy to:
- Roads and Bridges Directorate / World Bank Projects Center / PMT
Ref. R76/110716/1
Date 11th July, 2016

To/ TEAM International Consultant and Management Engineering
Sub; Rehabilitation of Expressway No.1/Section 7 (Nasiriya-Rumaila)
No. TCP.W.A1.EW.1.R7

SBS Delivery on Site

Dear Sir,

Referring to your letter REF:TI-BS-SLT-16-171 Dated on 29/06/2016 about SBS approval under
name (SOL T 6302), we would like to inform you that material has been delivered on site storage
area with total quantity (27000) kg (1800 pack) as shown in the packing list attached.

For your review and necessary action.

Best regards
Your sincerely

Deputy Project Manager
Eng. Thaer F. Ali

Attachments:
* Quality Report. (No. 3)
* Packing list no. 0802177116/240097 (1 paper)
* Packing list no. 0802177116/240098 (2 paper)
* Packing list no. 0802177117/240099 (3 paper)

Received by

[Signature]
12/02/2016
Rehabilitation of Expressway No.1 Section (R7) Nasiriya –Rymaila Project

Environmental and Social Management Plan (ESMP) for Section R7 Asphalt plant

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Net Weight</th>
<th>Gross Weight</th>
<th>VAT Code</th>
<th>Batch No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>024134</td>
<td>EUROPROPANE SOL T 6302 G PAL 500 P38 - I</td>
<td>kg</td>
<td>931</td>
<td>13046E10</td>
<td>7.065</td>
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<tr>
<td>000939</td>
<td>UNITAP AL 900 KG - SACCHI PVC 15 KG</td>
<td>kg</td>
<td>931</td>
<td>13046E10</td>
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<td></td>
<td></td>
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<td></td>
<td>kg</td>
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<td>13046E10</td>
<td>7.068</td>
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<td>kg</td>
<td>931</td>
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<tr>
<td></td>
<td></td>
<td>kg</td>
<td>931</td>
<td>13046E10</td>
<td>7.070</td>
<td></td>
</tr>
</tbody>
</table>

Note: The table above lists the packing list for the materials to be delivered to the destination, including the net and gross weights, and VAT code for each item. The consultant for R7 & R8 is responsible for this delivery.
Rehabilitation of Expressway No.1 Section (R7) Nasiriya – Rymaila Project
Environmental and Social Management Plan (ESMP) for Section R7 Asphalt Plant
Appendix (I I)

EHS World Bank Guidelines
1.0 Environmental

1.1 Air Emissions and Ambient Air Quality

Applicability and Approach

This guideline applies to facilities or projects that generate emissions to air at any stage of the project life-cycle. It complements the industry-specific emissions guidance presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines by providing information about common techniques for emissions management that may be applied to a range of industry sectors. This guideline provides an approach to the management of significant sources of emissions, including specific guidance for assessment and monitoring of impacts. It is also intended to provide additional information on approaches to emissions management in projects located in areas of poor air quality, where it may be necessary to establish project-specific emissions standards.

Emissions of air pollutants can occur from a wide variety of activities during the construction, operation, and decommissioning phases of a project. These activities can be categorized based on...
Environmental, Health, and Safety Guidelines
GENERAL EHS GUIDELINES: ENVIRONMENTAL AIR EMISSIONS AND AMBIENT AIR QUALITY

Ambient Air Quality

General Approach

Projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that:

- Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines (see Table 1.1.1), or other internationally recognized sources;
- Emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same area.

At facility level, impacts should be estimated through qualitative or quantitative assessments by the use of baseline air quality assessments and atmospheric dispersion models to assess potential ground level concentrations. Local atmospheric, climatic, and air quality data should be applied when modeling dispersion, protection against atmospheric downwash, wakes, or eddy effects of the source, nearby structures, and terrain features. The dispersion model applied should be internationally recognized, or comparable. Examples of acceptable emission estimation and dispersion modeling approaches for point and fugitive sources are

<table>
<thead>
<tr>
<th>Table 1.1.1: WHO Ambient Air Quality Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pollutant</strong></td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td><strong>Sulfur dioxide (SO₂)</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td><strong>Nitrogen dioxide (NO₂)</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Particulate Matter PM₁₀</strong></td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Particulate Matter PM₂₅</strong></td>
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<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td><strong>Ozone</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

* Significant sources of point and fugitive emissions are considered to be general sources which, for example, can contribute to an increase of one or more of the following pollutants within a given area: PM10: 50 tons per year; NOx: 500 tpy; SO2: 500 tpy; or are established through national legislation; and combustion sources with an equivalent heat input of 50 MWth or greater. The significance of emissions of inorganic and organic pollutants should be established on a project-specific basis taking into account toxic and other properties of the pollutant.
* “Guidance on the development of air quality regulations and other measures in support of the WHO guidelines.”
* Ambient air quality standards are ambient air quality levels established and published through national legislative and regulatory processes, and ambient air quality guidelines refer to ambient air quality levels primarily developed through clinical, toxicological, and epidemiological evidence (such as those published by the World Health Organization).

12 US EPA Prevention of Significant Deterioration of Air Quality (PSD) Limits applicable to non-degraded airsheds.
Environmental, Health, and Safety Guidelines
GENERAL EHS GUIDELINES: ENVIRONMENTAL
AIR EMISSIONS AND AMBIENT AIR QUALITY

included in Annex 1.1.1. These approaches include screening models for single source evaluations (SCREEN3 or AIRSCREEN), as well as more complex and refined models (AERMOD OR ADMS). Model selection is dependent on the complexity and geomorphology of the project site (e.g. mountainous terrain, urban or rural area).

Projects Located in Degraded Airsheds or Ecologically Sensitive Areas
Facilities or projects located within poor quality airsheds13, and within or next to areas established as ecologically sensitive (e.g. national parks), should ensure that any increase in pollution levels is as small as feasible, and amounts to a fraction of the applicable short-term and annual average air quality guidelines or standards as established in the project-specific environmental assessment. Suitable mitigation measures may also include the relocation of significant sources of emissions outside the airshed in question, use of cleaner fuels or technologies, application of comprehensive pollution control measures, offset activities at installations controlled by the project sponsor or other facilities within the same airshed, and buy-down of emissions within the same airshed.

Specific provisions for minimizing emissions and their impacts in poor air quality or ecologically sensitive airsheds should be established on a project-by-project or industry-specific basis. Offsets provisions outside the immediate control of the project sponsor or buy-downs should be monitored and enforced by the local agency responsible for granting and monitoring emission permits. Such provisions should be in place prior to final commissioning of the facility / project.

Point Sources
Point sources are discrete, stationary, identifiable sources of emissions that release pollutants to the atmosphere. They are typically located in manufacturing or production plants. Within a given point source, there may be several individual ‘emission points’ that comprise the point source.15

Point sources are characterized by the release of air pollutants typically associated with the combustion of fossil fuels, such as nitrogen oxides (NOx), sulfur dioxide (SO2), carbon monoxide (CO), and particulate matter (PM), as well as other air pollutants including certain volatile organic compounds (VOCs) and metals that may also be associated with a wide range of industrial activities.

Emissions from point sources should be avoided and controlled according to good international industry practice (GIIP) applicable to the relevant industry sector, depending on ambient conditions, through the combined application of process modifications and emissions controls, examples of which are provided in Annex 1.1.2. Additional recommendations regarding stack height and emissions from small combustion facilities are provided below.

Stack Height
The stack height for all point sources of emissions, whether ‘significant’ or not, should be designed according to GIIP (see Annex 1.1.3) to avoid excessive ground level concentrations due to downwash, wakes, and eddy effects, and to ensure reasonable diffusion to minimize impacts. For projects where there are multiple sources of emissions, stack heights should be established with due consideration to emissions from all other project sources, both point and fugitive. Non-significant sources of emissions,
including small combustion sources,\(^9\) should also use GIIP in stack design.

**Small Combustion Facilities Emissions Guidelines**

Small combustion processes are systems designed to deliver electrical or mechanical power, steam, heat, or any combination of these, regardless of the fuel type, with a total, rated heat input capacity of between three Megawatt thermal (MWh) and 50 MWh.

The emissions guidelines in Table 1.1.2 are applicable to small combustion process installations operating more than 500 hours per year, and those with an annual capacity utilization of more than 30 percent. Plants firing a mixture of fuels should compare emissions performance with these guidelines based on the sum of the relative contribution of each applied fuel.\(^8\) Lower emission values may apply if the proposed facility is located in an ecologically sensitive area, or airshed with poor air quality, in order to address potential cumulative impacts from the installation of more than one small combustion plant as part of a distributed generation project.

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\(^9\) Small combustion sources are those with a total rated heat input capacity of 50 MWh or less.

\(^8\) The contribution of a fuel is the percentage of heat input (LHV) provided by this fuel multiplied by its limit value.
<table>
<thead>
<tr>
<th>Combustion Technology / Fuel Type</th>
<th>Particulate Matter (PM)</th>
<th>Sulfur Dioxide (SO₂)</th>
<th>Nitrogen Oxides (NOₓ)</th>
<th>Dry Gas, Excess CO₂ Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td>N/A</td>
<td>N/A</td>
<td>200 (Spam ignition) 40% (Cdu Fuel) 1600 (Compression Ignition)</td>
<td>16</td>
</tr>
<tr>
<td>Liquid</td>
<td>50 or up to 100% justified by project specific considerations e.g. Economic feasibility or using lower ash content fuel, or adding secondary treatment to meet SO₂ and available environmental capacity of the site</td>
<td>1.5 percent, 1.5 percent justified by project specific considerations e.g. Economic feasibility of using lower SO₂ content fuel or adding secondary treatment to meet SO₂ and available environmental capacity of the site</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Turbine</td>
<td>Natural Gas ≤ 3MWth to ≤ 10MWth</td>
<td>N/A</td>
<td>42 pm (Electric generation) 100 pm (Mechanical drive)</td>
<td>16</td>
</tr>
<tr>
<td>Natural Gas ≤ 10MWth</td>
<td>N/A</td>
<td>N/A</td>
<td>25 pm (Electric generation) 100 pm (Mechanical drive)</td>
<td>15</td>
</tr>
<tr>
<td>Fuels other than Natural Gas ≤ 3MWth to ≤ 10MWth</td>
<td>N/A</td>
<td>0.0 percent, 0.0 percent, Sulfur ≤ 0.2 percent or 0.2 percent, Sulfur ≤ 0.2 percent if commercially available without significant excess fuel cost</td>
<td>95 pm (Electric generation) 100 pm (Mechanical drive)</td>
<td>15</td>
</tr>
<tr>
<td>Fuels other than Natural Gas ≥ 10MWth</td>
<td>N/A</td>
<td>0.1%, 0.1% or less % (≤ 0.1%) if commercially available without significant excess fuel cost</td>
<td>14 pm</td>
<td>15</td>
</tr>
<tr>
<td>Boiler</td>
<td>Gas</td>
<td>N/A</td>
<td>520</td>
<td>3</td>
</tr>
<tr>
<td>Liquid</td>
<td>50 or up to 150% justified by environmental assessment</td>
<td>400</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>solids</td>
<td>50 or up to 150% justified by environmental assessment</td>
<td>2000</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Notes: 1- If emissions guidelines for specific pollutants levels than those in the Table should be applicable to facilities located in urban industrial areas with depersonal emissions or close to environmentally sensitive areas more stringent emissions controls may be required. 2- MWth is a total input on HHV basis. 3- Emission factors are provided at 21% atmospheric pressure, 15°C. 4- MMB is to apply to the entire facility consisting of multiple units that are not necessarily considered to be emitted from a common source for NOₓ and PM limits for turbiners and boilers. 5- Guidelines values apply to facilities operating more than 500 hours per year with an annual capacity utilization factor of more than 30 percent.
Fugitive Sources
Fugitive source air emissions refer to emissions that are distributed spatially over a wide area and not confined to a specific discharge point. They originate in operations where exhausts are not captured and passed through a stack. Fugitive emissions have the potential for much greater ground-level impacts per unit than stationary source emissions, since they are discharged and dispersed close to the ground. The two main types of fugitive emissions are Volatile Organic Compounds (VOCs) and particulate matter (PM). Other contaminants (NOx, SOx, and CO) are mainly associated with combustion processes, as described above. Projects with potentially significant fugitive sources of emissions should establish the need for ambient quality assessment and monitoring practices.

Open burning of solid wastes, whether hazardous or non-hazardous, is not considered good practice and should be avoided, as the generation of polluting emissions from this type of source cannot be controlled effectively.

Volatile Organic Compounds (VOCs)
The most common sources of fugitive VOC emissions are associated with industrial activities that produce, store, and use VOC-containing liquids or gases where the material is under pressure, exposed to a lower vapor pressure, or displaced from an enclosed space. Typical sources include equipment leaks, open vats and mixing tanks, storage tanks, unit operations in wastewater treatment systems, and accidental releases. Equipment leaks include valves, fittings, and elbows which are subject to leaks under pressure. The recommended prevention and control techniques for VOC emissions associated with equipment leaks include:

- Equipment modifications, examples of which are presented in Annex 1.14;
- Implementing a leak detection and repair (LDAR) program that controls fugitive emissions by regularly monitoring to detect leaks, and implementing repairs within a predefined time period.\(^{18}\)

For VOC emissions associated with handling of chemicals in open vats and mixing processes, the recommended prevention and control techniques include:
- Substitution of less volatile substances, such as aqueous solvents;
- Collection of vapors through air extractors and subsequent treatment of gas stream by removing VOCs with control devices such as condensers or activated carbon absorption;
- Collection of vapors through air extractors and subsequent treatment with destructive control devices such as:
  - Catalytic incinerators: Used to reduce VOCs from process exhaust gases exiting paint spray booths, ovens, and other process operations
  - Thermal incinerators: Used to control VOC levels in a gas stream by passing the stream through a combustion chamber where the VOCs are burned in air at temperatures between 700°C to 1,300°C
  - Enclosed Oxidizing Flames: Used to convert VOCs into CO\(_2\) and H\(_2\)O by way of direct combustion
- Use of floating roofs on storage tanks to reduce the opportunity for volatilization by eliminating the headspace present in conventional storage tanks.

Particulate Matter (PM)
The most common pollutant involved in fugitive emissions is dust or particulate matter (PM). This is released during certain operations, such as transport and open storage of solid materials, and from exposed soil surfaces, including unpaved roads.

\(^{18}\) For more information, see Leak Detection and Repair Program (LDAR), at: http://www.ldar.net
Recommended prevention and control of these emissions sources include:

- Use of dust control methods, such as covers, water suppression, or increased moisture content for open materials storage piles, or controls, including air extraction and treatment through a baghouse or cyclone for material handling sources, such as conveyors and bins;
- Use of water suppression for control of loose materials on paved or unpaved road surfaces. Oil and oil by-products is not a recommended method to control road dust. Examples of additional control options for unpaved roads include those summarized in Annex 1.1.5.

**Ozone Depleting Substances (ODS)**

Several chemicals are classified as ozone depleting substances (ODSs) and are scheduled for phase-out under the Montreal Protocol on Substances that Deplete the Ozone Layer. 19 No new systems or processes should be installed using CFCs, halons, 1,1,1-trichloroethane, carbon tetrachloride, methyl bromide or HCFCs. HFCs should only be considered as interim/bridging alternatives as determined by the host country commitments and regulations. 20

**Mobile Sources – Land-based**

Similar to other combustion processes, emissions from vehicles include CO, NOX, SO2, PM and VOCs. Emissions from on-road and off-road vehicles should comply with national or regional programs. In the absence of these, the following approach should be considered:

- Regardless of the size or type of vehicle, fleet owners/operators should implement the manufacturer recommended engine maintenance programs;
- Drivers should be instructed on the benefits of driving practices that reduce both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits;
- Operators with fleets of 120 or more units of heavy duty vehicles (buses and trucks), or 540 or more light duty vehicles21 (cars and light trucks) within an airshed should consider additional ways to reduce potential impacts including:
  - Replacing older vehicles with newer, more fuel efficient alternatives
  - Converting high-use vehicles to cleaner fuels, where feasible
  - Installing and maintaining emissions control devices, such as catalytic converters
  - Implementing a regular vehicle maintenance and repair program

**Greenhouse Gases (GHGs)**

Sectors that may have potentially significant emissions of greenhouse gases (GHGs) include energy, transport, heavy industry (e.g. cement production, iron / steel manufacturing, aluminum smelting, petrochemical industries, petroleum refining, fertilizer manufacturing), agriculture, forestry and waste management. GHGs may be generated from direct emissions.

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19 Examples include: chlorofluorocarbons (CFCs); halons; 1,1,1-trichloroethane (methyl chlorofrom); carbon tetrachloride; hydrochlorofluorocarbons (HCFCs); hydrobromofluorocarbons (HBFCs); and methyl bromide. They are currently used in a variety of applications including: domestic, commercial, and process refrigeration (CFCs and HCFCs); domestic, commercial, and motor vehicle air conditioning (CFCs and HCFCs); for manufacturing foam products (CFCs); for solvent cleaning applications (CFCs, HCFCs, methyl chlorofrom, and carbon tetrachloride); as aerosol propellants (CFCs); in fire protection systems (halons and HBFCs); and as crop fumigants (methyl bromide).

20 Additional information is available through the Montreal Protocol Secretariat web site available at http://ozones.unep.org

21 The selected fleet size thresholds are assumed to represent potentially significant sources of emissions based on individual vehicles breaching 100,000 km / y using average emission factors.

22 The six greenhouse gases that form part of the Kyoto Protocol to the United Nations Framework Convention on Climate Change include: carbon dioxide (CO2); methane (CH4); nitrous oxide (N2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulfur hexafluoride (SF6).
from facilities within the physical project boundary and indirect emissions associated with the off-site production of power used by the project.

Recommendations for reduction and control of greenhouse gases include:

- Carbon financing;23
- Enhancement of energy efficiency (see section on Energy Conservation);
- Protection and enhancement of sinks and reservoirs of greenhouse gases;
- Promotion of sustainable forms of agriculture and forestry;
- Promotion, development and increased use of renewable forms of energy;
- Carbon capture and storage technologies;24
- Limitation and / or reduction of methane emissions through recovery and use in waste management, as well as in the production, transport and distribution of energy (coal, oil, and gas).

**Monitoring**

Emissions and air quality monitoring programs provide information that can be used to assess the effectiveness of emissions management strategies. A systematic planning process is recommended to ensure that the data collected are adequate for their intended purposes (and to avoid collecting unnecessary data). This process, sometimes referred to as a data quality objectives process, defines the purpose of collecting the data, the decisions to be made based on the data and the consequences of making an incorrect decision, the time and geographic boundaries, and the quality of data needed to make a correct decision. The air quality monitoring program should consider the following elements:

- Monitoring parameters: The monitoring parameters selected should reflect the pollutants of concern associated with project processes. For combustion processes, indicator parameters typically include the quality of inputs, such as the sulfur content of fuel.
- Baseline calculations: Before a project is developed, baseline air quality monitoring at and in the vicinity of the site should be undertaken to assess background levels of key pollutants, in order to differentiate between existing ambient conditions and project-related impacts.
- Monitoring type and frequency: Data on emissions and ambient air quality generated through the monitoring program should be representative of the emissions discharged by the project over time. Examples of time-dependent variations in the manufacturing process include batch process manufacturing and seasonal process variations. Emissions from highly variable processes may need to be sampled more frequently or through composite methods. Emissions monitoring frequency and duration may also range from continuous for some combustion process operating parameters or inputs (e.g., the quality of fuel) to less frequent, monthly, quarterly or yearly stack tests.
- Monitoring locations: Ambient air quality monitoring may consist of off-site or fence line monitoring either by the project sponsor, the competent government agency, or by collaboration between both. The location of ambient air

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23 Carbon financing as a carbon emissions reduction strategy may include the host government-endorsed Clean Development Mechanism or Joint Implementation of the United Nations Framework Convention on Climate Change.

24 Carbon dioxide capture and storage (CCS) is a process consisting of the separation of CO₂ from industrial and energy-related sources; transport to a storage location; and long-term isolation from the atmosphere, for example in geological formations, in the ocean, or in mineral carbonates (exsolution of CO₂ with mineral solubility in saline minerals to produce stable carbonate minerals). It is the signal of intensive research worldwide (Intergovernmental Panel on Climate Change (IPCC), Special Report, Carbon Dioxide Capture and Storage (2005)).

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quality monitoring stations should be established based on the results of scientific methods and mathematical models to evaluate potential impact to the receiving areas from an emissions source taking into consideration such aspects as the location of potentially affected communities and prevailing wind directions.

- **Sampling and analysis methods:** Monitoring programs should apply rational or international methods for sample collection and analysis, such as those published by the International Organization for Standardization, the European Committee for Standardization, or the U.S. Environmental Protection Agency. Sampling should be conducted by, or under the supervision of trained individuals. Analysis should be conducted by entities permitted or certified for this purpose. Sampling and analysis Quality Assurance / Quality Control (QA/QC) plans should be applied and documented to ensure that data quality is adequate for the intended data use (e.g., method detection limits are below levels of concern). Monitoring reports should include QA/QC documentation.

### Monitoring of Small Combustion Plans Emissions

- **Additional recommended monitoring approaches for boilers:**
  - Boilers with capacities between 3 MWe and 20 MWe:
    - Annual Stack Emission Testing: SO₂, NOₓ, and PM. For gaseous fuel-fired boilers, only NOₓ, SO₂ can be calculated based on fuel quality certification if no SO₂ control equipment is used.

- **Boilers with capacities between 20 MWe and < 50 MWe:**
  - Annual Stack Emission Testing: SO₂, NOₓ, and PM. For gaseous fuel-fired boilers, only NOₓ, SO₂ can be calculated based on fuel quality certification if no SO₂ control equipment is used.
  - Emission Monitoring: None

- **Boilers with capacities between 50 MWe and > 100 MWe:**
  - Annual Stack Emission Testing: SO₂, NOₓ, and PM. For gaseous fuel-fired boilers, only NOₓ, SO₂ can be calculated based on fuel quality certification if no SO₂ control equipment is used.

- **Additional monitoring requirements for engines:**
  - Annual Stack Emission Testing: NOx, SO₂ and PM (NOx only for gaseous fuel-fired diesel engines).
If Annual Stack Emission Testing results show constantly (3 consecutive years) and significantly (e.g. less than 75 percent) lower than the required levels, frequency of Annual Stack Emission Testing can be reduced from annual to every two or three years.

Emission Monitoring: NOx: Continuous monitoring of either NOx emissions or indicative NOx emissions using combustion parameters. SOx: Continuous monitoring if SOx control equipment is used. PM: Continuous monitoring of either PM emissions or indicative PM emissions using operating parameters.
Annex 1.1.1 – Air Emissions Estimation and Dispersion Modeling Methods

The following is a partial list of documents to aid in the estimation of air emissions from various processes and air dispersion models:

Australian Emission Estimation Technique Manual

Atmospheric Emission Inventory Guidebook, UN / ECE / EMEP and the European Environment Agency
http://www.aest.co.uk/netscn/airqual/TFEI/unece.htm

Emission factors and emission estimation methods, US EPA Office of Air Quality Planning & Standards
http://www.epa.gov/ttn/chief

Guidelines on Air Quality Models (Revised), US Environmental Protection Agency (EPA), 2005
http://www.epa.gov/ercm001/guidance/guide/appxw_05.pdf

Frequently Asked Questions, Air Quality Modeling and Assessment Unit (AQMUA), UK Environment Agency
http://www.environment-agency.gov.uk/subjects/airquality/236092/?version=1&lang=e

OECD Database on Use and Release of Industrial Chemicals
http://www.oils.oecd.org/ehs/unchem.nsf/

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### Environmental, Health, and Safety Guidelines

**General EHS Guidelines:**
- Environmental
- Air Emissions and Ambient Air Quality

### Annex 1.1.2 – Illustrative Point Source Air Emissions Prevention and Control Technologies

<table>
<thead>
<tr>
<th>Principal Sources and Issues</th>
<th>General Prevention / Process Modification Approach</th>
<th>Control Options</th>
<th>Emission Reduction Efficiency (%)</th>
<th>Gas Conditions</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Particulate Matter (PM)</strong></td>
<td>Fuel switching (e.g., selection of lower sulfur fuel) or removing the amount of the particulates added to a process.</td>
<td>Fabric Filters</td>
<td>99 - 99.7%</td>
<td>Dry gas, temp &lt;400°C</td>
<td>Applicability depends on flue gas properties including temperature, chemical properties, direction and load. Typical air to ash ratio range of 2.8 to 3.5 1/s m². Achievable outlet concentrations of 22 mg/m³.</td>
</tr>
<tr>
<td></td>
<td>Gas desulfurization. (ESP)</td>
<td>Electrostatic Precipitator (ESP)</td>
<td>57 - 99%</td>
<td>Depends on particle type</td>
<td>Pressurization gas to remove large particles. Effectivity dependent on removability of particle. Achievable outlet concentration of 10 mg/m³.</td>
</tr>
<tr>
<td></td>
<td>Cyclone</td>
<td>Cyclone</td>
<td>74 - 96%</td>
<td>None</td>
<td>Most efficient for larger particles. Achievable outlet concentrations of 20 - 40 mg/m³.</td>
</tr>
<tr>
<td></td>
<td>Wet Scrubber</td>
<td>Wet Scrubber</td>
<td>93 - 95%</td>
<td>None</td>
<td>Wet scrubber may be a disposal problem depending on local infrastructure. Achievable outlet concentrations of 10 - 25 mg/m³.</td>
</tr>
<tr>
<td><strong>Sulfur Dioxide (SO₂)</strong></td>
<td>Control system selection is heavily dependent on the fuel characteristics. For SO₂ concentrations in excess of 10%, the stream is passed through a sulfur plant until below the SO₂ emissions cut-off to generate high-grade sulfur for sale. Levels below 1% are not sufficient for this process, and therefore utilize absorption or scrubbing, where SO₂ molecules are captured onto a liquid phase or adsorption, where SO₂ molecules are captured on the surface of a solid adsorbent.</td>
<td>Fuel Switching</td>
<td>&gt;96%</td>
<td></td>
<td>Usually sold as a secondary product of base metal production or as a by-product of some chemical production or wastewater treatment processes.</td>
</tr>
<tr>
<td></td>
<td>Steam injection</td>
<td>Steam injection</td>
<td>35% - 70%</td>
<td></td>
<td>Calcium oxide is injected into the flue gas and the SO₂ is assimilated onto the material.</td>
</tr>
<tr>
<td></td>
<td>Dry Flue Gas Desulfurization</td>
<td>Dry Flue Gas Desulfurization</td>
<td>70% - 95%</td>
<td></td>
<td>Can be regenerable or permanent.</td>
</tr>
<tr>
<td></td>
<td>Wet Flue Gas Desulfurization</td>
<td>Wet Flue Gas Desulfurization</td>
<td>&gt;96%</td>
<td></td>
<td>Produces gypsum as a byproduct.</td>
</tr>
</tbody>
</table>
## Annex 11.2: Illustrative Point Source Air Emissions Prevention and Control Technologies (continued)

<table>
<thead>
<tr>
<th>Source Type</th>
<th>Fuel Type</th>
<th>Percent Reduction by Fuel Type</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combustion modification (incineration or biofuels)</td>
<td>Coal, Oil, Gas</td>
<td></td>
<td>These modifications are capable of reducing NOx emissions by 50 to 90%. The method of combustion control was expressed on the type of boiler and the method of firing fuel.</td>
</tr>
<tr>
<td>Low-NOx air-firing</td>
<td>Coal</td>
<td>10-30</td>
<td>10-30</td>
</tr>
<tr>
<td>Slagging combustion</td>
<td>Coal, Oil</td>
<td>20-60</td>
<td>20-60</td>
</tr>
<tr>
<td>Flue Gas Recirculation</td>
<td>N/A</td>
<td>20-30</td>
<td>30-50</td>
</tr>
<tr>
<td>Pit/tunnel injection</td>
<td>N/A</td>
<td>10-40</td>
<td>N/A</td>
</tr>
<tr>
<td>Low-NOx burners</td>
<td>Coal, Oil</td>
<td>30-60</td>
<td>30-60</td>
</tr>
<tr>
<td>Flue Gas Treatment</td>
<td>Coal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selective Catalytic Reduction (SCR)</td>
<td>Coal, Oil</td>
<td>60-90</td>
<td>50-90</td>
</tr>
<tr>
<td>Selective Non-Catalytic Reduction (SNCR)</td>
<td>N/A</td>
<td>30-70</td>
<td>30-70</td>
</tr>
</tbody>
</table>

**Note:** Compiled by IFC based on inputs from external experts.

**April 30, 2007**
Annex 1.1.3 - Good International Industry Practice (GIIP)

Stack Height

(Based on United States 40 CFR, part 51.100 (ii)).

\[ H_s = H + 1.5L; \]

where

- \( H_s \) = GEP stack height measured from the ground level elevation at the base of the stack
- \( H \) = Height of nearby structure(s) above the base of the stack.
- \( L \) = Lesser dimension, height (h) or width (w), of nearby structures
- ‘Nearby structures’ = Structures within/touching a radius of 5L but less than 800 m.

Annex 1.1.4 - Examples of VOC Emissions Controls

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Modification</th>
<th>Approximate Control Efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumps</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Seal-less design</td>
<td>100(^{25})</td>
</tr>
<tr>
<td></td>
<td>Closed-vent system</td>
<td>90(^{20})</td>
</tr>
<tr>
<td></td>
<td>Dual mechanical seal with barrier fluid maintained at a higher pressure than the pumped fluid</td>
<td>100</td>
</tr>
<tr>
<td>Compressors</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Closed-vent system</td>
<td>90(^{20})</td>
</tr>
<tr>
<td></td>
<td>Dual mechanical seal with barrier fluid maintained at a higher pressure than the compressed gas</td>
<td>100</td>
</tr>
<tr>
<td>Pressure Relief Devices</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Closed-vent system</td>
<td>90(^{20})</td>
</tr>
<tr>
<td></td>
<td>Rupture disk assembly</td>
<td>100(^{20})</td>
</tr>
<tr>
<td>Valves</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Seal-less design</td>
<td>100(^{20})</td>
</tr>
<tr>
<td>Connectors</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Weld together</td>
<td>100(^{20})</td>
</tr>
<tr>
<td>Open-ended Lines</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blind, cap, plug, or second valve</td>
<td>100(^{20})</td>
</tr>
<tr>
<td>Sampling Connections</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Closed-loop sampling</td>
<td>100(^{20})</td>
</tr>
</tbody>
</table>

Note: Examples of technologies are provided for illustrative purposes. The availability and applicability of any particular technology will vary depending on manufacturer specifications.

\(^{25}\) Seal-less equipment can be a large source of emissions in the event of equipment failure.

\(^{20}\) Actual efficiency of a closed-vent system depends on percentage of vapors collected and efficiency of control device to which the vapors are routed.

\(^{21}\) Control efficiency of closed-vent systems installed on a pressure relief device may be lower than other closed-vent systems.

April 30, 2007
## Annex 1.1.5 - Fugitive PM Emission Controls

<table>
<thead>
<tr>
<th>Control Type</th>
<th>Control Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Stabilization</td>
<td>0% - 96%</td>
</tr>
<tr>
<td>Hydroscopic salts/Binders/Adhesives</td>
<td>60% - 95%</td>
</tr>
<tr>
<td>Surfactants</td>
<td>0% - 66%</td>
</tr>
<tr>
<td>Wet Suppression – Watering</td>
<td>12% - 95%</td>
</tr>
<tr>
<td>Speed Reduction</td>
<td>0% - 80%</td>
</tr>
<tr>
<td>Traffic Reduction</td>
<td>Not quantified</td>
</tr>
<tr>
<td>Paving (Asphalt/Concrete)</td>
<td>85% - 99%</td>
</tr>
<tr>
<td>Covering with gravel, slag, or &quot;Road Carpet&quot;</td>
<td>30% - 93%</td>
</tr>
<tr>
<td>Vacuum Sweeping</td>
<td>0% - 55%</td>
</tr>
<tr>
<td>Water Flushing/Broom Sweeping</td>
<td>0% - 96%</td>
</tr>
</tbody>
</table>
Appendix III

{ THI QAR Municipality Official Approval for disposal of TERNA S.A Solid waste

(Document gives approval for solid waste disposal and land fill at THI QAR Landfill )
THI QAR Municipality Approval for Sewage treatment and disposal

(Document gives approval to TERNA to disposal of sewage at city treatment plant)