

**3. ENVIRONMENTAL MANAGEMENT PLAN  
(EMP)  
&  
SAFEGUARD PROCEDURES**

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### 3.0 INTRODUCTION

- 3.1 The Category 3 tropical storm that hit Hadramaut and Al-Mahara Governorates from the 23th to 25th October 2008 caused 91mm of rain to fall over an area of some 2 million ha. The 2 billion m<sup>3</sup> of water generated resulted in one of the worst natural disasters to hit Yemen in recent years, with more than 70 people dead, 25,000 displaced, over 2,800 houses destroyed, and infrastructure services severely damaged.
- 3.2 One significant casualty was the Rayyan to Bin Aifan Road, an important element of the national road network linking the coastal plain and the City of Mukalla to the interior and the Wadi Hadramaut. In particular, the Abdullah Gharib section was so badly damaged as to be impassable for the week after the storm.
- 3.3 While immediate action minimised disruption to supplies reaching the interior, the existing alignment, like earlier alignments destroyed by previous floods, largely follows the course of a wadi. There is therefore concern that with the less-predictable weather and extreme rainfall patterns expected from climate change, destructive flash floods will become increasingly frequent. MOPWH have therefore decided that major realignment of the Abdullah Gharib section beyond the influence of major wadi flows is required.



**Figure 1.2 Existing and Proposed Alignments of the Abdullah Gharib Section**

Consulting Engineering Services of India (CES) was appointed to investigate the extent of flood damage, to submit proposals for repair and/or reconstruction to ensure long-term viability, and to prepare preliminary engineering designs for two options, both a mix of reconstruction and realignment within the existing route corridor. CES produced a *Draft Feasibility and Preliminary Engineering Design Report* in July 2009. MOPWH subsequently decided neither option provided adequate security against future floods and instructed CES to investigate an alternative alignment at higher elevations to the east of the present corridor. *Final Feasibility Study* prepared by a Design Consultant and finalized in October 2009 included three alternative realignment routes as well as a site-specific hydrological study and an economic appraisal. The proposed road alignment was considered optimal.

The task of elaborating an ESIA was entrusted to Dar Alhandasah (Shair and Partners) of Sana'a and Beirut. The original ESIA was based on the Draft Feasibility Report dated July 2009 and *Final Tender Documents* for construction dated January 2010. The ESIA noted that no site-specific hydrological assessment, economic appraisal, or preliminary design information had been issued for the realigned route prior to ESIA or the issue of tender documents.

CES has pointed out to the World Bank that the Final Feasibility Study dated October 2009 includes a site-specific hydrological assessment and economic appraisal, that all operational impacts have been addressed by the design, and that the EMP is included in the tender documents.

## **4.0 PROJECT DESCRIPTION**

### **4.1 Description of the existing road**

Although much repair work has previously been undertaken some washed-out sections have only been replaced with compacted gravel and remain unsurfaced. Elsewhere, lengths of retaining wall have not been reconstructed. While now operational, the section consequentially remains susceptible to future damage from flows less extreme than in 2008.

### **4.2 Description of the proposed works**

The proposed realignment of the Abdullah Gharib section extends for a distance of some 7.5 km and will comprise a 7.0 m wide asphalt single carriageway (one lane in each direction) with a 1.5 m wide gravel shoulder. Structures along the route will include:

- 27 culverts, each 1x3x2 m in size;
- 2 bridges, 120 m and 80 m in length;
- Some 1,000m of retaining walls of various heights.

For proper cross-road drainage, 27 culverts and 2 bridges have been designed at various locations to mitigate erosion impacts. The bridges will comprise a 7 m carriageway with a 2 m wide kerb/footpath on either side. The culverts and bridges have been designed according to project hydrological and soil investigation studies, as well as international standards, primarily those of AASHTO, ASTM, and BSI. Given the routing over higher ground, the realignment will involve substantial 'cut' and 'fill' to achieve acceptable gradients and radii for the smooth passage of the many large vehicles that will use the road. Volume of fill

materials for the construction of the road, including excess cut materials, are addressed in detail in BOQ of Tender documents Volume I. Various engineering measures (retaining walls in cut and fill, road side lined drains and earthen drains, and placement of gabions) have been taken to manage erosion.

The steepest section of the road is 12%, for one stretch of 250 meters. In Yemen, a gradient of 13-15% is allowed. In general, the gradient provided in the design is 7%.

Like the existing road, the realigned route intersects no existing metalled roads. The small number of unsurfaced tracks crossed will be reinstated on completion to maintain access.

## **5.0 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT**

### **5.1 Introduction**

An initial Environmental and Social Impact Assessment has been carried out in 2010 to identify critical issues, Project impact and mitigation measures and design a Environment Management Plan. In this context, the general policies, guidelines, codes of practices provided in the Environmental and Social Screening and Assessment Framework (ESSAF), which is consistent to Bank operational policies and procedures has been followed.

The new alignment passes through hill slopes and shows existence of shrubs and bushes scattered in and around the corridor. No agricultural activities are noted including grazing of cattle. Small natural streams crosses the road corridor and the hill slopes are stable with rock formation. Hence, erosion is not considered to be a contributing negative factor; however the Project includes a number of erosion management structures. Also, no other utility lines are in existence within the newly identified corridor.

An estimation of traffic flows for the design horizon of 2033 points out the realignment is not expected to generate additional traffic or become a preference for vehicles currently using an alternative route. The section is remote from destinations and there is minimal local traffic,

Considering the nature and magnitude of reconstruction works, potential environmental impacts are likely to be negligible. Some minor impacts on air pollution are likely to occur during construction as well as a temporary increase in noise level.

The land corridor for the alignment belongs to the Government. There is no requirement of land acquisition and also no need of involuntary resettlement.

Bedu women have been identified to be potentially affected in the construction and operational phases through the demolition of one water cistern, as well as indirect impacts of the improved road opening the area to others in terms of stock movement and watering and firewood gathering. With regards to the demolition of the water cistern, it is to be replaced with a similar cistern in accordance with community consultations. With regards to assertion that the improved road will open the area to increased resource pressures, the population density of the region is low, and thus competition is expected to increase only within the existing population. The local natural resource agencies will be expected to support and enforce existing rules regarding livestock management and firewood gathering.

No major impacts are anticipated and the project is classified under Category B as per the World Bank Operational Policies. Under the Yemeni Environmental Regulations, the project falls under Category 2.

Overall, the project has beneficial effect. Some of the benefits include: (i) Reduction in congestion, increase in comfort level of passengers and drivers including savings of time; (ii) Enhancement of safety & reduction of accident; and (iii) Overall enhancement of environmental conditions.

Significance of environmental impacts arising due to ‘**With Project**’ and ‘**Without Project**’ has been evaluated based on environmental parameters. **Table 1.1** shows the significance of environmental impacts.

Some identified adversities arising from the project implementation and operation have been avoided and/or mitigated through the actual design of the realignment. The costs of addressing these impacts are included in the construction costs. Residual potential negative impacts can be prevented or minimized as a result of a timely and proper implementation of the EMP. Some of the main potential impacts addressed during design include:

- Road Safety: Risks associated with sharp road curves have been avoided for security reasons. Proposed curve radius in the realignment varies from 50 meters to 500 meters. The minimum radius of curve in the realignment is 40 meters and only at three bends. Additionally, 1,000 meters guardrail and 25 different road signs have been included.
- Erosion Impacts: Step gradient have been avoided. The overall gradient in the design is below 7% -- except for a 250m stretch with a 12% gradient. Erosion management structures have been included in the design.
- Loss of seasonally productive land: realignment corridor has been designed to avoid productive land
- Surplus spoil:

Surplus debris is to be disposed to the areas identified and approved by the engineer. These areas have been included in General Guidelines hereinafter. With proper disposal of debris, the wadi flow will not be obstructed and there will be no loss of virgin land. The playground is located far away from the proposed alignment and hence demolition of playground not required. Only one water tank will be required to be demolished. A similar water tank will be constructed by the contractor in consultation with the villagers.

## 5.2 Impacts during Different Phases of Implementation

**Table 1.2** shows the summary of likely environmental impacts during the following phases of implementation:

- Preconstruction Activity Phase
- Construction Activity Phase, and
- Post Construction Phase (i.e. Operational Phase)

### 5.3 Environmental Management Plan

Prediction of likely environmental impacts and recommending the Environmental Management Plan (EMP) to offset/ reduce/ eliminate the adversities arising from the proposed project are main purposes of this study. Suggested EMP outlines:

- Mitigation measures to be taken during the construction and operation phase of the project, including responsibilities and costs
- Monitoring plan
- Capacity building

**Table 1.3** shows the summary of Environmental Management Plan.

**Table 1.1: Significance of Environmental Impacts**

Sl. No.	Environmental Parameters	Without Project	With Project	Remarks
1	Visual and aesthetic environment	(-)	(++)	Full of debris and broken concrete structures are found scattered all along the site. With the implementation of the project, the visual and aesthetic environment will improve
2	Land use pattern	(0)	(0)	No likely change in land use pattern due to step and rocky terrain.
3	Socioeconomic conditions	(-)	(+++)	Quality of life of the citizens will improve and generation of employment is expected
4	Smooth Traffic Movement	(- -)	(+++)	Traffic disruptions and delays will be reduced and thereby will save financial and economic losses.
5	Air quality	(0)	(+)	Temporary effected during construction phase only
6	Noise Quality	(0)	(+)	Temporary increase in noise level is expected during construction phase only
7	Cultural Property/ Archeological Sites	(0)	(0)	There is no risk of damages to cultural property
8	Indigenous people	(0)	(0)	No indigenous people are going to be affected.
9	Biological Environment (Flora & Fauna)	(0)	(0)	No impact on Flora and Fauna
10	Water and Soil Contamination	(0)	(0)	No impact
11	Destruction/ Disruption of Land & Vegetation	(0)	(0)	No Impact
12	Soil Erosion	( - )	(++)	With the implementation of the protection works, the wadi embankment erosion will be substantially reduced.

**Note:**

- (0) No Impact
- (-) Mid negative impacts
- (- -) Moderately negative impacts
- (+) Mild positive impacts
- (++) Moderate positive impacts
- (+++) extremely positive impacts

**ble 1.2: Summary of Likely Environmental Impacts during Implementation Phase**

Sl. No.	Activity	Issues Involved	Likely Impacts on Environmental Parameters	Degree of Impact
<b>(A) Pre-Construction Phase</b>				
1	Pre-construction Phase	Finalization of Engineering Design and Planning works and Project Finance - NIL	No Likely impacts	Negligible
		Official Meeting		
		Rehabilitation/ Resettlement & Land acquisition		
<b>(B) Construction Phase</b>				
	Construction Phase	Material Movement	Public Nuisance	Mild
		Operation of Construction Yards	Air quality & Noise Quality	Mild and Temporary, Restricted to construction period.
		Disposal of Waste Material	Soil Quality, Water Quality, Solid Waste Disposal	Mild
		Quarrying Operation	Land use pattern	Mild
		Construction Camps:		
		Traffic Congestion, Blocking or impairing access along the existing street	Circulation Impacts	Mild & Temporary, Restricted to construction period.
		Site office	Disposal of waste	Mild
		Equipment Storage and Machinery Maintenance	Occupational health and Safety	Moderate
		Employment Opportunities	Local people get employment	Beneficial Impacts
		Land use pattern	No likely impacts	Nil
		Aquatic Ecology	Not affected	Nil
		Terrestrial Ecology	Not affected	Nil

SI · N o.	Acti vity	Issues Involved	Likely Impacts on Environmental Parameters	Degree of Impact
		Reshifting and reallocation of underground/ overhead utilities	No likely impacts except for existing sewage pipe removals which has effect on worker's health	Nil and moderate
<b>(C) Operational Phase</b>				
3	Operational Phase	Operational and Maintenance	No likely impacts	Negligible

**Table 1.3: Summary of EMP (Project Implementation and Operation Phase)**

Sl. No	Project Activity/ Environmental Issues	Action/ Measures to be Taken	Responsible Organizations	Anticipated Costs
1.	Air quality and noise quality due to construction yard activity	Use close/covered trucks for transportation of construction materials. Clean surrounding area from dust by water sprinkling, removal of excess materials and cleaning of sites upon completion of activities. Select sites for construction camp and storage yard as per recommendation of EMP.	Prospective Contractor (PC) in consultation with MWPH	For various test at site , ,Cost is included in Bill No . 6 ( EMP) in Volume I of Tender documents and for other measures as per Contract specification Volume II of Tender Document , the contractor must include in his rate the cost for this item
2.	Borrow pits and quarrying	Firm-up contact with approved quarry and borrow pit sources, obtain permit from the relevant authorities for construction and disposal operations, and obtain balance output and requirement of material.	(PC)	For various test at site , ,Cost is included in Bill No . 6 ( EMP) in Volume I of Tender documents and for other measures as per Contract specification Volume II of Tender Document , the contractor must include in his rate the cost for this item
3.	Disposal of Construction debris	Weekly inspection of sites for collection and disposal of construction debris to approved landfill sites.	PC (Inspection by MWPH)	For various test at site , ,Cost is included in Bill No . 6 ( EMP) in Volume I of Tender

Sl. No	Project Activity/ Environmental Issues	Action/ Measures to be Taken	Responsible Organizations	Anticipated Costs
				documents and for other measures as per Contract specification Volume II of Tender Document , the contractor must include in his rate the cost for this item
4.	Traffic Management	Secure assistance from local police for traffic control during construction phase and prepare proper traffic diversion plans. Workers shall have relevant safety equipment.	PC in consultation with MWPH and Traffic Department	For various test at site , ,Cost is included in Bill No . 6 ( EMP) in Volume I of Tender documents and for other measures as per Contract specification Volume II of Tender Document , the contractor must include in his rate the cost for this item
5.	Construction Workers Colony/site office	Install lavatory at construction workers colony/ site office. Provision of collection domestic refuse and its disposal.	PC	For various test at site , ,Cost is included in Bill No . 6 ( EMP) in Volume I of Tender documents and for other measures as per Contract specification Volume II of Tender Document , the contractor must include

Sl. No	Project Activity/ Environmental Issues	Action/ Measures to be Taken	Responsible Organizations	Anticipated Costs
				in his rate the cost for this item
6.	Noise Pollution	Workers working in the vicinity of equipment generating high noise levels provided with earplugs, proper maintenance of construction equipment /machinery and vehicles.Termination of works at established times	PC	For various test at site , ,Cost is included in Bill No . 6 ( EMP) in Volume I of Tender documents and for other measures as per Contract specification Volume II of Tender Document , the contractor must include in his rate the cost for this item
7.	Air Pollution	Construction equipment/ machinery and vehicles be maintained in good condition. Dust cover to the vehicles carrying construction material. Sprinkling of water in dusty area.	PC	For various test at site , ,Cost is included in Bill No . 6 ( EMP) in Volume I of Tender documents and for other measures as per Contract specification Volume II of Tender Document , the contractor must include in his rate the cost for this item
8.	Equipment storage and maintenance yard	Waste collection, storage and disposal in proper manner. Whenever possible (in case of lubricants) should be reused.	PC	For various test at site , ,Cost is included in Bill No . 6 ( EMP) in Volume I of Tender

Sl. No	Project Activity/ Environmental Issues	Action/ Measures to be Taken	Responsible Organizations	Anticipated Costs
				documents and for other measures as per Contract specification Volume II of Tender Document , the contractor must include in his rate the cost for this item
9.	Transportation of Construction material	Routine check of vehicles used for transportation for adequate maintenance and compliance with emission norms and transportation and disposal established procedures.	PC (Inspection by MWPH)	For various test at site , ,Cost is included in Bill No . 6 ( EMP) in Volume I of Tender documents and for other measures as per Contract specification Volume II of Tender Document , the contractor must include in his rate the cost for this item
10.	Pollution (Air, noise due to Construction yard)	Ensure location of Construction yard at least 500m from habitation.	PC	For various test at site , ,Cost is included in Bill No . 6 ( EMP) in Volume I of Tender documents and for other measures as per Contract specification Volume II of Tender Document , the contractor must include

Sl. No	Project Activity/ Environmental Issues	Action/ Measures to be Taken	Responsible Organizations	Anticipated Costs
				in his rate the cost for this item
11.	Use of water on and off-site	All water on site will be transported in tankers by the Contractor of its own.	PC	For various test at site. Cost is included in Bill No. 6 ( EMP) in Volume I of Tender documents and for other measures as per Contract specification Volume II of Tender Document , the contractor must include in his rate the cost for this item
12.	Transportation and disposal of debris	Transportation and Disposal of debris according to the established procedures and into approved landfill sites, located away from habitations and well fields.	PC	For various test at site. Cost is included in Bill No. 6 ( EMP) in Volume I of Tender documents and for other measures as per Contract specification Volume II of Tender Document , the contractor must include in his rate the cost for this item
<b>OPERATION PHASE:</b>				
1.	Operation and Maintenance	All spare parts shall be readily available, provision of standby pumps and alternate power supply (Generator sets).	MWPH	

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<b>Sl. No</b>	<b>Project Activity/ Environmental Issues</b>	<b>Action/ Measures to be Taken</b>	<b>Responsible Organizations</b>	<b>Anticipated Costs</b>
2.	Routine Maintenance	Routine maintenance to be carried out and records to be maintained	MWPH	
3.	Preventive Maintenance	Daily observations recorded, half yearly, and Annual Maintenance shall be conducted.	MWPH	

## 5.4 General Guidelines

In addition to the above-mentioned recommendations and measures for mitigating negative impacts of construction works provided by the EMP, this following section provides general guidelines on the environmental sound practices applicable to this Project.

## 5.5 General

- i. The Contractor and his employees shall adhere to the mitigation measures set down and take all other measures required by the Engineer to prevent harm, and to minimize the impact of his operations on the environment.
- ii. The Contractor shall not be permitted to unnecessarily strip clear the right of way. The Contractor shall only clear the minimum width for construction and diversion roads should not be constructed alongside the existing road.
- iii. Remedial actions which cannot be effectively carried out during construction should be carried out on completion of each Section of the road (earthworks, pavement and drainage) and before issuance of the Taking Over Certificate:
  - (a) These sections should be landscaped and any necessary remedial works should be undertaken without delay, including grassing and reforestation;
  - (b) Water courses should be cleared of debris and drains and culverts checked for clear flow paths; and
  - (c) Borrow pits should be dressed as fish ponds, or drained and made safe, as agreed with the land owner.
- iv. The Contractor shall limit construction works to between 6 am and 7 pm if it is to be carried out in or near residential areas.
- v. The Contractor shall avoid the use of heavy or noisy equipment in specified areas at night, or in sensitive areas such as near a hospital.
- vi. To prevent dust pollution during dry periods, the Contractor shall carry out regular watering of earth and gravel haul roads and shall cover material haulage trucks with tarpaulins to prevent spillage.

### 5.5.1 Transport

- i. The Contractor shall use selected routes to the project site, as agreed with the Engineer, and appropriately sized vehicles suitable to the class of road, and shall restrict loads to prevent damage to roads and bridges used for transportation purposes. The Contractor shall be held responsible for any damage caused to the roads and bridges due to the transportation of excessive loads, and shall be required to repair such damage to the approval of the Engineer.

- ii. The Contractor shall not use any vehicles, either on or off road with grossly excessive, exhaust or noise emissions. In any built up areas, noise mufflers shall be installed and maintained in good condition on all motorized equipment under the control of the Contractor.
- iii. Adequate traffic control measures shall be maintained by the Contractor throughout the duration of the Contract and such measures shall be subject to prior approval of the Engineer.

#### **5.5.2 Workforce**

- i. The Contractor should whenever possible locally recruit the majority of the workforce and shall provide appropriate training as necessary.
- ii. The Contractor shall install and maintain a temporary septic tank system for any residential labor camp and without causing pollution of nearby watercourses.
- iii. The Contractor shall establish a method and system for storing and disposing of all solid wastes generated by the labor camp and/or base camp.
- iv. The Contractor shall not allow the use of fuel wood for cooking or heating in any labor camp or base camp and provide alternate facilities using other fuels.
- v. The Contractor shall ensure that site offices, depots, asphalt plants and workshops are located in appropriate areas as approved by the Engineer and not within 500 meters of existing residential settlements and not within 1,000 meters for asphalt plants.
- vi. The Contractor shall ensure that site offices, depots and particularly storage areas for diesel fuel and bitumen and asphalt plants are not located within 500 meters of watercourses, and are operated so that no pollutants enter watercourses, either overland or through groundwater seepage, especially during periods of rain. This will require lubricants to be recycled and a ditch to be constructed around the area with an approved settling pond/oil trap at the outlet.
- vii. The contractor shall not use fuel wood as a means of heating during the processing or preparation of any materials forming part of the Works.

#### **5.5.3 Quarries and Borrow Pits**

- i. Operation of a new borrows area, on land, in a river, or in an existing area, shall be subject to prior approval of the Engineer, and the operation shall cease if so instructed by the Engineer. Borrow pits shall be prohibited where they might interfere with the natural or designed drainage patterns. River locations shall be prohibited if they might undermine or damage the river banks, or carry too much fine material downstream.
- ii. The Contractor shall ensure that all borrow pits used are left in a trim and tidy condition with stable side slopes, and are drained ensuring that no stagnant water bodies are created which could breed mosquitoes.

- iii. Rock or gravel taken from a river shall be far enough removed to limit the depth of material removed to one-tenth of the width of the river at any one location, and not to disrupt the river flow, or damage or undermine the river banks.
- iv. The Contractor will be responsible for materials reuse optimization as well as for finding an outlet if there is subsequent surplus of construction materials at the end of the construction.
- v. The location of crushing plants shall be subject to the approval of the Engineer, and not be close to environmentally sensitive areas or to existing residential settlements, and shall be operated with approved fitted dust control devices.

#### **5.5.4 Earthworks**

- i. Earthworks shall be properly controlled, especially during the rainy season.
- ii. The Contractor shall maintain stable cut and fill slopes at all times and cause the least possible disturbance to areas outside the prescribed limits of the work.
- iii. The Contractor shall complete cut and fill operations to final cross-sections at any one location as soon as possible and preferably in one continuous operation to avoid partially completed earthworks, especially during the rainy season.
- iv. In order to protect any cut or fill slopes from erosion, in accordance with the drawings, cut off drains and toe-drains shall be provided at the top and bottom of slopes and be planted with grass or other plant cover. Cut off drains should be provided above high cuts to minimize water runoff and slope erosion.
- v. Any excavated cut or unsuitable material shall be disposed of in designated tipping areas as agreed to by the Engineer.
- vi. Tips should not be located where they can cause future slides, interfere with agricultural land or any other properties, or cause soil from the dump to be washed into any watercourse. Drains may need to be dug within and around the tips, as directed by the Engineer.

#### **5.5.5 Historical and Archaeological Sites**

- i. If the Contractor discovers archeological sites, historical sites, remains and objects, including graveyards and/or individual graves during excavation or construction, the Contractor shall:
  - (a) Stop the construction activities in the area of the chance find.
  - (b) Delineate the discovered site or area.
  - (c) Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be present until the responsible local authorities and the Ministry of Culture take over.

- (d) Notify the supervisory Engineer who in turn will notify the responsible local authorities and the Ministry of Culture immediately (less than 24 hours).
- (e) Contact the responsible local authorities and the Ministry of Culture who would be in charge of protecting and preserving the site before deciding on the proper procedures to be carried out. This would require a preliminary evaluation of the findings to be performed by the archeologists of the Ministry of Culture (within 72 hours). The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage, including the aesthetic, historic, scientific or research, social and economic values.
- (f) Ensure that decisions on how to handle the finding be taken by the responsible authorities and the Ministry of Culture. This could include changes in the layout (such as when the finding is an irremovable remain of cultural or archeological importance) conservation, preservation, restoration and salvage.
- (g) Implementation for the authority decision concerning the management of the finding shall be communicated in writing by the Ministry of Culture; and
- (h) Construction work will resume only after authorization is given by the responsible local authorities and the Ministry of Culture concerning the safeguard of the heritage.

#### **5.5.6 Disposal of Construction and Vehicle Waste**

- i. Debris generated due to the dismantling of the existing structures shall be suitably reused, to the extent feasible, in the proposed construction (e.g. as fill materials for embankments). The disposal of remaining debris shall be carried out only at sites identified and approved by the project engineer. The contractor should ensure that these sites (a) are not located within designated forest areas; (b) do not impact natural drainage courses; and (c) do not impact endangered/rare flora. Under no circumstances shall the contractor dispose of any material in environmentally sensitive areas.
- ii. In the event any debris or silt from the sites is deposited on adjacent land, the Contractor shall immediately remove such, debris or silt and restore the affected area to its original state to the satisfaction of the Supervisor/Engineer.
- iii. Bentonite slurry or similar debris generated from pile driving or other construction activities shall be disposed of to avoid overflow into the surface water bodies or form mud puddles in the area.
- iv. All arrangements for transportation during construction including provision, maintenance, dismantling and clearing debris, where necessary, will be considered incidental to the work and should be planned and implemented by the contractor as approved and directed by the Engineer.
- v. Vehicle/machinery and equipment operations, maintenance and refueling shall be carried out to avoid spillage of fuels and lubricants and ground contamination. An 'oil interceptor' will be provided for wash down and refueling areas. Fuel storage shall be located in proper bounded areas.

- vi. All spills and collected petroleum products shall be disposed of in accordance with standard environmental procedures/guidelines. Fuel storage and refilling areas shall be located at least 300m from all cross drainage structures and important water bodies or as directed by the Engineer.

## **5.6 Environmental Monitoring Plan (EMP)**

A Monitoring Plan (MP) is presented in this paragraph for sustainable implementation of the suggested EMP during project construction stage. The Operational Stage mainly requires maintenance of the road, which shall be done by the Maintenance Department of MWPH.

### **5.6.1 Construction Monitoring Plan Phase**

An Environmental Officer shall be appointed by the PIU who shall be responsible for monitoring the implementation of various clauses of the EMP. The Environmental Officer shall be appointed on a contract basis by the PIU and the PIU shall be responsible to check the performance of the Environmental Officer.

### **5.6.2 Responsibility of the Environmental Officer**

The Environmental Officer shall be responsible for carrying out inspection during the entire length of the construction phase. Each inspection shall be for three days duration and preferably one inspection in a month. After each inspection the Environmental Officer shall prepare a report containing location and activity under progress, areas of non-compliance with the EMP and share it with the PIU. He will give remarks on actions to be taken for proper implementation of the mitigating measures included in this EMP. Specifically the Environmental Officer will: (i) Implement regular monitoring according to checklist provided in point 5.5.3; (ii) monitor environmental quality according to point 5.5.4; and specific mitigation measures included in Annex 1. The report should also contain records of communication between the Supervision Consultant and the Contractor and/or Project Beneficiaries if necessary, on matters relating to this EMP. On completion of the project construction works, the Environmental Officer will prepare at the end of the project Monitoring Review Report. This report will contain:

- background to the project
- the empirical findings of the monitoring program and the site inspections
- a statement on the methodologies adopted for monitoring, the suitability of equipment utilized, its performance, the practical and technical difficulties experienced in collecting and analyzing the data, recommendations for future works
- a statement on suitability of resources available for monitoring and inspection and recommendations for future works
- a statement on the efficiency, or otherwise, of mitigation measures proposed
- a statement on the significance of any changes identified, both physical and social, as compared to those predicted
- a statement of lessons to be learnt and recommendations on any actions to be taken to ensure that these lessons are translated into positive actions on future projects
- a summary statement of the overall impact on the environment of the construction phase

### 5.6.3 Checklist for the Environmental Officer (EO)

The activities given in the following Table are required to be checked during each visit by EO and recorded properly and a copy must be submitted immediately to the Supervision Consultant, the Contractor and PIU.

#### Checklist of the activities to be checked by the EMO

Description of Activities	Yes	No	Remarks, if any
<p><b>1. General:</b></p> <ul style="list-style-type: none"> <li>- Are required recommendations of EMP generally being met and maintained?</li> <li>- Have workers working in the noisy areas been provided with protective devices?</li> <li>- Are workers working in good sanitation system?</li> <li>- Are medical check-up being done for the workers and particularly tests for HIV/AIDS?</li> <li>- Are construction personnel, equipment, and vehicles operating within the defined work area?</li> <li>- Is sprinkling of water being done in densely populated areas?</li> <li>- Are garbage, construction debris, and other waste being collected regularly and disposed off properly?</li> <li>- Are the vehicles carrying material and debris being covered properly?</li> <li>- Are the vehicles using approved access routes?</li> <li>- Are all necessary utility approvals, diversion plans, and traffic management plans in place?</li> </ul> <p><b>2. Access Roads:</b></p> <ul style="list-style-type: none"> <li>- Are access roads properly demarcated?</li> <li>- Is run-off from access roads causing water logging in or erosion to adjacent areas/properties?</li> </ul> <p><b>3. Camps:</b></p> <ul style="list-style-type: none"> <li>- Are camps located correctly?</li> <li>- Are lavatory facilities provided in construction camps?</li> <li>- Is septic tank built in the camps?</li> <li>- Is proper site drainage system and outfall discharges provided with erosion protection?</li> <li>- Is water logging condition prevailing inside the camp or drainage outfall causing flooding/water logging to adjacent areas/properties?</li> <li>- Are potable water facilities provided inside the camps?</li> <li>- Are domestic refuse and solid waste collected regularly and disposed to the approved landfill sites (verify name of site and compliance)?</li> </ul>			

**Checklist of the activities to be checked by the EMO**

Description of Activities	Yes	No	Remarks, if any
<ul style="list-style-type: none"> <li>- Are camps secured properly?</li> <li>- Are all fuel stores etc placed on appropriately sized hard stands with suitable fuel leaks retention ponds?</li> <li>- Are fuelling and maintenance of equipment conducted at defined sites?</li> <li>- Are proper records being kept on volume of waste generated?</li> <li>- Are first aid facilities provided at sites and camps?</li> <li>- Are good house keeping practices followed at camps?</li> </ul> <p><b>4. Material storage:</b></p> <ul style="list-style-type: none"> <li>- Are spoil heaps of an appropriate size?</li> <li>- Are materials stored properly?</li> <li>- Is there evidence of excessive wind blowing off material? If so, such material should be stored in confined places or properly covered to avoid wind borne particles to cause air quality problems or dust problems on adjacent properties.</li> <li>- Is there evidence of turbid waters running off from heaps? If so, assess environmental impact and mitigation measures.</li> </ul> <p><b>5. Excavation and trench digging works:</b></p> <ul style="list-style-type: none"> <li>- Are access points to the excavated sites or trenches appropriate?</li> <li>- Is top soil being salvaged and placed as specified in the contract specifications?</li> <li>- Are men working in excavated site or trenches equipped and protected properly?</li> <li>- Is cut material placed away from sides of excavated sites or trenches?</li> </ul> <p><b>6. Backfill:</b></p> <ul style="list-style-type: none"> <li>- Are soil and topsoil properly replaced without mixing?</li> <li>- Is backfill done properly?</li> </ul> <p><b>7. Construction sites:</b></p> <ul style="list-style-type: none"> <li>- Are site secured properly?</li> <li>- Are warning signs/cautionary boards placed near the construction site?</li> <li>- Are good house keeping practices followed at construction sites?</li> <li>- Are proper public safety provided near the operation of heavy equipments?</li> </ul>			

**Checklist of the activities to be checked by the EMO**

Description of Activities	Yes	No	Remarks, if any
<p>- Are materials stored properly especially bitumen?</p> <p><b>8. Clean up:</b></p> <p>- Is the final clean up appropriately timed up?</p> <p>- Has all man-made debris been removed?</p> <p>- Has access to all areas been restored?</p> <p>- Have all excavated sites /trenches/construction camps/workers camps been restored to as close as practicable to original configurations?</p>			

**5.6.4 Summary of Environmental Quality Monitoring**

The following Table gives summary of Environmental Quality Monitoring.

Sl. No.	Environmental Components	Indicator Parameters <sup>1</sup>	Frequency	Location
1.0	Air Quality	Respirable Particulate Matter (RPM) Suspended Particulate Matter (SPM) Nitrogen Oxides Oxides of Sulfur Dust fall	The inspection and testing should be planned for: (i) setting baseline conditions prior to construction start; (ii) during the peak periods of construction activities for which the contractors shall give advance notice; and (iii) if any complaint	At 5 locations (near the construction sites, Construction Camp, Crusher Plant & schools and hospitals, if any)
2.0	Noise Quality	Max. and Min. Noise Level Meter Equivalent Noise Level	The inspection and testing should be planned for: (i) setting baseline conditions prior to construction start; (ii) during the peak periods of construction activities for which the contractors shall give advance notice; and (iii) if any complaint	At 5 samples Construction sites, Construction Yard, Crushers, Hospitals & Schools, Residential Areas, if any.

<sup>1</sup> . Environmental quality parameters shall be measured and reported in accordance with guidelines, standards and procedures established by WHO latest edition and MOE requirements as applicable.

3.0	Public Health	Periodic Health check-up of construction workers, and HIV check ups (Yearly) Period reports of accidents associated with the works or construction activities of the public or road users and workers.	Quarterly  Monthly	-
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### 5.6.5 Laboratory Testing

The Contractor shall be responsible to carry out the various tests from an approved laboratory by the PIU and should include the name of the certified laboratory for doing sampling and testing in the Bidding document. The approved laboratory should submit the standards and procedures to be adopted for sampling and testing to the PIU through the Contractor before commencement of the work. The various parameters to be tested must be according to Yemen Guidelines/ WHO Standards. The details of various parameters to be tested for various items of tests are given hereinafter. The sampling and testing should be witnessed by PIU/ EMO and signed on the field reports. The Contractor is hereby instructed to fill up the rates of various laboratory testing and field testing to be carried out as given in the Bill of Quantities (BOQ).

### 5.6.6 Health Check-up

The health check-up should be conducted for HIV tests, Malaria and Diarrhea and drinking water quality tests.

### Standards for Quality of Drinking Water

Sl. No.	Item	Unit	Limit in Yemen		WHO Standards
			Desirable	Permissible	
<b>Physical Parameter</b>					
1.	Taste	-	Acceptable to people		Should be acceptable
2.	Odor	-	Acceptable to people		Should be acceptable
3.	Color	Pt-Co	15	15	15 TCU
4.	Turbidity	NTU	1	5	Median $5 \leq 1$ Single $\leq 5$
5.	Temperature	C	8-25	25	-
6.	pH	-	6.5-8.5	5.5-9	-
7.	Electrical Conductivity (EC)	$\mu$ mhos/cm	450-1000	2500	-
<b>Chemical Parameters</b>					
1.	Total Dissolved Solids (TDS)	mg/l	650	1500	-

Sl. No.	Item	Unit	Limit in Yemen		WHO Standards
			Desirable	Permissible	
2.	Bicarbonate (HCO <sub>3</sub> )	mg/l	150	500	-
3.	Chloride(Cl)	mg/l	200	600	250
4.	Sulfate (SO <sub>4</sub> )	mg/l	200	600	-
5.	Fluoride(F)	mg/l	0.5	1.5	1.5
6.	Calcium (Ca)	mg/l	75	200	-
7.	Magnesium (Mg)	mg/l	30		-
8.	Barium (Ba)	mg/l	0.1	0.15	0.7
9.	Sodium (Na)	mg/l	200	400	-
10.	Potassium (K)	mg/l	12	12	-
11.	Nitrate (NO <sub>3</sub> )	mg/l	45	50	50
12.	Iron (Fe)	mg/l	0.3	1	0.3
13.	Manganese (Mn)	mg/l	0.1	0.2	0.1
14.	Copper (Cu)	mg/l	1	1.5	1
15.	Zinc (Zn)	mg/l	5	15	-
16.	Silver (Ag)	mg/l	0.01	0.02	-
17.	Aluminium (Al)	mg/l	0.2	0.3	0.2
18.	Nickel (Ni)	mg/l	0.05	0.1	0.02
19.	Boron (B)	mg/l	0.5	1	0.3
<b>Organic Compounds</b>					
1.	Endrin	mg/l	0.0002		-
2.	Methoxine	mg/l	0.1		-
3.	Toxaphene	mg/l	0.002		-
1.	Lead	mg/l	0.05		0.01
2.	Selenium	mg/l	0.01		0.01
3.	Arsenic	mg/l	0.05		0.01
4.	Chromium	mg/l	0.05		0.05
5.	Cyanide	mg/l	0.1		0.07
6.	Cadmium	mg/l	0.005		0.003
7.	Mercury	mg/l	0.001		0.001
8.	Antimony	mg/l	0.01		0.005
<b>Chemical Pollutants</b>					
1.	Ammonium Hydroxide	mg/l	0.5		1.5
2.	Phosphorous Pentoxide	mg/l	5		-
3.	Silicon Dioxide	mg/l	40		-
4.	Biochemical Oxygen Demand	mg/l	NA		-
5.	Chemical Oxygen Demand	mg/l	3		-
<b>Radio Active Compounds</b>					
1.	Alpha emitters	pCi/l	0.1		0.1 µg/l
2.	Beta emitters	pCi/l	1		1 µg/l
<b>Viruses</b>					
1.	Coliforms	No./10 0 ml	Nil		-

Sl. No.	Item	Unit	Limit in Yemen		WHO Standards
			Desirable	Permissible	
2.	Fecal Coliforms	No./100 ml	Nil		-

### Microbiological Quality Guidelines of Yemen-EPA for Wastewater Use in Agriculture

Sl.No.	Re-use Conditions	Intestinal Nematodes (Arithmetic mean of no. of eggs per 1 liter)	Fecal Coliforms (Geometric mean of no. per 100 ml)
1	Irrigation of crops likely to be eaten uncooked	≤ 1	≤ 1000
2	Irrigation of sports fields, public parks & garden with which the public may come into direct contact	≤ 1	≤ 200
3	Irrigation of cereal crops, industrial crops, fodder crops, pasture & trees	≤ 1	-
4	Irrigation of fruit trees (irrigation should cease 2 weeks before fruit is picked up and no fruit should be picked off the ground)	≤ 1	-

### Ambient Air Quality Standards (in $\mu\text{g}/\text{m}^3$ ) of Yemen, WHO & USEPA

Air Pollutants	Time Weighted Average	Yemen-EPA <sup>1</sup>	WHO (1999) <sup>2</sup>	USEPA (July 1997) <sup>3</sup>	World Bank Guidelines
Nitrogen Dioxide (NO <sub>2</sub> )	Annual	-	40	100 (P&S)	100
	24 hours	150	200	-	150
	1 hour	400	-	-	-
Sulphur Dioxide (SO <sub>2</sub> )	Annual	-	50	80 (P)	80
	24 hours	-	125	365 (P)	150
	3 hours	-	-	1300 (S)	-
	10 minutes	-	500	-	-
Carbon Monoxide (CO)	8 hours	10,000	10,000	10,000 (P)	-
	1 hour	20,000	30,000	40,000 (P)	-
	30 minutes	-	60,000	-	-
	15 minutes	-	100,000	-	-
Lead (Pb)	Annual	1	0.5	-	-
	Quarterly	-	-	1.5 (P&S)	-
Particulate Matters	Annual	60	-	-	80
	24 hours	150	-	-	230
PM <sub>10</sub>	Annual	-	-	50 (P&S)	-
	24 hours	70	-	150 (P&S)	-
PM <sub>2.5</sub>	Annual	-	-	15 (P&S)	-

### Ambient Air Quality Standards (in $\mu\text{g}/\text{m}^3$ ) of Yemen, WHO & USEPA

Air Pollutants	Time Weighted Average	Yemen-EPA <sup>1</sup>	WHO (1999) <sup>2</sup>	USEPA (July 1997) <sup>3</sup>	World Bank Guidelines
	24 hours	-	-	65 (P&S)	-
Ozone (O <sub>3</sub> )	8 hours	120	120	157 (P&S)	-
	1 hour	200	-	235 (P&S)	-
Carbon Dioxide (CO <sub>2</sub> )	Annual	60	-	-	-
	24 hours	150	-	-	-
	1 hour	250	-	-	-

Table legend: P- Primary standard, S-Secondary standard

References:

<sup>1</sup> Guidelines & Regulations of EPA, Republic of Yemen, Council of Ministers, Decree No. 148 of year 2000.

<sup>2</sup> WHO, Air Quality Guidelines

<sup>3</sup> USEPA, July 1997, EPA Office of Air Quality Planning & Standards, USEPA, Triangle Park, USA

### Permissible Noise Limits as per Environment Protection Law, Yemen

Type of Area	Limit in dB(A) as per Article A of the Law			Limit in dB(A) as per Article B of the Law		
	Time			Time		
	A	B	C	A	B	C
Country side residential area & park area	45	40	35	60	55	55
Residential area (outside the city)	50	45	40	65	60	55
Residential area (inside the city)	55	50	45	65	60	55
Residential area (inside the city around workshops & commercial areas)	60	55	50	65	60	55
Industrial & commercial area	70	70	70	70	65	60

The World Bank guideline values of noise are as follows:

Industrial & commercial area: Daytime & Nighttime: 70dB (A)

Residential, institutional & educational area: Da

### Capacity Building

The Environmental Officer will also be responsible for briefing construction workers on the requirements of the EMP and the activities expected of the contractor. She/He will also brief the contractor's senior site staff on their specific responsibilities under the EMP and the expectations of them.

This briefing will take the form of one formal half-day classroom-type seminar and sub sequent informal on-the-job training in response to constructor's need. Both may need to be repeated as new or replacement staff join the project.

Location	Structure/Issue	Mitigation Measure (*)
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**Annex 1: Cost Estimate for Monitoring Plan**

**Bill No. 6 : Environmental Monitoring Parameters (EMP)**

**Construction of New Alignment of Abdullah Gharib Section on Rayyan Bin Aifan Road**

**Contract No. : FPERP-RR5**

<b>Item No</b>	<b>Description</b>	<b>Unit</b>	<b>Quantity</b>	<b>Rate (US\$)</b>	<b>Amount (US\$)</b>
E101	Visit to the project site by EMO for 3 days duration of each visit and at least one visit in each month	Day	54.00	\$60	\$3,240
E102	Testing of air quality samples during construction period (Twice in a month at 5 locations near construction sites, construction camp). On any complaint.	No. of Locations	180.00	\$20	\$3,600
E103	Testing of noise quality samples during construction period (Twice in a month at 5 locations near construction sites, construction camp) On any complaint.	No. of Locations	180.00	\$30	\$5,400
E104	Test of the samples for Public health checkup	No. of Samples	150.00	\$30	\$4,500
	- HIV				
	- Malaria				
	- Diarrhea				
	(Quarterly to be done and at least 25 samples each quarter)				
	- Other tests				
	Drinking water quality (at least one sample each month)	No. of Samples	18.00	\$50	\$900
<b>Total of Bill No.6 (carried to Summary of Bills)</b>					<b>\$17,640.00</b>

Starts	Ends		
Km ...	Km ...	Mosque	<p>Do not use area nearby area for temporary storage of construction material or as construction waste temporary accumulation site. Do not locate construction machinery/equipment nearby Mosque or Mosque's entrance.</p> <p>While working, in order to reduce nuisance form dust or noise, constructor will work around prayer time.</p>
Km ...	Km ...	Agricultural Lands	Do not store construction materials, construction waste, machinery and equipment in the area nearby, as this might result in pollution of water by construction run-off or leakages.
Km ...	Km ...	Playground	Do not use nearby area for temporary storage of construction material or as construction waste temporary accumulation site. Do not locate construction machinery/equipment nearby. Place relevant traffic control signs.
Km ...	Km ...	Cistern	Demolition and building of a new cistern with the same characteristics (i.e. Hexagonal shape, 16 square meter area, and 3.5 meters deep) out of the road corridor. The new cistern will cost \$5,000 and will be used for storage of water during rain/flash flood
Km ...	Km ...	Unpaved Tracks	Do not use nearby area for temporary storage of construction material or as construction waste temporary accumulation site to prevent blocking access. Do not locate construction machinery/equipment nearby approaching unpaved tracks.

Annex 2: Specific mitigation measures to be undertaken by Contractor

(\*) Environmental Officer will also report on these mitigation measures as part of its Monitoring responsibilities.