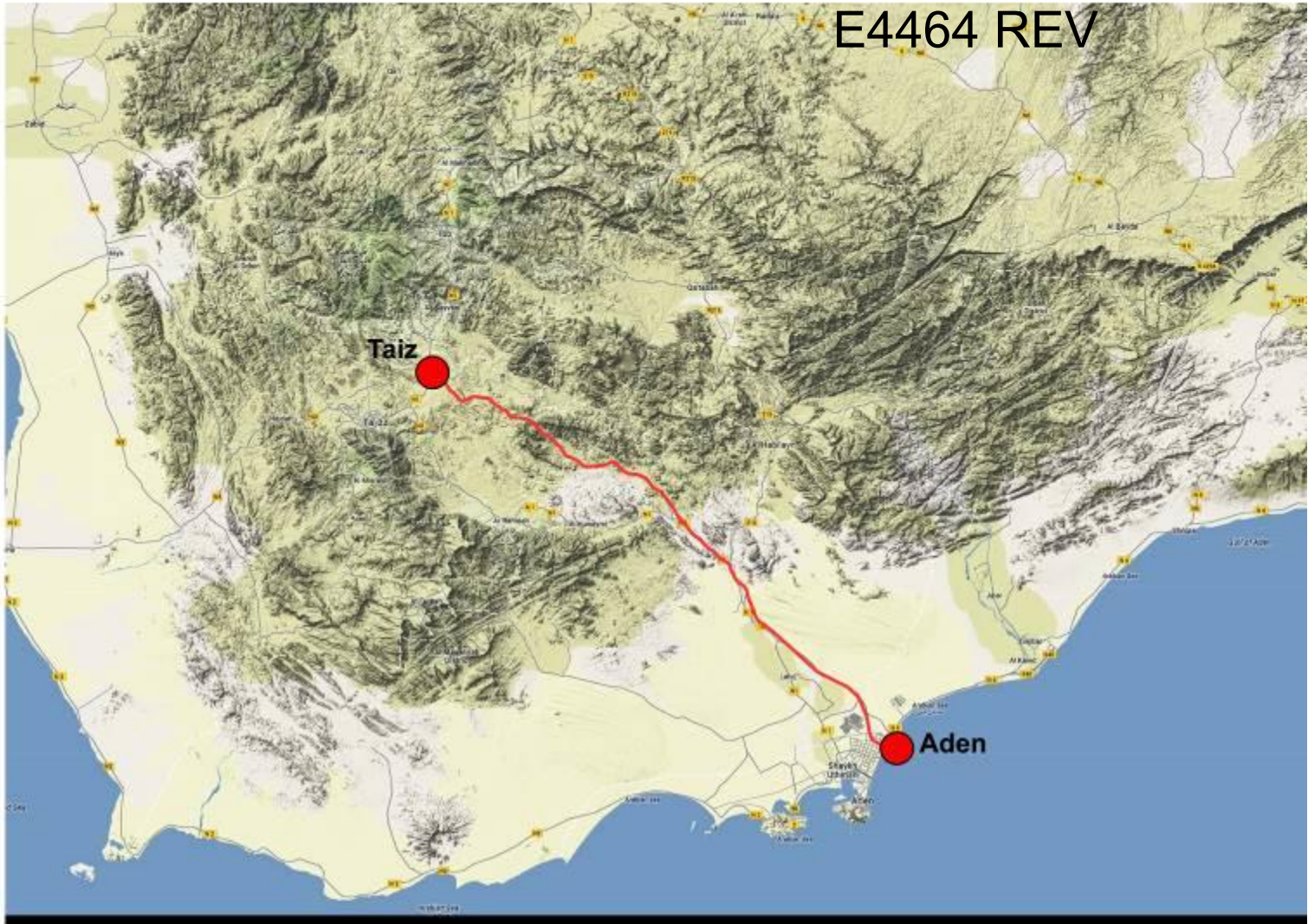


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Environmental & Social Impact Assessment (ESIA)/ Environmental & Social Management Plan (ESMP) for Yemen International Corridor Highway Project section between Taiz and the city of Aden (140 km)

Final Report

April 08, 2014



Public Disclosure Authorized

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Final Environmental and Social Impact Assessment (ESIA) / Environment & Social Management Plan (ESMP) Report

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List of Abbreviations

AASHTO	:	Association of Highway and Transportation Standards
AIDS	:	Acquired Immunodeficiency Syndrome
APHA	:	American Public Health Association
AWWA	:	American Water Works Association
BOD	:	Biological Oxygen Demand
CC	:	Compensation Committee
CH	:	Chainage
CITES	:	International Convention on Trade of Endangered Species
CO	:	Carbon Monoxide
COI	:	Corridor of Impact
DD	:	Data Deficient
EC	:	Electrical Conductivity
EIA	:	Environmental Impact Assessment
EPA	:	Environmental Protection Authority
EPC	:	Environment Protection Council
EPL	:	Environment Protection Law
ESIA	:	Environmental and Social Impact Assessment
ESMP	:	Environmental and Social Management Plan
FAO	:	Food and Agriculture Organization
GCC	:	Gulf Cooperation Council
GNI	:	Gross National Income
GoAMM	:	Ministry of Culture - General Organization for Antiquities, Museums and Manuscripts
GoY	:	Government of Yemen
GRC	:	Grievance Redressal Cell
HIV	:	Human Immunodeficiency Virus
ICB	:	International Competitive Bidding
IDA	:	International Development Association
IUCN	:	International Union for Conservation of Nature and Natural Resources
IVI	:	Importance Value Index
Km	:	Kilometre
LC	:	Least Concern
MAI	:	Ministry of Agriculture and Irrigation
MOLA	:	Ministry of Local Administration
MoPD	:	Ministry of Planning and Development
MoWE	:	Ministry of Water and Environment

MPWH	:	Ministry of Public Works and Highways
NDC	:	National Dialogue Conference
NE	:	Not Evaluated
NEAP	:	National Environmental Action Plan
NGO	:	Non-Government Organization
NWRA	:	National Water Resource Authority
OP	:	Operational Policy
PAP	:	Project Affected Persons
PIU	:	Project Implementation Unit
PLM	:	People with Limited Mobility
PM	:	Particulate Matter
PRS	:	Poverty Reduction Strategy
R&R	:	Rehabilitation and Resettlement
RAP	:	Resettlement Action Plan
RMF	:	Road Maintenance Fund
RoW	:	Right of Way
SAYICH	:	Saada–Aden Yemen International Corridor Highway
SC	:	Supervision Consultant
SFD	:	Saudi Fund for Development
SPM	:	Suspended Particulate Matter
TDS	:	Total Dissolved Solids
ToR	:	Term of Reference
TSS	:	Total Suspended Solids
UNCCD	:	United Nations Convention to Combat Desertification
UNDP	:	United Nations Development Programme
US	:	United States
VSPL	:	Voyants Solution Pvt. Ltd.
VU	:	Vulnerable
WB	:	The World Bank
WHO	:	World Health Organization
WWF	:	World Wildlife Fund for Nature
YAEC	:	Yemen Advance for Engineering Consultants & Contracting

0 EXECUTIVE SUMMARY

0.1 Introduction

This executive summary aims at presenting the main findings of the Environmental and Social Impact Assessment (ESIA) conducted for two sub-sections of the new highway, for which funding have been identified. The first sub-section which is to be funded by the World Bank (IDA) is located between Aden and Noubat Dokaim with a length of 55 km. The second sections, to be funded by the Saudi Fund for Development, is located between Noubat Dokaim and Taiz, with a length of 85 km. The total length of both sections is 140 km. The new highway is being developed as part of the completely new dual carriageway highway between Aden and the border with Saudi Arabia (denominated as “Saada–Aden Yemen International Corridor Highway” or “SAYICH). This new 710 km long North-South route would adequately serve current and future transport needs.

The most direct beneficiaries of the Corridor Highway Project, and of the wider SAYICH Program, are Yemeni road users, which may be vehicle owners, but can also be passengers traveling in buses, or owners of cargo being transported by truck.

The ESIA is based (i) on the scope of work given in Terms of Reference (TOR) provided to the Consultant, (ii) on discussions between the consultant and MPWH officials and (iii) on consultations with stakeholders during the site visits and surveys (iv) a thorough review and analysis of the technical interventions (road construction) of the project which are provided in the detailed technical design which was previously prepared by an engineering design consultant, (v) a review of the environmental and social assessment requirements for such projects as defined by the Government of Yemen and the World Bank’s applicable policies and guidelines, and (vi) the cataloguing of environmental and social issues which were identified during the site visits and stakeholders consultations.

The document consists of the following chapters: introduction, project description policy legal and administrative framework, description of baseline environmental and socio-economic conditions, public consultation, community participation and grievance redress mechanism, analysis of project alternatives, potential environmental and social impacts, environmental and social management plan, monitoring and institutional strengthening and institutional arrangements.

0.2 Project Description

The construction on the new alignment over the entire length shall be double carriageway. The project road starts at Al-Alam near the coastal city of Aden and ends at Al-Ganad, about 12 km northeast of the city of Taiz. The proposed Aden -Taiz (140 km) road section traverses through three Governorates of Republic of Yemen namely; Aden, Lahj and Taiz. One of the criteria for the selection of the corridor was to avoid passing through towns, villages and settlements.

The highway was originally designed as a 6-lane road (3 travel lanes in each direction). However, on the 55 km subsection between Aden and Noubat Dokaim the highway will only be built as a 4-lane road (2 travel lanes in each direction), but with a platform wide enough to accommodate two additional lanes in the future. The

overall platform width is 36.7 m, to accommodate 2 x 3 travel lanes, each 3.65 m in width, of which only the two outer lanes in each direction will be built now. The median will be (i) wide enough to accommodate two additional travel lanes (one in each direction) in the future when traffic levels require such an additional investment, and (ii) will still be 6 m wide after the addition of the two lanes, or 3.6 meters wide in mountainous terrain. The typical cross-section will also include, on each side of the road, a 2.0 m wide verge, and gravel and paved hard shoulders, each of 1.2 m in width. On the 85 km subsection between Noubat Dokaim and Taiz the civil works will be done in line with the original design, with all 6 travel lanes to be built now. The design speed is of 100 or 120 km/h, depending on local conditions. This will be a “controlled access” highway, with entry and exit only possible at the interchanges which will connect this highway with the rest of the Yemeni road network. Numerous road culverts (5 x 5 m and 3 x 3 m) are foreseen for provision of access between different sides of the highway, and for access between villages and farmland. These culverts will be suitable for pedestrians and animals. Civil works will also include the duct for a new fibre optic backbone cable and related manholes, etc. which will be incorporated into the road embankment or sub-base.

A view of the proposed highway alignment is shown below.



From North to South, the corridor of the highway starts and runs through a wide and flat-bottomed intensively-cultivated valley approximately up to Ch.km 5.5. After that; it crosses a rugged hilly and mountainous region, divided by many steep-sided and deep wadis, approximately up to Ch. Km 24.5 near Mawiyeh town.

Approximately from Ch.24.5 to Ch.39.5, the road alignment runs through relatively narrow valley bounded by steep rugged mountains.

The alignment crosses these mountains at several locations. The valley is intensively cultivated and planted. Along this stretch, the road alignment crosses several rugged basaltic hills. The area between Ch.39.5 and Ch.50 is rugged hilly rocky side that contains some steep igneous mountains. Approximately from Ch.50. to Ch. 90.5; the road corridor passes through relatively low-rise soil hilly areas that are built up by thick soil deposits.

The site is divided by several steep-sided wadis. Approximately, from Ch.90.5 to the end of the road, the roadway passes through flat to gently rolling and undulated terrain covered mostly by fine, loose wind-blown sand and crossed by many sand dunes.

The typical cross-section of the new highway is shown in Chapter 2 of this ESIA.

The overall purpose of this ESIA is to fully comply with the applicable regulations, policies and guidelines which apply to the project of building the new Corridor Highway between Aden and Taiz (140 km).

0.3 Policy, legal and administrative framework

A desk study was carried out by the study team to assess and prepare the most applicable legal and administrative framework to the proposed project. The assessment has taken into consideration, both the potential Yemeni environmental laws and those policies and procedures of the World Bank related to the subject project.

Yemeni Environmental Laws & land acquisition Regulation

- The Environment Protection Law (EPL) number 26 of 1995
- Article 35 of Environment Protection Law (EPL)
- Article 36 of Environment Protection Law (EPL)
- The Public Eminent Domain Law Articles 1, 2, 4, 6, 7 , 12, 15, 21 & 27

Yemen Government Policy, Strategies and Programs Relevant to Environmental Protection & Social Causes

- National Environmental Action Plan, 1996
- Environment & Sustainable Investment Program 2003-08
- Biodiversity Strategy, 1999-03
- Environmental Impact Assessment Policy for the Republic of Yemen 1997
- Annual Reports on the State of Environment (by EPA),
- Evaluation of Future Development of the EIA System in Yemen 2001.
- Social Welfare Fund (SWF), an agency under the Ministry of Insurance and Social Affairs (MISA)
- Poverty Reduction Strategy (PRS)
- Yemeni Women's National Strategy

World Bank's Policies and Procedures

The World Bank has 10 current Operational Policies and Procedures:

- OP/BP 4.01 Environmental Assessment
- OP/BP 4.04 Natural Habitats
- OP/BP 4.09 Pest Management
- OP/BP 4.10 Indigenous Peoples
- OP/BP 4.11 Physical Cultural Resources
- OP/BP 4.12 Involuntary Resettlement
- OP/BP 4.36 Forests
- OP/BP 4.37 Safety of Dams
- OP/BP 7.50 Projects on International Waterways
- OP/BP 7.60 Projects in Disputed Areas

With respect to this project, three key policies are being triggered.

- Environmental Assessment (OP/BP 4.01),
- Involuntary Resettlement (OP/BP 4.12) and
- Physical Cultural Resources (OP/BP 4.11)

0.4 Description of Baseline Environmental and Socio-Economic Conditions

Depending on the local topographic conditions, the RoW is between 50-70 meters wide. It is also considered that a corridor of 500 meters on each side of the proposed alignment will be indirectly affected during the construction period of the project. Indirect environmental influence could affect nearby agricultural and grazing land, water bodies, forest land etc. although there is no declared forest land in the project area.

Geologically the proposed highway corridor between Aden and Taiz runs along two geo-morphological units, namely the Yemeni Highland Geomorphologic Province and the Gulf of Aden Coastal Plains.

The Climate of Yemen is characterized as semi-arid type with rainy summers and a cool, moderately dry winter. Temperatures are generally high particularly in the coastal regions. The highlands enjoy a cool temperate, with temperatures occasionally dipping below 0 °C (32.0 °F) at some places. Some areas of the western highlands such as around Taiz receive about 1,000–1,500 mm (39.4–59.1 in) of rain each year. Humidity ranges from 23 to 60%. Wind speeds ranges from 4 to 16 knots in highlands and in coastal areas are from 5 to 19 knots.

Air pollution is not identified as a critical issue in the area of the planned road alignment since it is passing mostly through rural areas and villages without much traffic or polluting industrial or commercial activities. Air quality in most of the project area is dominated by natural factors, such as dust blown up by wind from the land areas not covered by vegetation. There are some small-scale industries near the planned highway alignment near Taiz (Al-Ganad) and small-scale industries engaged in stone cutting and cement block manufacturing which are sources of some limited air pollution within the project area. There are also unpaved roads near the planned road alignment and traffic on those roads cause a significant amount of dust in those areas. Air Quality monitoring was carried out at six locations along the proposed alignment and was found that all the gaseous air pollutants were within the WHO standards. Only PM₁₀ was found to be marginally on higher side due to dust.

Noise sources of significance are mainly man-made (i) operation of stationary motors to power pumps for drawing water from wells, and for grain mills, (ii) farm tractors used in the agriculture fields, and (iii) motorized vehicles travelling on the mostly unpaved local roads. There are some very limited activities in the project area which create vibrations. People generally use rocks for construction of their houses or other small structures. Noise monitoring was carried out at six locations and was found out that results at all the locations are within the limits of WHO standards for Industrial and Commercial areas. At two locations the noise was higher due to high wind movements and being near to traffic junction.

Hydrology: Due to unconformity of bedding and inter fingering of Quaternary soil formations with the underlying igneous rock formations, local perched water confined in water bearing lenses may also be found.

Surface and Ground Water Resources: Depth to groundwater in these local aquifers may vary from few meters to about 20m; one of the most important and most studied aquifers is that underlying the coastal catchments of Wadi Tuban and Wadi Bana to the east. The planned alignment of the highway runs through Wadi Tuban approximately from km 90 to km 125. Only two perennial wadis were observed during the field visits in December 2013. One of them is Wadi Warzan which is crossed by the planned highway alignment at several locations, approximately from km 60 to km 75. There are many other locations where the planned road would cross small seasonal water passes which are typically dry and only carry water for short periods during and after rains. The number of such water crossings in each Governorate is given below:

Sl. No.	Description	Taiz	Lahj	Aden	Total
1	Surface Water crossings	142	24	0	166

There are large numbers of water wells in the area of influence of the planned highway. The list of affected water wells is listed below:

Sl. No.	Type of Properties	Taiz	Lahj	Aden	Total
1	Wells	16	5	1	22

Ecology: Flora in the entire project corridor is generally rather sparse and has been altered to various extents as a result of several types of pressure on the existing natural habitats, primarily by agriculture, grazing and habitation. The predominant over storey vegetation along the project road alignment is *Acacia abyssinica*, *Acacia asak* and *Ziziphus leucodermis* etc. In addition, *Azadirachta indica*, *Mangifera indica* and *Ficus spp* and the understorey vegetation on and near the alignment of the project road are *Calotropis procera*, *Euphorbia cactus*, *Opuntia ficus-indicus* and *Jatropha dhofarica* etc. No species of threatened, rare or endangered categories of IUCN (International Union for Conservation of Nature and Natural Resources) Red Data Book have been observed along the project road corridor. as many as 21,025 trees will be affected, out of which 2,146 trees are fruit bearing and the remaining 18,879 trees are non-fruit bearing. In addition, about 412,050 Qat plants will also be affected. Overall, a total of about 433,075 trees/plants will be required to be cut for the construction of proposed YCHP. The list of all affected trees/plants is given below:

Sl. No.	Trees	Taiz	Lahj	Aden	Total
1	Fruit bearing	926	1220	00	2146
2	Non-Fruit Bearing	11128	7751	00	18879
3	Qat	390037	22013	00	412050
Total		402091	30984	00	433075

Agricultural crop observed along the project road alignment is Qat (*Catha edulis*), which is considered among one of the most profitable cash crops in the country. The highland section of the project road is further known for growing millet, sorghum and wheat crops, fruits such as grapes, nuts, apples and pomegranate, as well as pumpkins, tomatoes, onions, beans and potatoes as vegetables, and coffee as another cash crop.

Wildlife observed all along the project road alignment are the Hamadryas Baboon (*Papio hamadryas*), though its numbers too are said to be diminishing. Among the smaller mammals are Rock Hyrax (*Procavia capensis*), Wild Cat (*Felis silvestris*), Hyena, Fox and Common Hare.

Demographic profile: Baseline socio-economic survey on a random basis of 25 percent of the surveyed households in the proposed highway corridor was carried out. The majority of population is in the governorate of Taiz (64.36%) followed by Lahj (19.49%) and Aden (16.15%). The analysis of the field survey reveals that 50.4% of the population is male and 49.6% is female. At all the project governorates rural population relatively more as compared to urban population. The average family size along the project area is 8.2 members. However, the average size of the affected households is 11.8 members because there are several very big households among the affected. The majority of families are Joint (93%) followed by Nuclear (5.7%) and Extended (1.3%). The literacy rate in the project area is 91.7 % and thus higher in comparison with the country average. 54.7% have undergone Primary educations, 9.8% secondary, 3.6% university level, whereas 20.8% households are just literate. Occupation wise majority of households' members are engaged in agriculture (56.3%) followed by others (19.7% i.e. unemployed persons, aged family members, housewives and children), students (13.5%), labourer activities (2.7%), business (2.6%), government service (1.6%), private service (1.4%). Majority of households (72.6%) have reported their annual income in range of US\$ 500-600, followed by 9.4% households in the range US\$ 600-800. Baseline survey revealed that people along the project area are typically in reasonably good health and fitness. However, during the field survey some of them have reported to be affected, or have recently been affected, by diseases such as malaria, dengue fever, polio, hepatitis, mylasis and amoebiasis. Significant proportion of households in the project area belong to lower income groups and are further disadvantaged by relatively poor access to community infrastructure such as Hospitals, Schools, Religious schools, Drinking water, Electricity, Landline phones, Supermarket, Police station, Banks, Chemist and Internet cafes. Women's participation in society is typically limited to their household work and they constitute only 4.7% of the work force for agriculture.

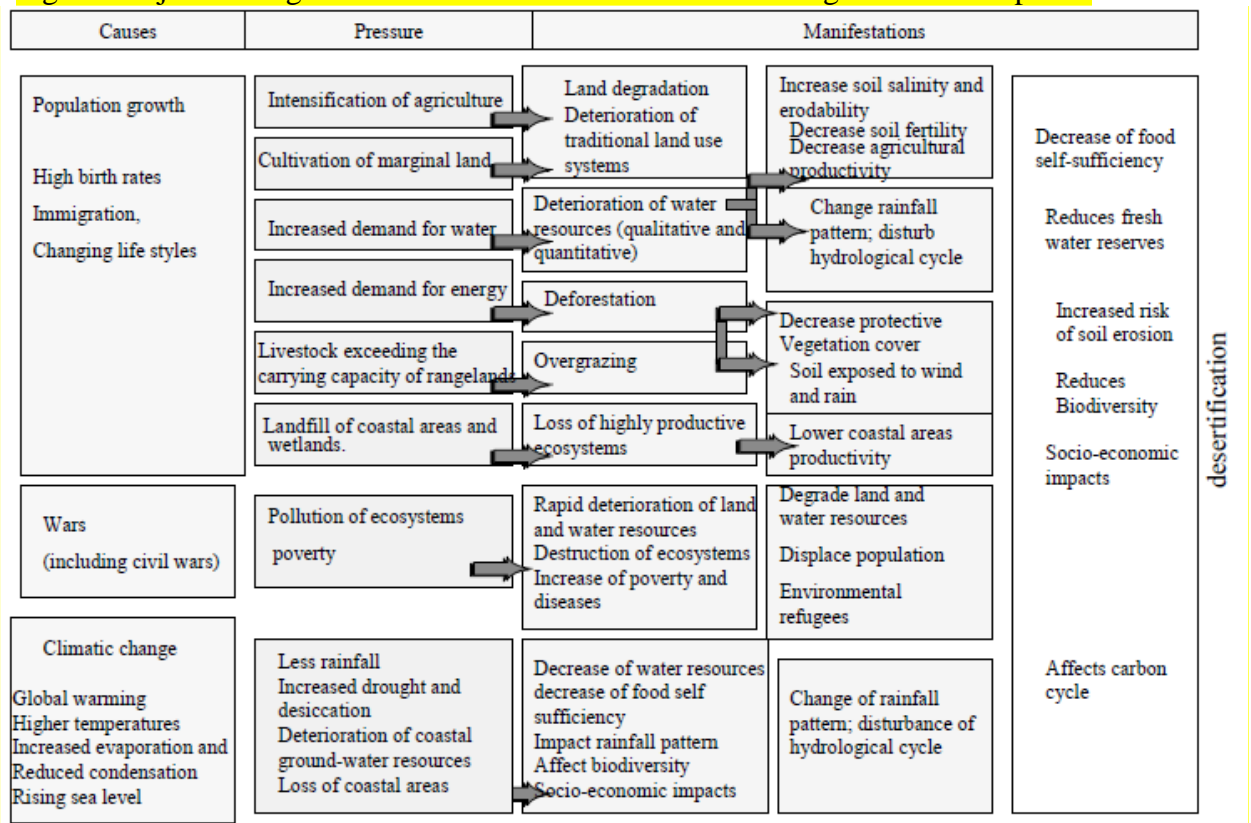
Road Safety: Traffic injuries rank among the top 10 causes of death in Yemen. About 13,000 accidents with injuries each year, affecting about 17,000 people and their families. The number of recorded fatal accidents is 990, 226 and 299 in Taiz, Lahj and Aden Governorates alone.

Land use: Overall, the data shows that the largest land use categories are “unused” with 486.38 hectares followed by “arid land” with 347.39 hectares, out of the total of 1,221 hectares of land to be acquired. The land used for any types of crops is approximately 177 hectares.

Desertification:

Yemen suffers from desertification, which is defined as “land degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climatic variations and human activities”.¹ For more than a decade, the Government of Yemen has recognized that desertification threatens seriously the natural resource-base.² The most well known causes of desertification are those stemming from demographic growth and are linked to satisfying the primary needs of populations faced with ever increasing needs for food, fodder, firewood, etc. The direct causes of desertification are: climate, geology and soil, topography, natural calamities, provision of infrastructure, misuse of natural resources, agricultural abandonment. While no recent analysis of the contribution of various different causes is available, the following figure summarizes the causes of desertification across the region.

Figure: Major Driving Forces of Desertification in the Arab Region and its impacts³



¹ Source: Ministry of Agriculture and Irrigation (2000): Draft National Action Plan to Combat Desertification for Yemen pp vii

² Ibid. pp 1

³ Source: Abahussain A. A., Anwar Sh. Abdu, Waleed K. Al-Zubari, Nabil Alaa El-Deen, Mahmmod Abdul Raheem (2002): Desertification in the Arab Region: Analysis of current status and trends in Journal of Arid Environments, 51:521-545; doi:10.1006, available online at <http://www.idealibrary.com> accessed on 18th April 2014

In Yemen, the provision of infrastructure has been identified as a contributor to desertification along the shorelines of Abyan, Tuban, Hodeidah-Duraihimi etc., where it is leading to very intense, erratic, and unforeseeable coastal dune erosion and sand movement. Also, due to lack of efficient urban planning in Yemen, most agricultural land in cities and along main roads is exploited for residential or other urban usages, resulting in loss of highly productive lands.

While the proposed construction of the Corridor Highway is not likely to directly contribute to an increase in desertification, there could potentially be an indirect impact due to the removal of vegetation for the construction of the road. In order to minimize this, the project includes plantation along the alignment, wherever sufficient water is available. In specific locations, where local people have asked for beautification, landscaping and plantation have been integrated in those plans. While a notional budget has been provided for roadside plantation, actual availability of land and water, and consultation with stakeholders, like local leaders, residents, etc. will determine the extent to which plantation will be effected. Monitoring of the plantation to be carried out under the project is also required as part of the Environmental Management Plan.

Other measures such as improved urban planning, or restrictions on the use of ground water, are beyond the scope of the project.

Cultural properties: There are 10 graves and 8 small village mosques which will be directly affected by the new project and which will need to be relocated.

0.5 Public Consultation, Community Participation And Grievance Redress Mechanism

Extensive public consultations were carried out with various stakeholders throughout the length of the proposed highway corridor between Aden and Taiz. The main public consultations were undertaken with in groups which included government officials, PAPs, and community leaders (sheiks) in 13 villages. Consultations with women groups were held separately in 10 villages. The groups identified during the consultation process included:

- People affected by land acquisition
- People to be physically displaced
- Government officials at governorate and district levels
- Community leaders
- Business owners, operators and workers in installations along the alignment of the planned expressway, including owners and employees of informal and unlicensed entities
- Residents along the alignment of the highway including women
- Farmers with land close to the planned highway alignment
- Women living along the planned highway alignment
- People and Communities affected by the needed relocation of mosques or graves.

Issues Raised during the consultation process were: Land acquisition minimization, Resettlement impacts mitigation measures, Underpasses at schools, madrasa, religious schools and hospitals, Wayside amenities and public facilities including toilets and drinking water, Road safety measures, Pedestrian pathways, Shifting of religious places at appropriate locations with community consensus, Resettlement assistance

package, Income and employment generation schemes should be launched all along the project influence area, Compensation should be computed at current market price of land and structures, Special signage near schools, college and road turnings and crossings, Street lighting, Traffic signal lights, People were asked if they support the proposed highway or not.

Responses received from people were positive and the main concern was regarding the resettlement and adequate compensation. The local people stated that due to availability of road there will be faster interaction with the people of other villages. Hence road will play role in relationship building.

Women's Consultations and discussions were also held separately in 10 villages, in line with local customs and traditions. These consultation meetings were organized to get wider public input from female project affected persons. Consultations with women were conducted with the objectives including: (i) identifying women specific issues in the project; (ii) securing participation of women in definition of mitigation measures; (iii) ascertain the views of the affected women groups with reference to land acquisition and project road alignment; (iv) understand views of the women on livelihood rehabilitation options; (v) obtain opinion of the women groups on issues related to the impacts on religious and community assets and relocation of the same; (vi) hear women's opinion on problems and prospects of road related issues; and (vii) to establish an understanding by the women of the overall developmental objectives and benefits of the project. The issues raised by women are presented in this ESIA.

Post ESIA Consultations: Regular communication processes shall be established with the affected communities. Prior to and during the construction activities, the staff of the Project Implementation Unit (PIU) of MPWH staff will organize consultations in various locations along the project corridor, with participation of civil works contractors and the supervision consultants.

Grievance redress mechanism is presented in the Resettlement Action Plan and the Grievance management system is described in detail in chapter on Institutional Arrangements.

0.6 Analysis of project alternatives

As part of the project feasibility study, several alternative corridors for the new highway between Taiz and Aden were defined, studied and compared. detailed investigation of three alternative corridors for the new highway, each with its own character:

- The "Green Corridor" with a length of 143.6 km. This is a relatively short alignment located near to the axis of the existing road.
- The "Yellow Corridor" with a length of 153.3 km. This corridor would maximise economic and social development along the alignment, by providing access to a large area which is now relatively isolated.
- The "Blue Corridor" with a length of 135.3 km. This corridor would be a compromise solution between a short route and nevertheless facilitating improved development along the alignment by integrating some areas that are presently rather isolated.

These three alternative corridors were defined as technically possible and verified in the field. They were then evaluated based on various criteria, some of which are linked to each other: Traffic and development impact, Design, Geology, Hydrology, Environment and Social and Cost & initial economic feasibility evaluation.

Environment and Social criteria used were: settlement areas, social infrastructure and human health, caused by noise, by air pollution, and by traffic accidents, land resources and agriculture, caused by loss or severance of land resources and agricultural soil, together with the social impact on the rural population, natural environment, vegetation, forests and habitats, due to habitat degradation and loss of biodiversity, groundwater resources and wadis, by pollution of sensitive aquifers or surface waters (such as by spillage accidents) or by a change of natural flow of surface waters, cultural heritage, landscape resources and tourism potential, by loss or severance of traditional hillside terraces, of traditional architecture, or of landscape attractive to tourism and ecotourism.

For comparison of alternative corridors, the main impacts of the different alternatives have been compiled in the table below.

Summary of likely impacts for the three alternative corridors

Impacts	Alternative		
	Green	Yellow	Blue
Settlement areas (km within 300 m corridor)	11	7	7
Schools (number within 300 m corridor)	9	6	33
Hospitals (number within 300 m corridor)	1	1	5
Intensively used agricultural areas (km)	20	14	7
Extensively used agricultural areas (km)	24	21	15
Natural environment, forests (km)	36	39	57
Groundwater resources (km)	89	71	73
Wadis (number)	5	7	8
Cultural heritage, tourism potential (km)	21	21	5
Length (km)	143,6	154,9	135,3
Area covered, land consumption (km²)	6,00	6,47	5,66

The result of the overall evaluation of the three potential corridors (Green, Yellow and Blue) showed that a fourth possible alternative composed of a combination of two of the alternatives would compound their respective advantages and provide the best results - this would be the combination of the Blue alternative for the northern part (to the North of Noubat Dokaim) and the Yellow alternative for the Southern part of the highway. This combination was denominated as the Purple corridor, which showed the most advantages and the best results. The eight interchanges on this Purple alternative are at: Taiz, Mawiyah, Ad Durayjah, Musaymir, Aqan, Noubat Dokaim, and Al Hutahand Aden. Based on the results of the multi criteria analysis, the Purple corridor alternative was then selected for the detailed engineering design and feasibility studies.

0.7 Potential Environmental and Social Impacts

This Chapter identifies the potential impacts of the project that are likely to occur, before and during construction, and during the operational/maintenance phase. The chapter also identifies the mitigation measures which are designed to help reducing

the magnitude of adverse impacts and to keep them at acceptable levels, thereby combining the goal of long term sustainable development of a region with sound environmental and social considerations.

Impacts on the physical environment: Impacts were predicted on the following parameters:

- Micro Climate,
- Air quality,
- Dust,
- Generation of exhaust gases will occur due to the operation of various types of heavy machinery with internal combustion engines, mostly for earth movement and for laying of pavement,

Mitigations Measures Suggested:

- Equipment and machinery used for construction will be regularly maintained to minimize the pollution emission levels.
- Regular monitoring of Particulate Matter at crusher sites, during the construction, will be conducted. If established limits are exceeded, water spraying will be used if water is available. Alternatively, screens will be installed in the downwind direction to reduce the spreading of particulate matter beyond the crusher sites.
- Avoiding queuing of the construction traffic vehicle fleet on the roads adjacent to the sites to minimize the exhaust emissions generated during construction work.
- During operation stage, roadside plants that will be planted in some areas along the highway with sufficient water will act as pollution sink.
- Reduction of emission that can be effected by improved engines and quality of fuel are beyond the scope of this project

Noise & Vibrations Mitigation measures: Noise impacts (including from rock blasting) can be mitigated by confining the construction activities to normal working hours in the areas near settlements / villages and by employing modern construction equipment with noise insulation. Specific measures to mitigate noise impacts during the construction phase may include the following provisions: Source Controls, Site Controls, Time and activity constraints, Community Awareness. Other measures includes: Workers camp siting, scheduling of noise construction operations, No Horn Sign boards, appropriate signage's and signals for slowing down near sensitive receptors, Proper maintenance of vehicles, Provision of personal protective equipment's and controlled blasting. Noise barriers at locations where the highway passes within a short distance of settlements/villages or sensible receptors (schools/hospitals/mosques/madrassa).

Impacts on Water Environment: (i) Highway construction may obstruct the movement of water through these channels, causing difficulty to the farmers to irrigate their land or have water near their houses. (ii) Degradation of water quality can occur due to an increase in sediment load into watercourses near the construction sites. (iii) Degradation of water quality is also possible due to accidental discharges into watercourses from drainage of workers' camps and from spillage in vehicle parking and/or fuel and lubricant storage areas.

Mitigations Measures Suggested during construction stage:

- Restriction of work on construction of bridges and culverts during the rainy season.
- Use of silt fencing, sediment traps etc. for minimization of soil movement.
- Construction of cofferdam with materials that cannot be brought into suspension by flowing waters.
- Provision of cover of tarpaulins or other material under the bridge deck to prevent debris, wastes and toxic compounds from entering the stream.
- Avoidance of lead-based paints in painting bridge components
- Use of oil/water separators at drainage of construction camps to extract floating oils.

- Proper storage of contaminated liquids and disposal after treatment to bring such liquids within prescribed permissible limits.
- Fuelling area for vehicles and equipment's will be selected away from water bodies.

Mitigations Measures Suggested during operation phase:

- Modification of embankment slopes to prevent entry of contaminated water into watercourses.
- Drilling of alternative wells, to replace those wells to which access by local populatins is effectively blocked by the new highway, after consultation with affected local communities.
- Water harvesting will be used as much as possible. Since water harvesting requires detailed knowledge of local micro-conditions, the feasibility of water harvesting at potential locations will be evaluated jointly between MPWH, the supervision engineer and local communities. If feasible, the necessary physical works will be incorporated in the contractor's program of works through change orders.

Impacts on Landscape and soil: The total quantity of borrow materials is 27,000,000 m³ and of aggregates is 7,100,000 m³. Since most of the borrow materials will come from areas which will be cut anyway to create the highway platform, there will only be a limited impact in terms of borrow areas outside the right-of-way of the highway. Soil contamination could occur due to following reasons which may happen during construction and operation phase:

1. Maintenance (especially oil change) of machinery and operation of the diesel generator sets on the construction.
2. Oil Spills from operation of the mechanical workshops, diesel pumps and diesel storage, during transportation and transfer, parking places, and diesel generator sets.
3. Operation of the emulsion sprayer.
4. Operation of the residential facilities for the labour and staff.
5. Accidental spill of emulsion, oil and other materials.
6. Residue of blasting chemicals

Mitigations Measures Suggested:

- If land at borrow pits and quarries needs to be acquired permanently, it will be compensated as per the entitlement framework given in the RAP.
- The Contractor will identify the disposal locations for surplus materials in consultation with Supervision Consultant, MPWH and local communities in order to minimize the impact on trees and other vegetation and on natural hydrology/drainage systems of the project area.
- After their use, local quarries and borrow areas will be closed, rehabilitated and made safe.
- The land used for temporary construction camps, workshops, labour camps and parking areas will be restored to its original condition as much as possible so that it can be used for the same purpose it had been used earlier.
- Any land used temporarily, such as for construction camps, offices, plants, storage yards, traffic detours, etc. will not be located on fertile land unless unavoidable. If these are to be located on fertile land, the topsoil will be stripped; stored properly and such areas will be restored after completion of work.

- Soil erosion (especially during the rainy season) will be avoided through the available methods, such as retaining structures, erosion fences, etc.
- Wherever the availability of water makes this possible, vegetation will be planted on embankments slopes.
- The road drainage systems will be built to ensure that water runoff from the highway will flow into the road drainage system to prevent any possibility of soil erosion.

Ecological Impacts: Approximately 21,025 trees which will have to be cut in the Right-of-Way of the new highway. Of that total number, about 2,146 trees are fruit bearing trees like mango, pomegranate, orange and guava etc. and 18,879 trees are non-fruit bearing like Athl, Alab, and Amrud and Adelbert etc. There will be loss of approximately 412,050 Qat plants. There are wild animals like wild cat, jackal, hyena, common mongoose and fox in the project area. During the construction phase of the project these animals will migrate to some other places due to direct impact on their habitation. There are nests of birds on the trees in the project area. The cutting of trees will directly affect the habitation of these birds (like common sparrow). Even if there will not be any direct impact on the habitat of birds, they could still be affected indirectly due to air and noise pollution during construction and operation phase of the project.

Mitigations Measures Suggested:

- As much as possible and depending on the local conditions (availability of water and soil), plantation of roadside vegetation will be carried out along the highway embankment and in the highway median.
- The location of construction camps, stone crushing unit, asphalt mixing plant and waste disposal sites will be chosen so that they are at a distance of at least 2000 m away from areas with known concentrations of plants or wildlife

Social Impacts

The main negative impacts expected due to land acquisition during the pre-construction phase are:

- loss of agricultural land and the resulting loss of agricultural production and in turn of livelihood for farmers;
- loss of land used for residential purposes, which is often combined with the demolition of residential structures and the resulting loss of living space for people;
- loss of land used for commercial purposes, which is often combined with the demolition of commercial structures such as shops, etc. and the resulting loss of income from commercial activities;
- loss of water wells, leading to a loss of access to water resources;
- loss of mosques and graves which are cultural resources

According to census survey results, a total of 2,685 households are likely to be affected by land acquisition. Among them, 308 households are tenants. In total 31,695 persons will be affected. These households earn their livelihood primarily through agriculture, Qat cultivation, wage labour and through small businesses. A total of 1,224.8 hectares of land is to be acquired permanently for the project. Of the three governorates involved in the project, land acquisition will be disproportionately heavy in Lahj Governorate (909.6 ha.), significant in Taiz Governorate (277.9 ha.), and

relatively minor in Aden Governorate (37.3 ha). The impact of land acquisition on livelihoods is likely to be significant in many cases. Of the 2,159 individual plots involved in land acquisition, 1,318 are to be acquired in their entirety (100%) while the remaining 841 plots are to be acquired in part.

In addition to land acquisition, YCHP will require substantial demolition of structures and relocation of residents. In all, 169 households (or 2,789 people) will be required to relocate. Among the governorates, Taiz will require the greatest relocation (2,546 people), compared to 233 in Lahj and 10 people in Aden. As many as 1,224.80 hectares of land will be required for the project, belonging to private owners (485.91 ha), communities (299.58 ha) and the State (439.31 ha. of public land).

A total of 170 residential structures are to be demolished, of which 127 residential structures are located in Taiz Governorate and 42 in Lahj Governorate. There are 61 shops or other commercial structures that may need to be demolished due to the project. The great majority of impacts on such businesses will occur in Lahj Governorate, where 43 commercial structures will be demolished, most of which are at one single location near Noubat Dokaim where a large interchange is to be built. It has recently been decided to change the design of this intersection which will significantly reduce the need for acquisition of commercial land and demolition of commercial structures. 17 commercial structures will be demolished in Taiz Governorate.

In all, YCHP will acquire 161 hectares of agriculture land, plus 696.18 hectares of pasture area. The majority of agriculture land acquisition will take place in Taiz Governorate (118.46 ha) followed by Lahj (40.07 ha). Only 2.47 ha of agricultural land will be acquired in Aden Governorate.

Among 2,159 plots of land, there are 1,329 plots of private agricultural land, of which 721 plots (54%) will be wholly acquired (by 100%).

The majority of crops on land to be acquired is corn (82.21 ha) followed by clover 13.36 ha, wheat (6.33 ha), sorghum (4.44 ha) and henna (0.47 ha).

The field survey has also revealed that as many 433,075 trees/plants are likely to be affected due to the construction of the proposed highway. These include as many as 412,050 Qat plants (which are classified as trees), 794 banana, 522 mango, 187 papaya, 169 guava, 50 lemon, and 18,879 trees of other types.

The land attachment assets which are likely to be affected due to the proposed highway corridor project involves 22 water wells, 2 water pools, 38 fences, 16 guard rooms, 10 graves, 8 mosques and one barn.

31,695 persons (of which 19,974 are male and 15,721 female) will potentially be impacted or will suffer socio-economic losses as a result of project activities due to land acquisition for the project.

2,789 persons (of which 1,405 are male and 1,384 female) will be potentially impacted through residential assets losses as a result of the project.

463 persons (of which 231 are male and 232 female) will be potentially impacted/suffer losses due to demolition of commercial assets (small shops) as a result of project implementation.

Mitigations Measures Suggested:

- Mitigation for loss of land will be done on the basis of compensation either in cash, or land-for-land swaps, or a combination of both. Mitigation for crop loss will be on the basis of cash compensation taking into account the cropping pattern of the fields. Vulnerable groups may be provided with special support for livelihood restoration.
- Cultural resources such as graves and mosques shall be relocated in consultation with local people and the cost of relocation will be covered through cash payments.
- Water wells will be also relocated in consultation with local people, supported by cash payments to pay for digging or boring new wells.
- The loss of residential or commercial structures will also be compensated through cash payments or rebuilding of equivalent structures by the civil works contractor.
- The design includes 60 locations along the new highway where it can be crossed, namely (i) 12 road intersections with overpasses, (ii) 3 bridge underpasses, (iii) 2 bridge overpasses, (iv) 20 road culverts and (v) 23 large other culverts suitable for pedestrians and small vehicles (farm tractors, etc.). These structures are located at all those places where local populations need to cross the highway on a regular basis, in order to access farm fields, other villages, shops, etc. The average distance between designed crossings is 2.3 km, but in the populated areas the actual distances are much smaller.

Positive Social Impacts:

- In the short term, the construction itself of the road will bring important short-term benefits through job opportunities for thousands of workers, unskilled and skilled, (about 1.28 million person-days of unskilled work alone during the 3 to 4 years of project execution, at a rate of about US\$ 18 per day). Unskilled workers, which in economic terms are part of the bottom 40% of the population, will typically be recruited from the area of the physical works, resulting in direct income generation.
- In the medium and long term, the new Highway Project is expected to bring trade facilitation and general economic revitalization, by lowering transportation costs and travel times, reducing overall trade costs, and by bringing access to international markets through Aden deeper into the country. The highway will also provide better access by rural populations to markets and services located in the larger cities along the new highway (Aden, Lahj and Taiz). Most social services, such as general healthcare, emergency medical services, education, etc. are located in the cities and the new highway will provide faster and easier access to those.
- The project is expected to have a transformational impact due to the new institutional arrangements for asset management and maintenance that it will introduce, again providing business opportunities for local firms and communities along the highway corridor.

0.8 Environmental And Social Management Plan (ESMP)

The Environmental and Social Management plan matrix prepared for the proposed project during construction and operation / maintenance phase is given in **Table 0.1 and Table 0.2**. The main element of ESMP is the cost of implementation which shall be integrated into the contractor's cost. The project envisages about **US\$ 8,073,100** required to cover the following aspects :

- ESMP construction and operation/maintenance phase;
- Training, and
- Environmental enhancements

Table 0.1: ESMP during Pre-construction and Construction Phase

Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (Incl. Enforcement & Coordination)	Cost Estimate	Comments (e.g. secondary impacts)
Agricultural Land Acquisition	Economic and Livelihood loss	Proper Compensation for 161.00 ha of agriculture land shall be provided as per the rates decided (Details provided in RAP).	PIU, MPWH, Revenue Department of Taiz, Lahj and Aden Governorates	An average compensation rate of US\$ 4/m ² is decided for agricultural land. The cost estimate is US\$ 6,440,000. Details are given in RAP.	Appreciation of the land cost in the vicinity of Highway. Ribbon development along the highway.
Acquisition of private and Government Properties, Water access units and religious structures.	Economic loss, Temporary loss of shelters, Temporary non-availability of water for domestic use and for irrigation	Proper Compensation for 22 water wells, 2 water pools, 38 fences, 16 guard rooms, 10 graves, 8 mosques and one barn shall be provided as per the rates decided (Details provided in RAP), Relocation of graves and mosques with consultation with local people. Relocation of water wells in consultation with local people.	PIU, MPWH, Revenue Department of Taiz and Lahj and Aden Governorates.	As per the Entitlement matrix given in RAP.	Pressure on water resources in nearby areas.
Cutting of fruit, non-fruit bearing and Qat	Livelihood loss, Loss to Ecology, Loss of nests of birds living on	Total number of 21,025 trees shall be affected due to Highway construction, out of which about 2,146 trees are fruit-bearing and the rest 18,879 trees are non-fruit bearing. In addition, about 412,050 Qat	PIU, MPWH, Revenue Department of Taiz and Lahj and Aden Governorates	A compensation rate of US\$ 5 to 500 / tree for fruit, non-fruit bearing trees and for Qat trees	

Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (Incl. Enforcement & Coordination)	Cost Estimate	Comments (e.g. secondary impacts)
trees. Relocation of Qat trees.	these trees.	plants shall also be affected. Green belt development and median plantation has been proposed along the alignment where water is available.		US\$ 15 / tree is decided. (Relocation of Qat trees: US\$ 3/tree.) The total cost estimate is US\$ 865,305 for destroyed Qat trees and US\$ 1,854,225 for relocation of Qat trees, US\$ 244,245 for fruit-bearing trees and US\$ 943,950 for non-fruit bearing/other trees.	
Location of Crushers, hot-mix and Batching Plants.	Air and Noise, Loss of agriculture land, Loss of natural landscape.	Hot mix and batching plants to be located sufficiently away from settlements, agricultural operations or any commercial establishments. Such plants shall be located at least 1000 m away from the nearest village/ settlement preferably in the downwind direction. Arrangements to control dust pollution through provision of windscreens, water sprinkling and dust encapsulation shall have to be provided at all such sites.	Contractor/ SC, PIU, MPWH	Included within Contractor's price. The cost of monitoring is given in Table 9.1.	Temporary land acquisition.
Operation of Construction Vehicles, Equipment and Machinery.	Air pollution, Noise and Oil spill lead to soil and water contamination.	All vehicles, equipment and machinery to be operated shall be of good international standards. All dumpers carrying construction material and debris should be covered to avoid dust pollution. Use Personal Protective Gear by workers, to be made mandatory at these sites. EHS Guidelines of the World Bank Group to be	Contractor/ SC	Included within Contractor's price. The cost of monitoring is given in Table 9.1.	

Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (Incl. Enforcement & Coordination)	Cost Estimate	Comments (e.g. secondary impacts)
		<p>followed for all construction activities.</p> <p>Idling of vehicles shall not be permitted.</p> <p>All vehicles should adhere to pollution norms.</p> <p>Vehicles and other machinery to be maintained to reduce the air borne contaminants and noise pollution.</p> <p>Noise limits for construction equipment to be operated such as compactors, rollers, front loaders concrete mixers, cranes (moveable), vibrators and saws shall not exceed 75 dB (A), measured at one meter from the edge of the equipment in free field.</p>			
<p>Arrangement of Water for Construction purposes.</p>	<p>Shortage of Water for Local people. Dispute over Water use/resources.</p>	<p>Contractor is not allowed to use any community water resources.</p> <p>To avoid disruption/disturbance to other water users, the contractor shall extract water from fixed locations in consultation with the SC before finalizing the locations.</p> <p>Contractor shall provide a list of locations and type of sources from where water for construction shall be used.</p> <p>Contractor shall not be allowed to pump water from any irrigation canal.</p> <p>The water for construction shall be used mainly from Wadis (Rivers) or water stored in small dams during rainy season. The water from these sources</p>	<p>Contractor, SC and PIU (MPWH)</p>	<p>Included in Construction cost.</p>	

Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (Incl. Enforcement & Coordination)	Cost Estimate	Comments (e.g. secondary impacts)
		shall not affect the usage of local people as discussed with Governors and local people.			
Sitting of Labour and Construction camps	Social Issues due to cultural differences, Loss of agriculture land, Loss of natural landscape	Arrangement of local Labor. Avoid camp construction on agricultural land.	Contractor, SC and PIU (MPWH)	Included in Construction cost.	Livelihood generation for local people.
Generation and disposal of construction wastes and excess materials.	Agricultural soil Pasture land, Loss of landscape value, Dust and noise pollution	Waste land shall be used for waste disposal as 439.32 ha of wastelands are available along the alignment. Confining vehicle maintenance and refuelling to areas in construction camps designed to contain spilled lubricants and fuels. Use special containers with complete labelling, Use second containment tanks for oil collection and handling, Collection, storage and disposal to approved disposal sites, according to EPA requirements, and, to the extent possible, reuse, recycle and properly disposing off all construction materials. Collection of rehabilitation material and transferring it to a licensed dumping site. It is recommended managing the rehabilitation materials for further utilization in the road construction.	Contractor, SC and PIU (MPWH)	Included in Construction cost and the cost of monitoring is given in Table 9.1.	
Opening of Borrow and	Agricultural land and pasture land,	No borrow and quarry site shall be opened without permission of the SC. The location, shape and size	Contractor, SC and PIU (MPWH)	Included in Construction cost and	

Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (Incl. Enforcement & Coordination)	Cost Estimate	Comments (e.g. secondary impacts)
Quarry Sites	Change in land use, Loss of productive soil, Dust Generation.	<p>of the designated borrow and quarry areas shall be as approved by the SC and as per the agreement between the land owner and the contractor.</p> <p>The unpaved surfaces used for the haulage of borrow soil and aggregates materials, if passing through the settlements or habitation shall be maintained dust free by the contractor. Sprinkling of water shall be carried out at least twice a day to control dust along such roads during their period of usage.</p> <p>During dry and windy seasons (winter and summer) frequency of water sprinkling shall be increased near the settlement areas and SC shall decide the numbers of sprinkling locations depending on the local requirement.</p> <p>Contractor shall rehabilitate the borrow areas as soon as work is over for a particular borrow area in accordance with the agreement between the land owner and the contractor. A completion certificate indicating that the redevelopment plan has been executed, countersigned by the owner, shall be furnished by the Contractor for record of the PIU, MPWH.</p>		the cost of monitoring is given in Table 9.1.	
Construction near Wadis	Obstruction of flow of water, Contamination of surface water, Silting of water bodies.	<p>The Wadi Tuban and Aakan are perennial which are crossing the alignment, all other water bodies and wadis are seasonal hence, the contractor shall make sure that the flow of wadis/water bodies/water ways shall not be obstructed / prevented during the presence of water in the water bodies.</p> <p>Construction work close to these seasonal</p>	Contractor, SC and PIU (MPWH)	Included in Construction cost. The cost of monitoring is given in Table 9.1.	Dispute over water usage between local persons and labors.

Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (Incl. Enforcement & Coordination)	Cost Estimate	Comments (e.g. secondary impacts)
		<p>Wadis/water bodies/water ways shall be undertaken only during the dry season. If construction work is expected to disrupt users of community water bodies, advance notice shall be served to the affected community.</p> <p>Contractor shall serve advance notice to the downstream users of water wherever excavation/drilling is to take place in the water bodies.</p> <p>Contractor shall take prior approval of the competent authority or SC for any such activity. The PIU, MPWH shall ensure that contractor has served the notice to the downstream users of water well in advance.</p>			
Traffic Diversion And Construction Site Access Points	<p>Air Quality And Noise</p> <p>Road and labour safety</p>	<p>Reduce working night shifts as much as possible in populated areas and apply road watering after heavy movements</p> <p>Apply the Yemeni regulation for ambient noise levels during this phase as a major tool in designing the construction activities schedule.</p> <p>Measure concentrations of particulate matter</p> <p>Use personal protective gear by workers, and make first aid available onsite.</p> <p>Provide warning signs at suitable distance around working areas</p>	Contractor, SC and PIU (MPWH)	Included in Construction cost. The cost of monitoring is given in Table 9.1 .	
Chance Finds	Physical Cultural Resources may be	(a) Stop the construction activities in the area of the chance find;	Contractor, SC and PIU (MPWH)	Included in Construction cost.	

Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (Incl. Enforcement & Coordination)	Cost Estimate	Comments (e.g. secondary impacts)
	impacted	<ul style="list-style-type: none"> (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 (within 24 hours or less); (e) Responsible local authorities and the Ministry of Culture would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed by the archeologists from the Heritage Authority (within 72 hours). The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historic, scientific or research, social and economic values; (f) Decisions on how to handle the finding shall be taken by the responsible authorities from the Heritage Authority. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeologically 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 			

Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (Incl. Enforcement & Coordination)	Cost Estimate	Comments (e.g. secondary impacts)
		Ministry of Culture; and (h) Construction work could resume only after permission is given from the responsible local authorities and the Ministry of Culture concerning safeguard of the heritage.			
Miscellaneous activities like fuelling, painting etc.	Soil and water pollution	Use of sand platforms for fuelling and transferring of fuel. In case of any oil or paint spillage, immediately remove the contaminated material and dispose it at safe place.	Contractor, SC and PIU (MPWH)	Included in Construction cost.	

Table 0.2: ESMP during Operation / Maintenance Phase

Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (incl. enforcement & coordination)	Cost Estimates	Comments (e.g. secondary impacts)
Road Marking and painting on sign boards.	Road Safety, spillage of oil and paint etc. Air and Noise Quality Waste Management	Use proper warning signs at suitable distance; Immediately remove the contaminated soil and dispose the waste in Hazardous waste disposal site.	MPWH/EPA The cost of monitoring is given in Table 9.1.	As required / per unit.	Only in maintenance areas
Maintenance of side and median guardrails.		Avoid working at night.			
Repair of fence.		Proper collection of waste in working areas.			
Maintenance of road surface.		Avoid bitumen melting activities in open spaces.			
Maintenance of bridges, cleaning of underpasses and maintenance of drainage.		Regular Cleaning of underpasses and culverts.			
Maintenance of service areas for relocated small businesses.	Waste Management	Periodic cleaning and maintaining services areas.	MPWH	As needed	Only in rest and service areas.
Monitoring of Restoration of Borrow area.	Landscape and aesthetics	During restoration period of borrow sites until the site is handed over to land owner.	MPWH and Contractor	Cost included in the cost of construction.	
Dismantling of Labor and construction camps	Landscape and aesthetics	During restoration period of labor and construction camps as per agreement with land owner until the site is handed over to land owner.	MPWH and Contractor	Cost included in the cost of construction.	



Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (incl. enforcement & coordination)	Cost Estimates	Comments (e.g. secondary impacts)
Greenbelt and Median plantation monitoring	Landscape and ecological	Plantation of trees to replace dead trees and regular watering of roadside plantation and median plantation.	MPWH/ Forest or Agriculture Department/Contractor	Cost included in the cost of construction.	

Environmental Enhancement: Consultations at various levels has been carried out in order to identify and select the existing facilities which should either be improved or to provide any new facilities in these areas under environmental enhancement proposal. 17 locations were identified based on the discussions with the communities for environmental enhancement. The locations included improvement of stadium,, school, provision of new water, health and recreation facilities for a total budget of USD 585,000.

The total monitoring and ESMP cost which includes the Environmental mitigation, Environmental & Social Monitoring cost, training cost, and environmental enhancement cost is estimated at **US\$ 8,073,100.**

0.9 Monitoring & Institutional Strengthening

Regular monitoring of all significant, environmental and social parameters is essential to ascertain compliance to the country's environmental social laws and regulations. The objectives of monitoring is to measure the compliance of construction activities with the ESMP, verify the results, ensure implementation of safety concepts and ensure that construction work is going ahead with all statutory permissions and consents. The monitoring arrangements are essentially the same for the two sub-sections financed by the World Bank (IDA) and the Saudi Fund for Development.

Each part of the site where construction is taking place needs to be formally inspected from an environmental and social viewpoint on a regular basis. An environmental and social monitoring program is presented for both the construction and operation / maintenance phases. The monitoring program will focus on air quality, water quality, soil quality, tree plantation; borrow area restoration, socio-economic activities within the project area. The Environmental quality monitoring program will consider the parameters for Air, water, soil and noise quality.

Environmental and Social (E&S) Specialists within the PIU (MPWH) will be responsible for monitoring of the compliance with the ESMP, and will work in close collaboration with the Ministry of Environment & Water (MoEW) and Environmental Protection Authority (EPA).

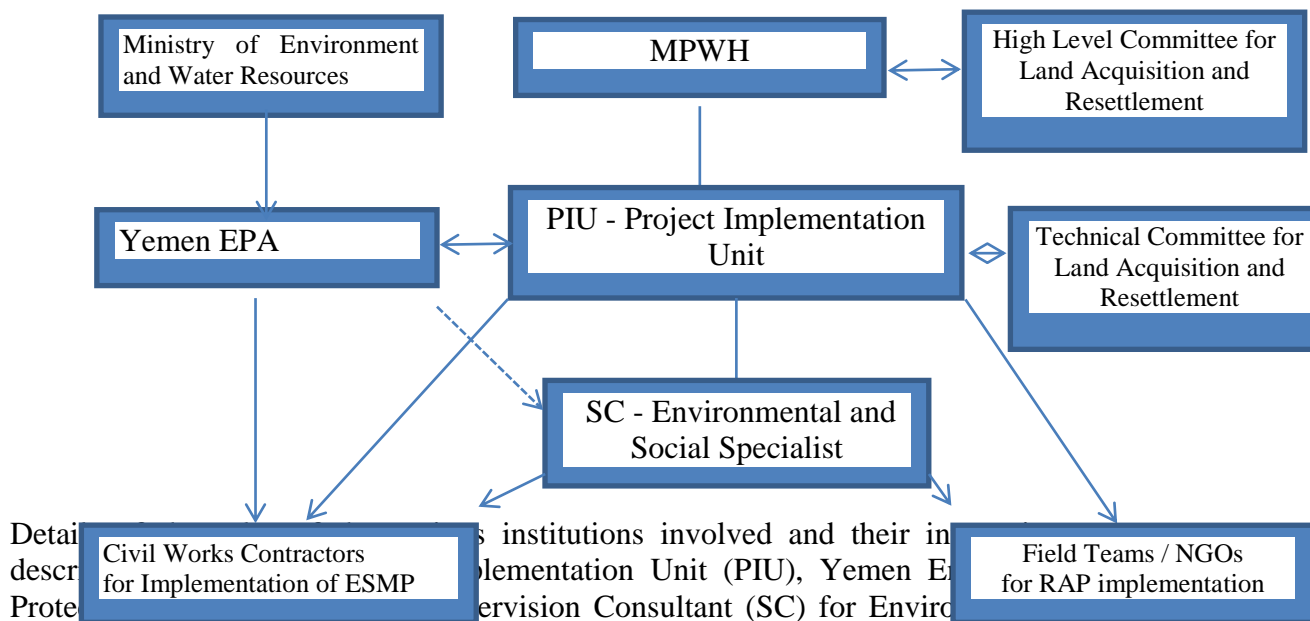
Upon completion of the project (i.e., during the operation / maintenance phase) and thereafter, periodic routine inspections / monitoring will continue by the dedicated E&S specialists at the PIU (MPWH) in collaboration with Ministry of Environment & Water and Environmental Protection Authority (EPA).

World Bank will monitor the implementation of road specific ESIA/ESMPs and other Safeguard related documents (Resettlement Action Plans etc.). In particular the Bank must ensure that proper monitoring takes place and that the reports are filed regularly. Should these reports indicate incomplete monitoring of specifically identified social issues; these will be reported to the responsible staff in the PIU (MPWH).

0.10 Institutional Arrangements

The institutional arrangements for ensuring adequate management of the environmental and social aspects of the Corridor Highway Project are described in

this chapter. Figure given below provides an overview of the institutional setup related to the implementation of the ESMP and RAP.



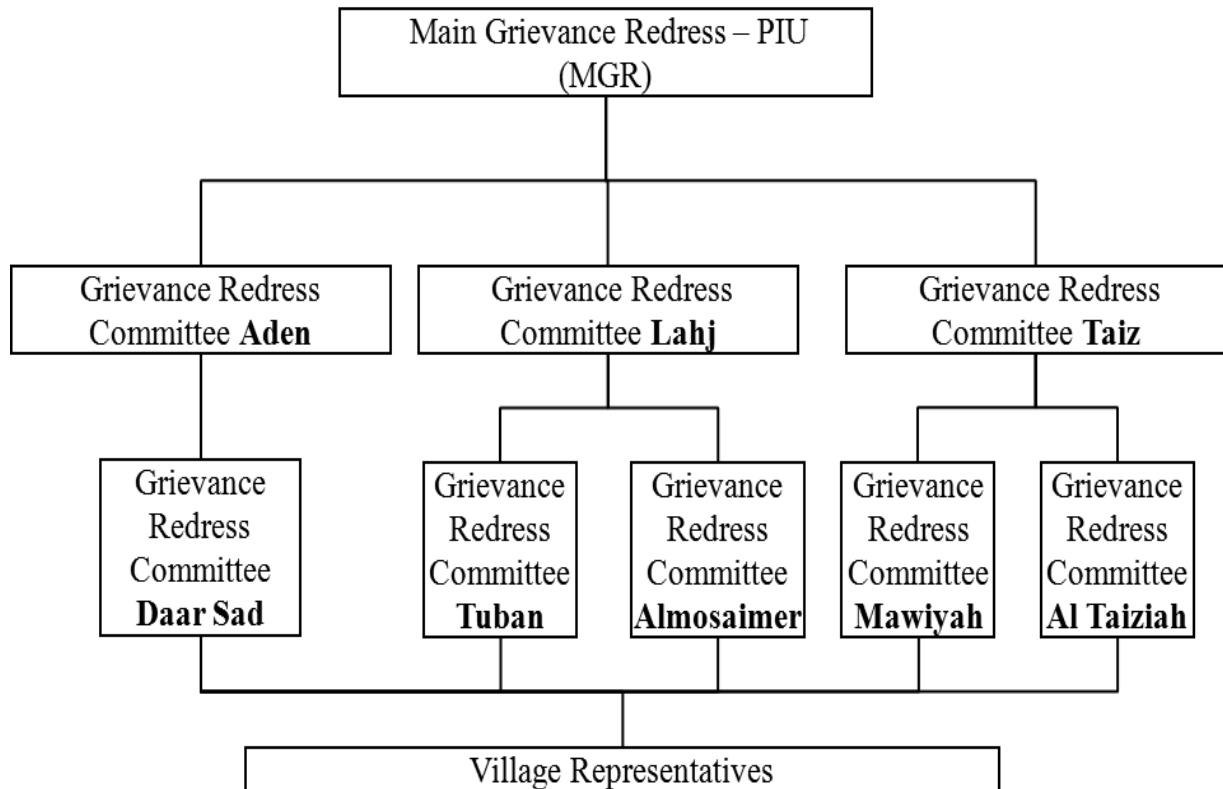
Detail description of the institutions involved and their inter-relationships in the implementation of the ESMP and RAP. The roles of these and other institutions in the implementation of the RAP are described in the RAP document.

RAP implementation: To ensure adequate management attention to RAP implementation, three functional entities have been created to manage various aspects and to ensure effective coordination among agencies and jurisdictions that will be involved. A High Supervisory Committee for Land Acquisition and Resettlement (HSC) in an inter-ministerial entity at the apex of the hierarchy. The YCHP Project Implementation Unit (PIU) will manage day-to-day aspects of RAP implementation. And a Technical Committee for Land Acquisition and Resettlement (TC) will support and assist the PIU in valuation of assets, determination of compensation rates, and other technical aspects associated with RAP implementation. RAP implementation also will be supported by relevant officials at the governorate and district levels. The roles and responsibilities of each of these entities are described.

Adaptive management arrangements decisions causing deviation from RAP arrangements anywhere along the two highway sub-sections funded by IDA and SFD are brought to the World Bank’s and SFD’s attention by MPWH during project supervision. The World Bank / SFD may object to such deviations if warranted. However, the scope for such adaptive management is limited. No changes will be made to eligibility criteria for resettlement assistance. Unit compensation rates will not be reduced, compensation amounts will not be less than that to be established through application of the unit compensation rates, and other entitlements or forms of assistance to affected persons will not be reduced in scope without the prior concurrence of the World Bank.

Grievance management system: The project will include multi-level arrangements for registering and addressing grievances and complaints from project-affected people. The primary purpose of the project grievance management mechanism is to provide clear and accountable means for affected persons to raise complaints and seek remedies when they believe they have been harmed by the project. An effective and responsive grievance management system also facilitates project progress, by

reducing the risks that unaddressed complaints eventually lead to construction delays, lengthy court procedures, or adverse public attention. The Grievance Redress Management System (GRMS) is placed below:



1 INTRODUCTION

1.1 Country Background

Situated on the southern part of the Arabian Peninsula, the Republic of Yemen has a population of some 24 million, of which about 76 percent live in rural areas where poverty incidence is particularly high. The country has a low GNI per capita of US\$1,110 (2011), while on the UNDP Human Development Index, Yemen ranked 154th out of 187 countries in 2011. However, the report also showed that average life expectancy is up from 41.6 years in 1970 to 62.7 in 2010, with women's life expectancy mirroring the overall trend. Across all economic and social indicators, Yemen is characterized by high levels of poverty and inequality.

In addition to the already existent widespread poverty, Yemen experienced intense and extensive domestic unrest from February 2011 until November 2011. The long-lasting conflict and turmoil, and severe shortages of food and fuel, combined with high commodity prices left many poor unprotected. During this period of crisis, the economy contracted by 10.5 percent and the number of those living below the poverty line is estimated to have increased by 8 percentage points to 50 percent of the Yemeni population. Rising fuel costs caused sharp increases in transport costs, sometimes reaching 100 percent in urban areas and twice as much in rural areas. Meanwhile, oil production is expected to continue to decline and reserves are expected to run out by 2021 in the absence of new oil discoveries and developments. State revenues from natural gas production and exports will offer some cushion, but cannot compensate for the loss of oil revenues.

As a result of the events of 2011, Yemen has embarked on a political transition based on an agreement brokered by the Gulf Cooperation Council (GCC). The Government of National Reconciliation was formed and confirmed by Parliament in December 2011. Presidential elections were held in February 2012, and President Abd Rabbuh Mansur Al-Hadi sworn in soon afterward. The National Dialogue Conference (NDC), a key element of the GCC agreement and transition process, was launched in an atmosphere of much hope, trepidation, and protest. The first phase of the transition is expected to end in the first half of 2014 with legislative and presidential elections to be held under a new constitution, followed by the inauguration of a new president and formation of a new parliament. The second phase of the transition will see the practical implementation of the agreements negotiated during the National Dialogue Conference.

In the meantime, the transition government has an opportunity to start addressing the underlying causes of instability and social strife in order to rebuild Yemen's social and economic base, and to restore macroeconomic stability. There is an overall sense of optimism and hope for inclusive change in post-revolution Yemen, but the country's transition may face significant risks if reforms and economic opportunities do not materialize quickly, and if substantive changes are not felt by the population. Yemen needs the collective support of the development community as it works to sustain its political transition and economic recovery, while fighting strong countervailing forces, including regional grievances that have led to enduring separatist violence in the north and south, al-Qaeda militancy, and recalcitrant elements of the previous regime in Sana'a.

1.2 Sectorial And Institutional Context

Yemen's road sector has gone through a radical transformation in the past three decades. The most striking element has been the creation of a network of modern paved roads linking most of the main cities and governorates, particularly in the densely populated and mountainous western part of the country. This network has indeed grown from only about 5,000 km in 1990 to about 14,000 km in 2010, a 280 percent increase over about twenty years. Major progress has also taken place in rural areas where about 5,500 km of paved roads have been constructed in the past twenty years (out of a total of 58,200 km of non-urban roads). The paved road network is in relatively good condition, in part due to its young age but also due to the mostly excellent geotechnical conditions and road building materials in Yemen. The improvements of the road network have had a major impact on the population and the economy, promoting internal and external trade, enabling a growing share of the population to have access to public services and markets, and ensuring that food imports reach remote areas.

Yemen has about 58,200 km of non-urban roads, of which 14,200 km are presently paved. The network of unpaved roads includes about 44,000 km; many of those are earth roads. There are many unpaved roads which are gradually being upgraded to paved standards under different Government programs. In total, very significant local and donor resources have been allocated to the road sector over the past few years.

Yemen's current road network (in kilometres)⁴

Paved roads – total	14,200
International	3,600
Main	5,100
Secondary and rural	5,500
Unpaved roads	44,000
Grand Total	58,200

The organization of the road sector and its main institutions has also undergone important changes in the past decades. The Ministry of Public Works and Highways (MPWH) has gradually taken firm control of the road sector and of the strategies and expenditure programs necessary for its development. In addition, a diverse set of private road construction and maintenance companies, and engineering firms, has emerged in Yemen with a cadre of qualified specialists who have a good understanding of the special physical conditions and human constraints in Yemen. Despite this positive change in Yemen's road sector, the Government still needs to develop more effective methods and institutions that are necessary for managing, operating and maintaining its road network at higher standards, particularly larger infrastructure such as new highways.

Yemen has one of the poorest traffic safety records in the region with almost 6,500 reported deaths every year on the road network. Traffic police records show about 13,000 accidents with injuries each year, affecting about 17,000 people and their

⁴Source: Ministry of Public Works and Highways

families⁵. Road traffic injuries rank among the top 10 causes of death in Yemen. Such high rates of road traffic injuries and fatalities, also characterized by the high share of pedestrian fatalities, disproportionately affect the economically active population in Yemen; hence, the economic and social consequences are significant. The key factors that contribute to the poor road safety records are: (i) poor road conditions and the lack of safety features in road design, (ii) unsafe driving behaviour; and (iii) ineffective enforcement of traffic laws and regulations. Prevalent among drivers are speeding and the use of communication devices (cell phones), while seat belts and other safety measures are not widely used. The World Bank has had a dialog with the Government on a range of needed measures to improve road safety, which include physical and non-physical measures (institutional and legislative). However, the unstable political and governance environment has not been conducive to the non-physical measures which should normally be applied as part of a comprehensive road safety strategy. In practical terms, physical road safety improvements on roads are presently the only viable and realistic measures likely to produce measurable results.

Notwithstanding the behavioural, institutional and political issues in Yemen, from the road sector's point of view it is urgent and critical to improve the physical features of roads to reduce the likelihood and severity of crashes. A formal road safety audit should be required not only for new construction (as planned under this project) but also for road rehabilitation and reconstruction where are ample opportunities to change the geometric design of roads and add other road safety features for improved safety.

1.3 Project Rationale And Expected Benefits

In terms of main road arteries, most of Yemen's major cities are connected by an existing North-South road. It begins in the southern port city of Aden and passes through Taiz, Ibb, Dhamar, Sana'a, Amran and Saada before reaching the Saudi Arabian border at Albayn. Although the existing road is a vital transportation route, it was not designed for efficient long-distance and inter-urban traffic. There are a host of problems affecting its use, first and foremost its inadequate physical capacity for handling rising levels of traffic. This lack of capacity has resulted in traffic jams, particularly where the road passes directly through the densely populated and congested centers of the capitals of eight governorates. Another problem is the high gradients and often sharp curves of the road, resulting in low average travel speeds of only between 40 to 60 km/hour. Overall, the road cannot serve as an efficient long-distance transport artery for passengers and commercial freight. The Ministry of Public Works and Highways estimates that traffic on the road had increased at a rate of 5 percent per year during the decade before the unrest in 2011, with traffic surpassing the road capacity on many sections. Although traffic growth has been stifled since 2011, long lines of vehicles still form today behind heavy trucks which slowly climb or descend the winding mountainous road sections. This leads to risky behaviour of drivers trying to overtake trucks, often resulting in serious accidents claiming many lives.

⁵In Yemen, data on traffic injuries and fatalities are collected by the traffic police as part of a nationwide system (not gender-disaggregated).

The MPWH has implemented partial solutions in the past, such as bypasses and ring roads in some cities, but they did not generally resolve the issues mentioned above, prompting the Government to seek a more comprehensive solution. With this intention, the Yemeni Government started already in 2003 to conceptualize and design a completely new dual carriageway highway between Aden and the border with Saudi Arabia (denominated as “Saada–Aden Yemen International Corridor Highway” or “SAYICH”). The new highway will provide the country with an additional 710 km long North-South route that will adequately serve its current and future transport needs. Detailed and in-depth studies to select the best overall highway alignment and the most appropriate technical design solutions were carried out between 2003 and 2005 by German and British engineering design firms hired by the GoY. Since that time, however and until recently the GoY had not been able to mobilize the funding necessary for that highway. This changed in the context of the National Dialog Conference, with several external partners showing interest in funding major new infrastructure projects in Yemen, and in particular the planned new Saada – Aden Yemen International Corridor Highway.

The different sections of the SAYICH Program are shown below. It envisions multiple donors for the different highway sections.

Section 1: Aden - Taiz

- Sub-Section from Aden to Noubat Dokaim: 55 km (planned IDA funding)
- Sub-Section from Noubat Dokaim to Taiz: 85 km (SFD funding)

Section 2: Taiz - Ibb - Dhamar - Sana'a: 214 km (funding to be identified)

Section 3: Sana'a - Amran - Saada (Albain border): 358 km (funding to be identified)

The first section of the new highway, for which funding has been identified, is located between Aden and Taiz, with a length of 140 km. The present ESIA covers this section. It is of particular importance in the context of the National Dialog, since it connects the areas of the former South and North Yemen, and thus the main conflicting interest groups. Recognizing the above and the need to demonstrate actual quick progress on the ground, the Government of the Kingdom of Saudi Arabia agreed in early 2013 to fund the construction of 85 km of this section, as a separate project, between the city of Taiz and the locality of Noubat Dokaim. Loan and Grant Agreements totalling US\$ 320 million were signed between the Saudi Fund for Development (SFD) and the GoY in March 2013.

The World Bank (IDA) is also planning to support the Government’s overall program for the Saada – Aden Yemen International Corridor Highway (SAYICH). The Government of Yemen has asked the World Bank to play a catalytic role in the mobilization of future large-scale funding for the SAYICH. The World Bank is planning to initially support the SAYICH Program through IDA resources of US\$ 150 million for the "Corridor Highway Project" which covers the part of Section 1 of the SAYICH which is not funded by the SFD, between Noubat Dokaim and Aden (55 km). The IDA-funded "Corridor Highway Project" will thus complement the separate SFD-funded project of the 85 km between Noubat Dokaim and Taiz. Very importantly, the IDA-funded project will include activities to lay the groundwork for the other future sections of the Corridor Highway for which funding has not yet been identified, such as preparing feasibility and design studies, and carrying out the ESIA, ESMP and RAP for those sections. The availability of those project preparation

studies (reviewed and endorsed by the Bank) will make other donors feel comfortable towards providing further funding in the future. However, there is no other funding committed to the SAYICH Program at this time and it is uncertain if and when other sections of the SAYICH can be started.

The direct and rather “technical” project rationale described above is thus to create better conditions for drivers, reduce vehicle operating costs and driving times and make the road safer. Beyond the quantifiable project benefits of transport cost reduction, time savings and reduced traffic fatalities which are captured in the traditional economic analysis, the project is expected to have numerous broader social benefits which feed into higher-level objectives pursued by the Government of Yemen and the World Bank. Even though these cannot be quantified with any reasonable level of precision, there is widespread consensus that the construction and subsequent operation of this highway will provide economic and social benefits at least to the inhabitants of the eight Governorates it will connect with each other. These are the Governorates of Aden, Lahj, Taiz, Ibb, Dhamar, Sana’a, Amran and Saada, which represent about two thirds (2/3) of Yemen’s total population.

- At the present time, Yemen’s biggest challenge is to remain a unified country with the necessary conditions for peace, security and stability, and to avoid a new civil war. The ongoing National Dialog Conference (NDC) is the forum where a peaceful settlement of differences is to be achieved. During the multi-party discussions in the NDC, the new Corridor Highway between Aden and the border to Saudi Arabia was identified by all parties as a key strategic project which would be crucial for unifying the country and provide much needed economic opportunities for the numerous communities along the corridor.
- In the short term, the construction itself of the road will bring important short-term benefits through job opportunities for thousands of workers, unskilled and skilled, including those who have been repatriated from Saudi Arabia and Gulf states in the recent past. It will also bring large-scale business opportunities for many Yemeni firms who will be involved in the construction activities, as contractors, sub-contractors and suppliers of goods and services. It is these direct short-term benefits that are of specific importance in the context of the ongoing political consolidation and unification process.
- In the medium and long term, the new Saada-Aden Yemen International Highway (SAYICH) Program, of which the Corridor Highway Project is the first part, is expected to bring trade facilitation and general economic revitalization, and better access by rural populations to the markets and services located in the larger cities along the new highway.
- The project is expected to have a transformational impact due to the new institutional arrangements for asset management and maintenance that it will introduce, again providing business opportunities for local firms and communities along the highway corridor.

More details about the social benefits of the project are presented in Chapter 7 (detailed impact assessment).

1.4 Expected Project Beneficiaries

The most direct beneficiaries of the Corridor Highway Project, and of the wider SAYICH Program, are *Yemeni road users*, which may be vehicle owners, but can also be passengers traveling in buses, or owners of cargo being transported by truck. These will benefit from reduced transportation s and travel times between the connected cities and regions, and much improved traveling comfort.

The *communities located along the new corridor* will benefit economically for two main reasons. First, during the construction period a large number of skilled and unskilled workers will be employed by private contractors, resulting in important income generation (about 1.28 million person-days of unskilled work alone during the 3 to 4 years of project execution, at a rate of about US\$ 18 per day). Unskilled workers, which in economic terms are part of the bottom 40% of the population, will typically be recruited from the area of the physical works, resulting in direct income generation for this group in the area of the road. Secondly, the passenger and freight traffic on the new highway will generate business opportunities for communities along the highway, both during construction (as suppliers to contractors) and during operation, at the rest and service areas.

The Ministry of Public Works and Highways will benefit from enhanced capacity in managing and maintaining the new corridor asset, while private contractors and consultants will benefit from the contracts that will arise from project execution and from the subsequent operation and maintenance of the new highway.

Both women and men are expected to benefit from the improved mobility, safety and access to markets and services along the corridor between Aden and Taiz. There is no hard gender-specific data available on road users, pedestrian traffic and on traffic injuries and deaths along the planned highway (and in Yemen in general). However, in terms of safety benefits it seems likely that (i) women and children will benefit in particular from the increased pedestrian safety generated by the project, since they tend to constitute the majority of pedestrians in settlements along the road, in order to access social services and markets (stores). The project will improve pedestrian safety mostly on the existing road, since the new road will take much of the high-speed traffic off the existing road and put it on the new highway which is further away from settlements. On the other hand, men will mostly benefit from those road safety improvements that address safety risks for drivers and vehicle occupants, which in their majority are men. Given that the project is to build a new major highway, it was found that it does not lend itself for gender-specific project actions or components, unlike urban and rural road projects which do often present such opportunities.

1.5 Methodology

The Environmental and Social Impact Assessment (ESIA) was based (i) on the scope of work given in Terms of Reference (TOR) provided to the Consultant, (ii) on discussions between the consultant and MPWH officials and (iii) on consultations with stakeholders during the site visits and surveys. The ESIA study is further based on (iv) a thorough review and analysis of the technical interventions (road construction) of the project which are provided in the detailed technical design which was previously prepared by an engineering design consultant, (v) a review of the environmental and social assessment requirements for such projects as defined by the

Government of Yemen and the World Bank's applicable policies and guidelines, and (vi) the cataloguing of environmental and social issues which were identified during the site visits and stakeholders consultations. Data was also collected from primary and secondary sources for the physical, biological and ecological environment.

Based on the location data of engineering design, the expected environmental and social impacts were identified and appropriate mitigation measures were proposed to reduce as much as possible the adverse environmental and social impacts of the project. This has led to the development of four Environmental and Social Management Plans (ESMP's); one separate ESMP for each of the four lots of civil works (contract packages) to be executed by contractors. Each ESMP includes an implementation schedule and defines the roles and responsibilities of the various actors. Budgetary provisions have been made to pay for mitigating or reducing adverse environmental and social impacts in line with the stipulations of relevant local laws, and the policies of the World Bank methodology

1.6 Environmental and Social Impact Assessment Process

The overall purpose of this ESIA is to fully comply with the applicable regulations, policies and guidelines which apply to the project of building the new Corridor Highway between Aden and Taiz (140 km). The specific objectives of the ESIA are:

1. To identify all potentially significant positive and adverse environmental and social impacts, along with the expected positive impacts of the project.
2. To identify measures for mitigating negative environmental and social impacts and for avoiding as much as possible any serious and irreversible damage to the environment and people.
3. To identify any possible measures which could help to make sure that expected project benefits materialize.
4. To establish an Environmental and Social Management and Monitoring Plan as a tool for implementing all envisaged measures and activities.
5. To ensure that environmental and social factors are considered in the decision-making process for the proposed road construction through effective consultations with potentially affected persons and stakeholders.
6. Where necessary, provide guidelines for potential adjustments to project design, further minimize negative impacts performance.
7. To inform the public about the proposed project and ensuring effective participation and involvement by stakeholders.

1.7 Screening

The Environmental and Social Screening of three potential project corridor alternatives was carried out during the original feasibility study for the Corridor Highway, keeping in mind the following aspects:

- The people who will be affected due to highway construction. Hence the settlements along the highway and the number of people affected in each settlement were considered during the screening exercise.

- The type of land resources needed for the project, such as agricultural land, pasture land, barren (desert) land which will have to be acquired before highway construction.
- The likely numbers of trees, vegetation, natural habitats, natural environment that will be affected were also compared for various corridor scenarios.
- The ground water and surface water sources that will be affected.
- The cultural and community assets that will be affected, such as religious structures, heritage sites, graves, historic sites, etc. along the project corridor.

Chapter 6 (Analysis of Project Alternatives) provides details on the initial corridor studies and the justification of the corridor which was chosen and for which the detailed engineering design was carried out.

1.8 Modification to Terms of Reference for the ESIA

The ESIA has been carried out in line with the TOR approved by the World Bank and for which consultations had been carried out. One minor change was made to the requirement of Environmental baseline data collection and presentation. Given the tight time frame for the preparation of the ESIA and the absence in Yemen of equipment for measuring air quality, it was agreed that site-specific measured data on air quality will be collected at the beginning of project implementation by the Consultant, at locations along the alignment of the planned highway. These locations have been identified and are shown in this ESIA report. It is to be noted that until now no air quality measurements have been carried out anywhere in Yemen.

1.9 Consultations with Stakeholders

In order to adopt a transparent and participatory approach towards the project, extensive stakeholder's consultations were conducted with different groups and at numerous locations during the survey. Since this is a *Category A* project according to the World Bank criteria, several subsequent sessions of public consultations were carried out with affected groups. First, public consultations were conducted before the finalization of TOR's for the ESIA. A second round of consultation was held during the extensive field surveys in December 2013 when the draft ESIA was being finalized.

Proceedings of the consultations were recorded and minutes prepared during formal consultations. Field notes on discussions were prepared for all non-formal consultations.

1.10 Co-ordination among Environmental, Social and Engineering teams

The ESIA study was carried out by environmental and social specialists (both foreign and local). The joint visits by environmental and social experts helped identify the environmental and social issues of the project. The public hearings were also conducted jointly by the social and environmental experts.

The detailed design report and feasibility study report were reviewed to understand the alignment of the planned highway, the technical interventions of the project, the areas of necessary land acquisition, the location of bridges, overpasses, underpasses, the construction materials to be used, volumes of earth movements, traffic data etc. There was continuous interaction with the design engineers and surveyors of the Ministry of Public Works and Highways (MPWH) during the study. The regional offices of MPWH in Taiz, Lahj and Aden Governorates participated with staff (surveyors and engineers) during the field surveys to guide the ESIA team on the highway alignment and the planned project interventions along the planned alignment.

The environmental and social team also organized many meetings with the officials of MPWH in its Headquarter in Sana'a in order to discuss the various project issues (engineering design, environmental, social, land needs, etc.) related to the project. Finally, the project will also benefit People with Limited Mobility (PLM) since the service areas along the new highway will be designed barrier-free to enable access with wheelchairs, crutches, etc.

1.11 Structure of the Report

This comprehensive ESIA report is structured sequentially in the following chapters:

Executive Summary

Chapter 1	:	Introduction
Chapter 2	:	Project Description
Chapter 3	:	Policy, Legal and Administrative Framework
Chapter 4	:	Description of Baseline Environment and Socio-Economic conditions
Chapter 5	:	Public Consultation, Community Participation and Grievance Redress Mechanism
Chapter 6	:	Analysis of Project Alternatives
Chapter 7	:	Potential Environmental and Social Impacts
Chapter 8	:	Environmental and Social Management Plan (ESMP)
Chapter 9	:	Monitoring and Institutional Strengthening
Chapter 10	:	Institutional Arrangements

Annexures

2 PROJECT DESCRIPTION

2.1 Physical Characteristics of the Project

The construction of the new Aden-Taiz highway consists of civil works on a new alignment over a length of 140 km (double carriageway). The project road starts at Al-Alam near the coastal city of Aden and ends at Al-Ganad, about 12 km northeast of the city of Taiz. One of the criteria for the selection of the corridor was to avoid passing through towns, villages and settlements.

The highway was originally designed as a 6-lane road (3 travel lanes in each direction). However, on the 55 km subsection between Aden and Noubat Dokaim the highway will only be built as a 4-lane road (2 travel lanes in each direction), but with a platform wide enough to accommodate two additional lanes in the future. The overall platform width is 36.7 m, to accommodate 2 x 3 travel lanes, each 3.65 m in width, of which only the two outer lanes in each direction will be built now. The median will be (i) wide enough to accommodate two additional travel lanes (one in each direction) in the future when traffic levels require such an additional investment, and (ii) will still be 6 m wide after the addition of the two lanes, or 3.6 meters wide in mountainous terrain. The typical cross-section will also include, on each side of the road, a 2.0 m wide verge, and gravel and paved hard shoulders, each of 1.2 m in width. From the start, all structures (bridges, culverts, intersections) will be built so that two additional lanes can be added later (if the need arises) without a need to modify those structures. Only the “outer” four travel lanes will thus be built, including shoulders. The “inner” two lanes will only be established at the level of “cut and fill/earthworks” and will initially be part of the median.

On the 85 km subsection between Noubat Dokaim and Taiz the civil works will be done in line with the original design, with all 6 travel lanes to be built now.

The typical cross-section of the new highway is shown in **Figure 2.2** further below.

The design speed is of 100 or 120 km/h, depending on local conditions. This will be a “controlled access” highway, with entry and exit only possible at the interchanges which will connect this highway with the rest of the Yemeni road network. The civil works will include the main carriageways, interchanges, highway structures and bridges, interconnecting and local (village and farmland) roads, installation of traffic safety measures and the rest and service areas. Flexible type pavement (asphalt concrete) with a total thickness of 50 cm (wearing course 5 cm, binder 5 cm, aggregate base course 20 cm and aggregate sub-base 20 cm) will be constructed above a 20 cm subgrade level. Traffic safety measures comprise double-sided median barriers and single-sided barriers at the shoulders. Most intersections along the highway have been designed as grade-separated interchanges, diamond type, due to the nature of the intersecting roads and traffic demand, in order to provide safety for vehicle movements in all directions. Connections with the Aden Ring Road and the Aden Coastal Road at Al Alam are designed as three-lane turbo-roundabouts. The highway will be fully equipped to enable required level of service for users, containing lighting at interchanges, rest areas and service areas. Numerous road culverts (5 x 5 m and 3 x 3 m) are foreseen for provision of access between different sides of the highway, and for access between villages and farmland. These culverts will be suitable for pedestrians and animals. Civil works will also include the duct for

a new fibre optic backbone cable and related manholes, etc. which will be incorporated into the road embankment or sub-base. For procurement purposes, the works are divided into two smaller, roughly equal lots in order to facilitate the participation of local Yemeni contractors in the works.

The project will include the services of a consulting firm to act as the Engineer (engineering supervision) for civil works and also to ensure adequate environmental and social safeguards management during construction of the highway, including post-construction services during at least one year. The main role of the Engineer will be to ensure that the works are implemented according to specifications, within the cost and according to the schedule.

2.2 Existing Conditions Along the Proposed Alignment for New Road

The proposed Aden -Taiz (140 km) road section traverses through three Governorates of Republic of Yemen namely; Aden, Lahj and Taiz.

As mentioned above, the project road starts at Al-Alam near the coastal city of Aden and passes through the districts of Al-Amad, Bi'r Jabir, Al-Hutah, Al-Anad, Noubat-Dokaim, Aquan, Musaymir, Ad Durayjah, Al-Qub'ah, Mawya and terminates at the locality of Al-Ganad, about 12 km northeast of the city of Taiz. About 36 km of the proposed length is located in Taiz Governorate, 99 km in Lahj Governorate and 5 km in Aden Governorate. A view of the proposed highway corridor is shown in **Figure 2.1**. The list of Villages located in the proximity of the proposed alignment is presented in **Table 2.1**.

The feasibility and design studies for the highway assign the chainage for the road in the opposite sense, with chainage km 0 being at Al-Ganad (near Taiz) and the end point at chainage km 140 located at Al-Alam near Aden. In that order, the corridor of the highway starts and runs through a wide and flat-bottomed intensively-cultivated valley approximately up to Ch.km 5.5. After that; it crosses a rugged hilly and mountainous region, divided by many steep-sided and deep wadis, approximately up to Ch. Km 24.5 near Mawiyeh town. Approximately from Ch.24.5 to Ch.39.5, the road alignment runs through relatively narrow valley bounded by steep rugged mountains. The alignment crosses these mountains at several locations. The valley is intensively cultivated and planted. Along this stretch, the road alignment crosses several rugged basaltic hills. The area between Ch.39.5 and Ch.50 is rugged hilly rocky side that contains some steep igneous mountains. Approximately from Ch.50. to Ch. 90.5; the road corridor passes through relatively low-rise soil hilly areas that are built up by thick soil deposits. The site is divided by several steep-sided wadis. Approximately, from Ch.90.5 to the end of the road, the roadway passes through flat to gently rolling and undulated terrain covered mostly by fine, loose wind-blown sand and crossed by many sand dunes.

Vegetation along the study route is variable. The stony surfaces of the hills and mountains are rather poorly vegetated where scattered shrubs, small bushes and small plantations were observed. Lowlands and valley areas are covered with brown silty-clayey soils that are intensively cultivated and planted mainly with variable vegetables.

Classification of the site based on the intensity of vegetation is as follows:

- From Ch. 0.0 (start of the roadway) to Ch. 5.5: very rich with plantations and farms.
- From Ch. 5.5 to Ch. 24.5: scattered plantations and farms, locally rich with plantations and farms.
- From Ch. 24.5 to Ch. 50: rich with wild bushes and small trees beside many spots of intensively cultivated and planted areas.
- From Ch. 50 to Ch. 90: scattered plantations and farms.
- From Ch. 120 to Ch. 140 (end): very poor vegetation cover, however some farms exist to the west of the corridor.

Further data regarding the site characteristics are provided in Chapter 4 on current environmental and social conditions.

Table 2.1: List of Villages along the proposed Highway Corridor

Sl. No.	Governorate	Villages
1.	Taiz	Alariq, Aljand, Alasrar, Alasria, Aldhurafi, Alhajr, Alhajrh, Alhamror, Alharbh, Alhubanh, Alhubaniah, Alhuzm, Aljurbh, Alkhalal, Alkharaz, Almaeniah, Almain, Almalik, Almanih, Almasatif, Almoaina, Almoainh, Alorbh, Alquhifa, Alshuaib, Alurbah, Alzuraqh, Alzwaqer, Bar Almahrwr, Habelalorebe, Hamirim, Hamirim – Thurah, Hass, HubilAltawil, Najd Albakili, ShabMahrws, Tamas, Thabh, , Tharwahand Thurah
2.	Lahj	Akan, AlSloob, AlThabr, Alanad, Albatan, Aldomyh, Aldoraigh, Almaksaa, Almosaimer, Alromaidh, Alsamolh, Alsarahina, Althabr, By aldrigh, By Hubailalfrh, By Hubail summer, By zik, Habelalorebe, HabilAlsawda, Hobail Alromaidh, Hobail Alshams, Hobail Talhi, jolMadram, Kattan, Moraib, Moraib Valley, Moreb, Moreb Valley, Nashm, Qailaa Mountain, Shaab Akhdad, Zaiqand Zaiq Alaala
3.	Aden	Al –Amad

**Source: Census survey, December 2013.*



Figure 2.1: Road Alignment Map

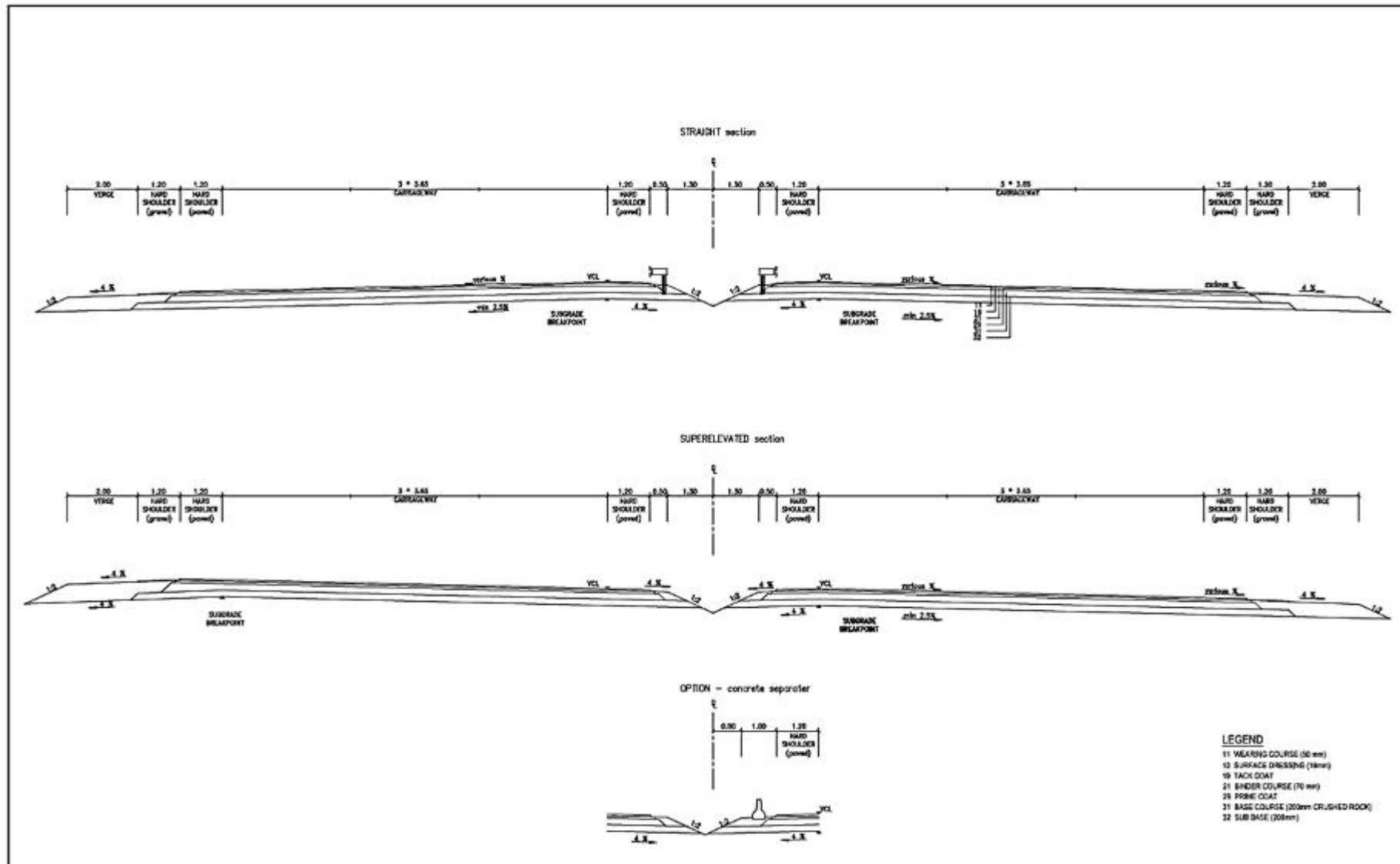


Figure 2.2: Typical Cross-Section

3 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

3.1 Introduction

Since 1990, the Government of Republic of Yemen (RoY) has established institutions and responsibilities for environmental management, joined international conventions and continues to develop sector legislation and procedures. A National Environmental Action Plan (NEAP) was adopted in 1995 and the Environmental Protection Law was enacted a year later. The NEAP established priority issues and actions in the main environmental fields such as water, land resources, natural habitats and waste management. Despite these efforts, Yemen continues to face serious environmental problems such as severe water crisis leading to loss of arable land, forests and unique habitats; waste pollution negatively affecting populations' health. These issues cause poverty and reduced development opportunities in the country. The following sections describe the relevant regulations and their implications for the project – for the preparation as well as the implementation phases.

3.2 Environmental Policy, Strategies & Law of Yemen

The Environment Protection Law (EPL) number 26 of 1995 forms the basis for the protection of the environment, issuance of permits, and Environmental Impact Assessments (EIA's). The provisions of this law are implemented through Executive Regulations (By-Law 148-2000), issued by a decree of the Council of Ministers to protect the environment, natural resources, society, and health. In addition, the law is designed to protect the national environment from activities practiced beyond national boundaries and to implement international commitments ratified by the Republic of Yemen in relation to environmental protection, control of pollution, conservation of natural resources, and the protection of such globally important environmental issues such as the ozone layer depletion and climate changes. The law equally stipulates the incorporation of environmental considerations in economic development plans at all levels and stages of planning for all sectors. It also requires the preparation of EIAs for projects proposed by the public and private sectors. However, to date there is still no regulatory framework to support the implementation of the EPL and the provision of undertaking EIAs for projects is not strictly enforced.

Subsequently, the Environment Protection Council (EPC) under the Council of Ministers issued bylaw No. 148 of 2000 as Executive Bylaw for the law 26 of 1995. This bylaw specifically mentions that licenses should not be granted prior to submission of evaluation study about the environmental effects and the appropriate authorities should examine the specifications, ingredients and regulations issued by the EPC. Such a study should be undertaken by an independent authority. New roads and improvements of main roads are identified as activities that require such an evaluation, according to Annexure 1 of the decree.

Equally important, environmental standards and specifications have been prepared by the former Environment Protection Council as annexes to the Executive Regulations, covering potable water quality, wastewater quality for agriculture, and ambient air quality, emissions, noise, biodiversity and protected areas. These include standard application forms intended for use by all relevant government bodies.

Also there are other policies, strategies and programs in Yemen to safeguard the Environment. The list of these policies, strategies and programs are given in **Table 3.1**.

Table 3.1: Government Policy, Strategies and Programs Relevant to Environmental Protection

Statements, strategies and programs	Year
National Environmental Action Plan	1996
Environment & Sustainable Investment Program	2003-08
Biodiversity Strategy	1999-03
Environmental Impact Assessment Policy for the Republic of Yemen	1997
Reports on the State of Environment (by EPA)	Annual
Evaluation of Future Development of the EIA System in Yemen	2001

3.3 Requirement of EIA and Environmental Permission for Highway Projects

Article 35 of EPL states that, *“It is not permissible for any competent body to give permission or issue a license to establish or operate or amend projects or establishments that affect and damage the environment or contribute to its deterioration or causing its pollution or participate in occurring such effects or harm human health or other living organism, only in accordance to the standards or criteria or specifications or conditions that are determined and specified by the Council”*.

Also Article 36 of EPL states that *”It is not permissible to issue license for projects and establishments which are by its nature a source of an environmental pollution or that is potentially causing environmental impacts and damages arising out of its activities unless an Environmental Impact Assessment statement referred to in this law is undertaken”*.

Hence in view of the Article 35 and 36 of EPL it is mandatory to undertake an Environmental Impact Assessment Study of any project which has adverse impacts on Environment, Ecology and Human Health in Yemen. The construction of new roads and improvements to existing main roads are identified as activities that require environmental effects evaluation. Therefore, an Environmental Clearance will be required from the Environmental Protection Council (EPC) of the Government of Yemen for the proposed Corridor Highway project.

3.4 International Conventions and Treaties Signed By Yemen

Yemen is signatory of more than 20 international conventions on environmental issues. Those relevant for the road sector are summarized in **Table 3.2**. However, at this time the capacities of national agencies to deal with the technical complexities and reporting requirements of international agreements are not sufficient.

Table 3.2: Environmental and other Conventions Ratified by the Government, relevant to the Road Sector

Convention	Place & Date of Stipulation	Ratification date in Yemen
Biological Diversity	Rio de Janeiro, 1992	03/12/1995
World Cultural & Natural Heritage	Paris, 1972	07/01/1981
Civil Responsibility for Damage from Oil Pollution	Paris, 1969	04/06/1979

Related to the issue of *cultural heritage*, Yemeni law (Law No. 21 of 1994 on Antiquities) is based on the concept of an archaeological site “perimeter” and of a 500 meters “observance area”. Within these two areas various protection levels are considered. There is however no specific procedures for chance finds specified in the law.

3.5 Institutional Setup in Yemen

In Yemen, the Ministry of Water and Environment is in charge of implementing the Environmental laws, polices, standards and specifications meant to conserve natural resources and to control pollution. The Yemen Environmental Protection Authority (EPA) is empowered by the Ministry to carry out functions to protect the environmental quality in the country. There are other Ministries and agencies which have direct and indirect responsibilities for the protection of the environment and pollution control. All the organisations that may have some responsibility during the implementation of the planned project, or that are otherwise related to road projects in general, are shown in **Table 3.3**.

Table 3.3: Organizations responsible during Project Implementation

Ministry or Government Body	Responsibility
Ministry of Water and Environment (MOWE)	Managing the water sector and coordinating the existing water agencies (NWRA, NWSA, etc.), as well as oversight of ecological matters.
Environmental Protection Authority (EPA)	Environmental protection and natural resources conservation with statutory planning, licensing, monitoring and auditing functions.
Ministry of Public Works and Highways (MOPWH)	Planning, construction and maintenance of all roads in Yemen, except feeder roads (Ministry of Agriculture) and earth tracks (Ministry of Local Administration).
Ministry of Local Administration (MOLA)	Maintaining earth tracks.
Ministry of Agriculture and Irrigation (MAI)	Maintaining feeder roads and overseeing the irrigation sector.
National Water Resource Authority (NWRA)	Managing, developing, exploiting, and conserving the water resources. Prepare basin plans and monitor water resources.

Ministry or Government Body	Responsibility
Ministry of Culture - General Organization for Antiquities, Museums and Manuscripts (GOAMM)	Conserving cultural heritage, excavation for antiquities, and archaeological sites. Enforcement of the antiquities law.
Ministry of Public Health (MOPH)	Financing, planning, regulation, management, and provision of health services at all levels
SAYICH PIU, Environmental and Social Unit	Responsible for overall monitoring of contractor compliance with ESMP during implementation stage

During the course of preparation of the Corridor Highway project, the EPA was consulted by MPWH. The Terms of Reference for the ESIA were shared with the EPA and their concurrence was obtained. EPA clearance will also be sought and obtained for the draft final ESIA report which will be reviewed by the EIA division of the EPA. In addition, the MPWH and EPA are collaborating to ensure that during the implementation stage, the impacts are in line with the predictions in the ESIA and that mitigation measures are being implemented as per the ESMP.

Civil society organizations in Yemen are weak. There are currently very few NGOs that could be considered as potential stakeholders in this project.

Although the Ministries and Government bodies that are related to implementation of the project have formal responsibilities, it is clear that because of budgetary constraints as well as differing capacities, these institutions may not work optimally in all contexts and in particular at the local level, presenting problems similar to those discussed under the Social Development section detailed below.

3.6 Other Project Related Policies and Procedures

The Republic of Yemen has many policies, procedures and programs which are directly or indirectly related to land acquisition, social development, poverty reduction and gender issues. These are explained in following sections

3.6.1 Land Acquisition

There is no Resettlement and Rehabilitation policy in Yemen, however there is an official procedure for land acquisition in Yemen included in “The Public Eminent Domain Law”. The Various articles concerning land acquisition are stated as follows:

- Articles 1, 2 (defining projects of public interest)
- Article 4 on the administrative procedures for land acquisition
- Article 6 on the mutually agreed procedures for land acquisition
- Article 7 on the judicial procedures for land acquisition
- Articles 12 – 16 on temporary acquisition of land
- Articles 21, 27 provisions for land acquisition

3.6.2 *Social Development Policies*

The GoY in cooperation with international funding agencies is implementing a series of programs to improve the socio-economic condition of people in Yemen. Some of these programs are relevant to the environment and therefore are included here.

The Social Welfare Fund (SWF), an agency under the Ministry of Insurance and Social Affairs (MISA) provides transfers of funds to those who are unable to work and to members of the poorest sections of Yemeni society.

The Public Works Project run by the Ministry of Planning and Development (MoPD) is designed to create short-term employment opportunities for those who are able to work.

The Social Fund for Development (SFD) seeks to provide support for long-term development opportunities for the poor.

3.6.3 *Poverty Reduction Strategy (PRS)*

The PRS reflects the role of the environment for the living standard of the poor in Yemen. In the past, the traditional farming systems had a balanced use of water resources and land use. But the social and economic changes in the last thirty years have resulted in changing farming and grazing practices and in rapidly expanding urban areas. This in turn has led to widespread soil erosion and sand encroachment, deforestation, agricultural and rangeland deterioration, and loss of farmland due to urban encroachment. While poverty does not necessarily lead to environmental degradation, there are clear effects of poverty on environment in Yemen today. The Government has therefore decided that the following environmental policies are to be strengthened within the PRS:

- Enhance the technical capacities of relevant institutions to develop comprehensive environment and development projects and programs relying on community participation;
- Institutional empowerment of local organizations;
- Find incentives accompanying awareness campaigns;
- Provide job opportunities through environmental projects;
- Finance projects that provide soft loans for the poor

In spite of the emphasis given to environmental issues in the PRS, the budget allocated by the GoY does not reflect the importance and significance of the needed environmental measures to be taken in support of poverty eradication.

3.6.4 *Gender Policies*

Although Yemen's constitution declares equal rights and obligations for men and women, and it is illegal in Yemen to make any kind of discrimination on the basis of sex, the government's capacity to enforce such laws is weak. This is due to the inadequacy of the administrative apparatus, and also due to the cultural context in which women are not considered equal to men. This is well reflected in comparative world-wide statistics which shows Yemen to be amongst the worst nations in terms of

gender equality. The new laws introduced since Yemeni unification in 1990 provide women with more rights, yet without effective enforcement (virtually ineffective). In 1997 the government adopted the Yemeni Women's National Strategy. Among the institutions established to work on women issues is the Women National Committee. Its duties includes; cooperating with local, regional and international organizations involved in projects for women, conducting studies relating to women, contributing to women legal awareness and holding workshops and conferences. Its effectiveness is hampered due to (a) by lack of adequate funding; (b) absence of coordination at a national level; (c) unavailability of data disaggregated by gender; and (d) ambiguity of its goals.

3.7 Protected Areas

Yemeni legislation also provides for protected areas, but none of those areas will be affected by the new highway project. This subject is covered in more detail in Chapter 4 (section 4.19) further below.

3.8 World Bank (WB) Safeguard Policies

The World Bank has 10 operational safeguard policies for the development projects that are funded by the Bank. The purpose of these policies is to ensure that social and environmental risks are prevented or at least minimized while increasing socio-economic benefits of approved projects in addition to preserving the environment.

These policies have been a means to increase the effectiveness and positive impacts of development projects and programs supported by the Bank.

The Bank's 10 safeguard policies are:

- OP/BP 4.01 Environmental Assessment
- OP/BP 4.04 Natural Habitats
- OP/BP 4.09 Pest Management
- OP/BP 4.10 Indigenous Peoples
- OP/BP 4.11 Physical Cultural Resources
- OP/BP 4.12 Involuntary Resettlement
- OP/BP 4.36 Forests
- OP/BP 4.37 Safety of Dams
- OP/BP 7.50 Projects on International Waterways
- OP/BP 7.60 Projects in Disputed Areas

With respect to this project, three key policies are being triggered. These are Environmental Assessment (OP/BP 4.01), Involuntary Resettlement (OP/BP 4.12) and Physical Cultural Resources (OP/BP 4.11)

3.8.1 OP/BP 4.01 Environmental Assessment

This policy is triggered if a project is likely to have significant adverse environmental impacts in its area of influence. For Category A projects, such as this project, a comprehensive Environmental and Social Impact Assessment and the resultant Environmental and Social Management Plan are required, with emphasis on integrating environmental measures in project planning, design, implementation and

operation, in addition to ensuring the environmental soundness and sustainability of investment projects.

The project's ESIA and ESMP take into account the natural environment (air, water, and land); human health and safety; and social aspects (involuntary resettlement, physical cultural resources, etc.) in addition to trans boundary and global environmental aspects. The policy requires consultations with potentially affected persons and analysis of alternatives as key parts of the process and documentation. The OP 4.01 is applicable to all components of Bank financed projects.

3.8.2 *OP/BP 4.12 Involuntary Resettlement*

This policy requires that adverse social impacts of projects it supports be mitigated, including when land or property is acquired or its use modified under a project so that Project-affected Persons (PAPs) suffer loss of income, residence, livelihoods or access to resources, either permanent or temporary, whether the land occupation/use is legal or illegal. Resettlement or relocation of PAPs adversely affected by project activities must be undertaken in accordance with laws, regulations and guidelines for Resettlement/Land Acquisition of Republic of Yemen Resettlement & Rehabilitation Policy and OP 4.12. If there is a gap between Republic of Yemen Resettlement & Rehabilitation Policy and the Bank's OP 4.12 then the Bank's provisions must apply.

According to OP 4.12, the main objectives of this policy are:

- Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs.
- Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits.
- Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

This policy covers direct economic and social impacts that both result from Banks assisted investment projects, and are caused by:

- The Involuntary taking of land resulting in:
 - Relocation or loss of shelter
 - Loss of assets or access to assets; or
 - Loss of income sources or means of livelihood, whether or not the affected persons must move to another location; or
- The involuntary restriction of access to legally designated parks and protected areas resulting in adverse impacts on the livelihoods of the displaced persons.

Furthermore, the Bank requires that appropriate and accessible grievance mechanisms are established for project affected persons. A Resettlement Action Plan (RAP) for the project was prepared as a separate document.

3.8.3 OP/BP 4.11 – Physical Cultural Resources

The Policy triggered if there are physical cultural resources will be affected due to proposed development. In the present case there are cultural resources such as a graves and Mosques that will be affected due to the proposed Corridor Highway development. In addition, the large volume of civil works could potentially unearth chance-finds and potentially affect them adversely. Therefore OP 4.11 will be triggered. Procedures to deal with such instances in line with the Yemeni law and OP 4.11 will need to be integrated into the civil works contract documents, through the ESMP.

3.8.4 Mandatory Policies – BP 17.50 Bank Disclosure Policies

This Bank Policy supports decision making process by the Borrower and Bank through allowing public access to information on environmental and social aspects of projects. Disclosure of key project documents, including Executive summaries in English and in the local language, is mandated:

- In Country – prior to project appraisal in the local language and in English
- In the World Bank Info Shop before project appraisal, in English with the Executive Summary in English and in the local language (documents can be in draft but must meet World Bank standards).

3.8.5 Other WB Guidelines

Other useful guidelines and manuals that have been considered during the ESIA phase of the project include:

- The World Bank Participation Source book
- IFC Involuntary Resettlement Guide book
- Safeguards Policy Basics – Red book
- Environmental, Health and Safety (EHS) General Guidelines of the World Bank Group
- Roads and the Environment. A Handbook. World Bank Technical Paper 376.
- Doing Better Business through Effective Public Consultation and Disclosure – A good Practice Manual, issued by IFC.
- Handbook for Preparing a Resettlement Action Plan, issued by IFC.

3.9 Saudi Fund For Development

The ESIA/ESMP and the RAP also cover the section of the Corridor Highway which is being funded by the Saudi Fund for Development (Noubat-Dokaim – Taiz, 85 km) under a separate project. The Government has agreed to apply World Bank safeguards policies also to that section.

3.10 Standards and Specifications for ESIA Study

The Government of Yemen has adopted the standards and specification of World Health Organization for Air quality and Noise which are to be applied during construction and operation phase of any developmental activity. . However, there are local Yemeni standards for Water quality with the Ministry of Water and Environment. In general, the approach used for the selection of standards is as



follows: (i) Yemeni standards are to be used if and when those are available. (ii) Where Yemeni standards have not been established, suitable foreign standards are used. (iii) All standards need to comply with the World Bank Group's EHS Guidelines. All the standards used are placed as **Annexure-3.1 to 3.3**.

4 DESCRIPTION OF BASELINE ENVIRONMENTAL AND SOCIO-ECONOMIC CONDITIONS

4.1 General

This chapter describes the current environmental and socio-economic conditions in the project area. The information presented in this chapter provides a sound basis for monitoring and evaluation of the project. The baseline analysis presented in this chapter takes into account the following:

- i. Past trends in the environmental and social conditions;
- ii. Other current or proposed development programs undertaken in the project area.

The environmental and social parameters considered in this chapter are: (i) land use, (ii) water, (iii) air and meteorological parameters, (iv) ecology, (v) noise and vibrations, (vi) various socio-economic parameters, and (vii) cultural and archaeological aspects.

4.2 Influence Area of the Project

The corridor of direct project influence is considered to be the Right-of-way (RoW) of the proposed YCHP. Depending on the local topographic conditions, the RoW is between 50-70 meters wide. The area of influence also includes nine pre-identified borrow sites for road building materials (sand, stone, etc.) which are mostly located within the right-of-way of the road (cut areas), four stone quarry sites, and the sites to be used for depositing excess materials from the areas of cuts to be made in the terrain.

It is also considered that a corridor of 500 meters on each side of the proposed alignment will be indirectly affected during the construction period of the project. Indirect environmental influence could affect nearby agricultural and grazing land, water bodies, forest land etc. although there is no declared forest land in the project area.

The locations of future construction site and labour camps are also considered to be part of the area of influence of the project. However, the location of those will only be identified later by the civil works contractors.

4.3 Sources of Data for ESIA Study

The data used for the preparation of ESIA report is reflected below:

Primary data was collected during field surveys by the team of environmental and social specialists for the full length of the YCHP alignment. The project feasibility study and the final design reports were used to identify the precise location of the proposed alignment on the ground and of all major features existing along the alignment. Primary data was collected through observations, consultations and group discussions, interviews, inventory of assets/trees/crops and through household surveys. Also, the consultant carried out measurements of various environmental conditions (i.e. noise, air and pollution, etc.).

Secondary data for the ESIA was collected from various existing published and unpublished reports, literature, documents as indicated below:

Data	Source
The Geology of Yemen	Geology and Mineral Resources of Yemen, 2001, Ministry of Oil and Mineral Resources, Republic of Yemen
Weather	www.weatherspark.com
Feasibility study/final design report	Dorsch Consult
Environment Protection law of Yemen	Republic of Yemen
Information from Water and Environment Ministry	Republic of Yemen
Information from Environmental Protection Agency (EPA) offices in Aden and Lahj Governorates	Republic of Yemen
World Wildlife Fund Working Papers	Western Asia: Oman, Yemen, and Saudi Arabia, Arabian Peninsula: Yemen and Saudi Arabia
IUCN	www.iucn.org
Agricultural Handbook	Republic of Yemen, 2012
Statistical Handbook	Republic of Yemen, 2012
Geological maps	Ministry of Geology and Mineral Resources, Republic of Yemen
World Bank	www.worldbank.org
World Wildlife Funds	www.wwfindia.org

The consultant’s team consulted various Government offices in Sana’a, Taiz, Lahj and Aden in order to collect available information for the study.

4.4 Topography

Yemen is located on the southern tip of the Arabian Peninsula, bordered by Saudi Arabia in North, by Oman in the East, and by the Red Sea in the West and the Bab-el-Mandeb, the strait that is connecting the Red Sea and the Gulf of Aden. Yemen has maritime borders with Djibouti, Eritrea, and Somalia. Its area is 527,970 sq. km.

The Empty Quarter desert (Ar Rub' al Khali) in the north of Yemen is one of the largest sand deserts in the world, encompassing most of the southern third of the Arabian Peninsula. Ramlat al-Sab`atayn is a desert region in central Yemen. Ramlat Dahm is a desert region in North West, part of the "Empty Quarter". The Tihamah, a narrow semi-desert coastal plain along the Red Sea, is part of the Arabian Peninsula coastal fog desert ecoregion which stretches further along the southern coast of the country in a very narrow strip.

The country's interior is dominated by mountains ranging from a few hundred meters up to the country’s highest point, Jabalan Nabi Shuayb (3,666 m; 12,028 ft.) near Sana'a, the country's capital. The mountains can be separated into the western highlands with relatively fertile soil and sufficient rainfall, and the central highland, a

picturesque area located between 2,000 and 3,200 meters of altitude, with rolling hills, small knolls, and some very prominent peaks. The central highlands are drier than the western highlands because of rain-shadow influences, but still receive sufficient rains during the wet season of the year so that extensive cropping is possible. The Mahra Mountains (Jabal Mahrat extends up to an elevation of 1300 m) are in the central and south-eastern part of the country through which the proposed highway alignment traverses.

The geomorphological point of view, the alignment of the road corridor can be characterized into six zones as described in **Table 4.1**

4.5 Soils and Geology

Yemen is covered with rocks whose ages date back to an era prior to the Cambrian era, about 3 billion years ago. Geologically, Yemen composes part of the Arabian Shield within the larger framework of the Arabian-Nubian Shield. The proposed highway corridor between Aden and Taiz runs along two geo-morphological units, namely the *Yemeni Highland Geomorphologic Province* and the *Gulf of Aden Costal Plains*.

The *Yemeni Highlands Geomorphologic Provinces* are built up mainly of igneous rocks and lie between the Red Sea Graben on the West and the Arabian Desert on the East. Wadis are characterized by strong head ward erosion, which is highly diversified and dissects the mountains of this physiographic province. These wadis are mostly structurally controlled by faults and joint sets that are demonstrated by steep and deep cuts. The water flows with high velocity on a large suspended bed load following periods of rains. This is the additional main cause of continued erosion and incision of water drains.

The *Gulf of Aden Costal Plains* are the areas of lowland bordering the sea on the south coast. They are composed of alluvial deposits of variable thickness and they receive runoff from adjoining mountainous areas.

Tectonic events, especially during the Tertiary period (*Cenozoic age*) are the main agent controlling the physiographical properties along the project road alignment, causing eruption of high and steep mountains of extrusive rocks at the first part, wide and flat-bottomed grabens filled with relatively thick soil deposits along the second part, relatively rugged hilly gravel side divided by many steep-sided wide wadis along the third part, and flat to gently rolling and undulating areas crossed by many sand dunes along the last part. The Geological Map is shown in **Figure 4.1**.

Table 4.1: Geomorphological Zone along project area: Taiz to Aden

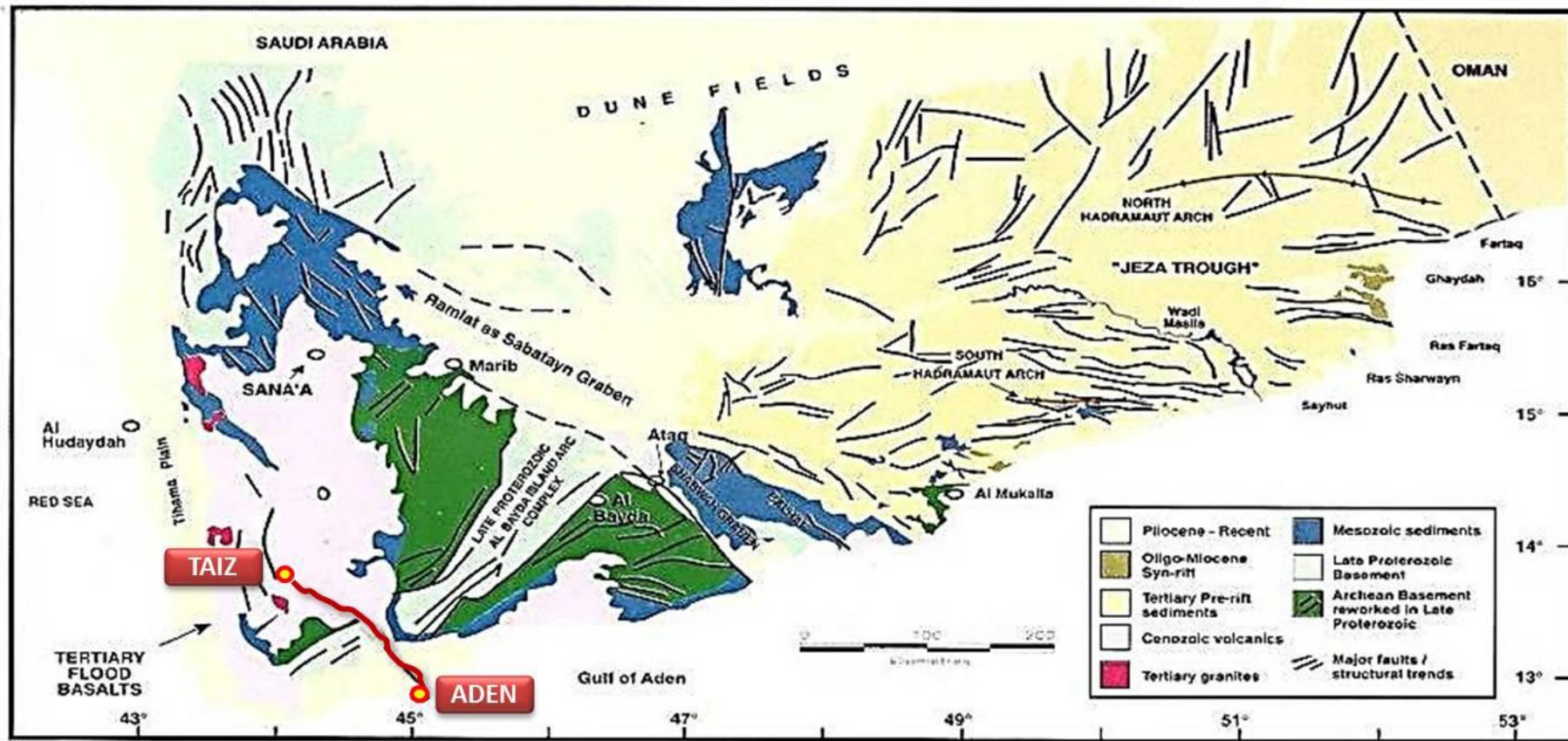
Zone	Road section	Characteristics
1	Km 0.00 to Km 5.500	Road corridor from Km 0.00 to Km 5.500 passes through open terrain, gently undulated and slightly rolling. This zone is covered by relatively thick silty – sandy soil and is characterized by relatively rich vegetation cover. It is divided into small farms and plantations.

Zone	Road section	Characteristics
2	Km 5.500 to Km 24.500	Road corridor from Km 5.500 to Km 24.500 passes through rugged hilly and mountainous areas built up from jointed and partly weathered massive basalt. Vegetation along this zone is rather poor and is limited to the valleys and lowland areas which are crossed by the road alignment at many locations.
3	Km 24.500 to Km 39.200	Road corridor from Km 24.500 to Km 39.200 passes through intensively vegetated narrow valley bounded by steep and high mountainous ranges composed of intrusive rocks. The valley is filled with relatively thick alluviums and agricultural soil. The road corridor hits the mountainous ridges at many locations.
4	Km 39.500 to Km 50.00	From Km 39.500 to Km 50.00 the road corridor passes through rugged hilly and mountainous areas which are locally rich with wild vegetative cover. The hills are composed from cemented soil-rock mixtures, whereas mountains are built up of intrusive rocks. Farms and plantations are scattered and are limited to graben sand valleys.
5	Km 50.000 to Km 90.500	The road corridor from Km 50.000 to Km 90.500 passes through partly rugged hilly areas which have rather poor vegetation cover. The hills are composed of cemented soil – rock mixtures. Some scattered basaltic outcrops were also observed. Some spots of rich vegetation were observed along with the wadis in this zone.
6	Km 90.500 of the road corridor to end of alignment at Km 140.000	From Km 90.500 of the road corridor to end of alignment at the sea coast at Km 140.000 the landscape is flat to gently undulating and is covered by wind-blown sand. Vegetation along this stretch of the alignment is very poor and is composed of scarce scrubs. Some farms and plantations were observed few hundred meters to west of the road corridor.

To establish the soil quality of the project area, soil samples were collected in the month of January 2014 from different locations along the YCHP. The result of the soil quality analysis is given in **Table 4.2**.

Table 4.2: Soil Monitoring Results

Location/Chainage	Organic matter %	Total nitrogen %	Potassium mg/L	Phosphorous mg/L	Organic carbon %	Sulphate mg/l	Sodium mg/l	Calcium sulphate Mg/100g
0+000	1.1	0.35	192	1.8	0.16	82.5	56.8	0.133
27+300	0.6	0.53	49.2	0.4	0.34	90.0	30.32	0.63
61+250	1.41	0.35	134.4	2	0.82	132.5	56.48	0.052
128+05	0.4	0.35	57	0.0	0.22	80.0	134.4	0.11



*Source: Ministry of Oil and Mineral Resources, Republic of Yemen

Figure 4.1: Geological Map of Yemen depicting the Road alignment

4.6 Climate and Meteorology

The climate of Yemen is characterized as semi-arid, where rainfall is generally limited but with significant variations depending on the elevations. Temperatures are generally high, particularly in the coastal regions. The highlands enjoy a temperate, rainy summer with an average high temperature of 21 °C (69.8 °F) and a cool, moderately dry winter with temperatures occasionally dipping below 0 °C (32.0 °F) at some places. Some areas of the western highlands such as around Taiz receive about 1,000–1,500 millimetres (39.4–59.1 in) of rain each year. In Aden, the average temperature is 25 °C (77.0 °F) in the month of January and 32 °C (89.6 °F) in June with highs often exceeding 37 °C (98.6 °F). Average annual rainfall of Aden is 127 millimetres (5 in).

The weather data used for the ESIA was collected from the weather monitoring stations located at Taiz International Airport and Aden International Airport. The historical weather data at both of these weather stations is considered to summarize the weather conditions within the project area. The historical meteorological information for these two weather stations was obtained from the “Weather Spark” website (<http://weatherspark.com/>). Taiz area has a hot desert climate and the area within 40 km of this station is covered by *shrub lands* (74%), *grasslands* (15%) and *croplands* (11%). Aden area has a hot desert climate and the area within 40 km of this station is covered by desert, ocean and the Aden metropolitan area.

4.7 Temperature

The temperature data of the year 2013 for the project road section between Taiz and Aden is shown in **Table 4.3**.

Table 4.3: Temperature data for Taiz and Aden

Temperature	Taiz		Aden	
	Day	Avg. daily temp	Day	Avg. daily temp
Hottest Day	July 16 th	36°C	May 26 th	38°C
Hottest Month	June	32°C	June	36°C
Coldest Day	January 19 th	9°C	March 10 th	19°C
Coldest Month	December	12°C	December	23°C

*Source: <http://weatherspark.com>

4.8 Humidity

The summary of humidity data for Taiz and Aden for the year 2013 is summarized below.

Taiz:

- The least humid month was in June with an average daily low relative humidity level of 23%.
- The most humid month was in August with an average daily low relative humidity level of 41%.

Aden:

- The least humid month was June with an average daily relative humidity of 41%.
- The most humid month was March with an average daily relative humidity of 60%.

4.9 Winds

Data on wind speed and direction in the project has also been collected for Taiz International Airport and Aden International Airport. The Annual wind rose diagrams for 2013 were prepared to analyse the wind speed and direction in the project area. The Taiz wind rose diagram indicates predominant winds from south-eastern and western directions with the wind speed ranging from 4 to 16 knots. The Aden wind rose diagram shows predominant winds from the east and southeast directions with the wind speed ranging of 5 to 19 knots. The wind rose diagrams of Taiz and Aden are shown in **Figure 4.2** and **Figure 4.3** respectively.

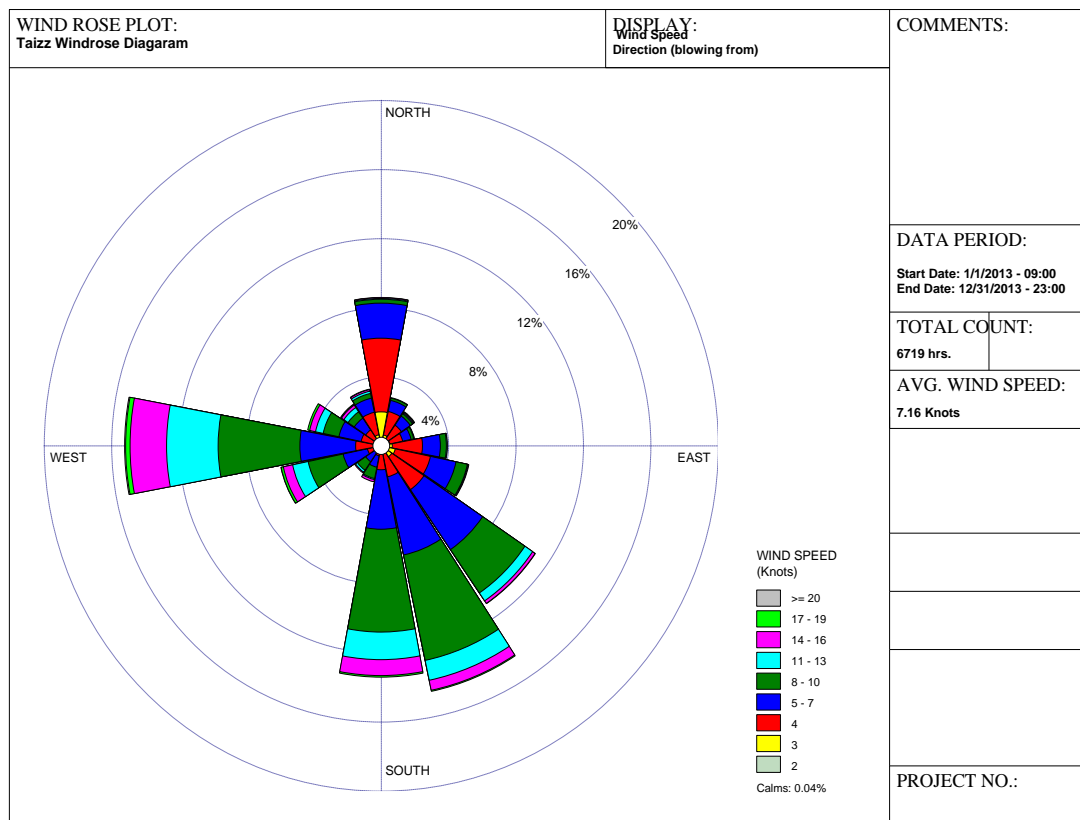
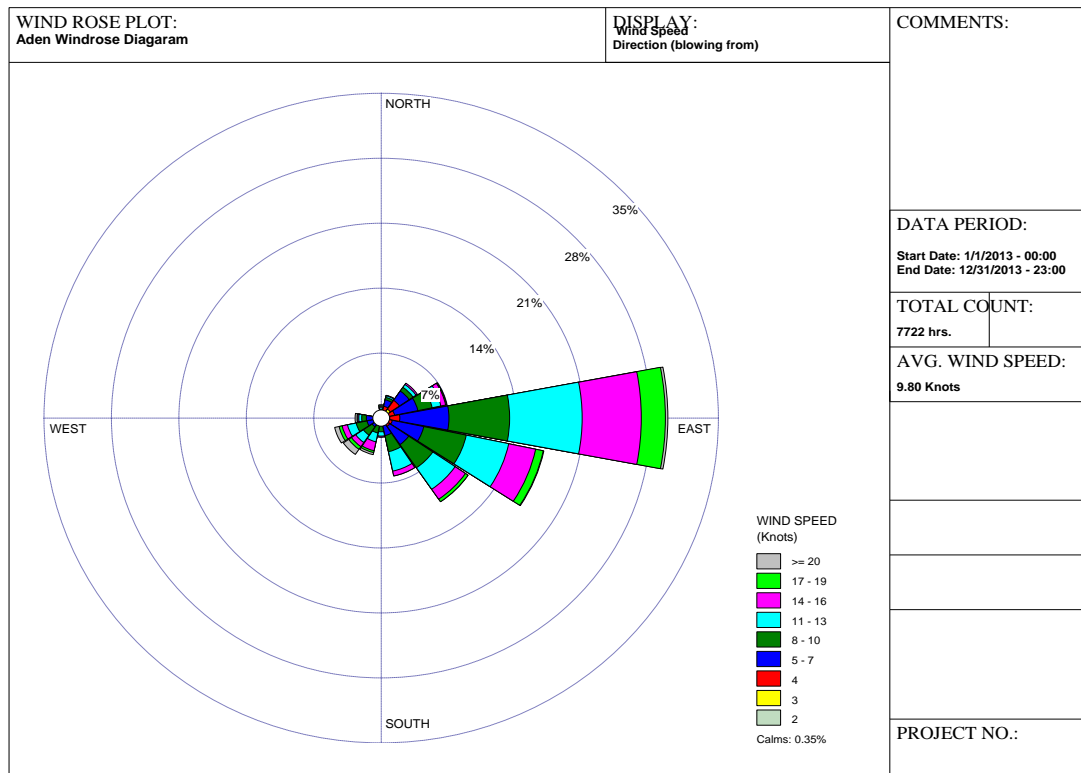


Figure 4.2: Wind Rose Taiz



WRPLOT View - Lakes Environmental Software

*Data Source: <http://weatherspark.com>, developed by VSPL

Figure 4.3: Wind Rose Aden

4.10 Air Quality

Air quality in most of the project area is dominated by natural factors, such as dust blown up by wind from the land areas not covered by vegetation.

There are some small-scale industries near the planned highway alignment near Taiz (Al-Ganad). **Plate 4.1 to 4.3** show examples such small-scale industries engaged in stone cutting and cement block manufacturing which are sources of some limited air pollution within the project area. As shown in **Plate 4.4** there are also unpaved roads near the planned road alignment and traffic on those roads cause a significant amount of dust in those areas.

Another source of existing air pollution is vehicle traffic emissions. While this type of air pollution is minimal in rural areas (mostly farm tractors operating on fields and local tracks), it is more significant especially in the Aden metropolitan area. Near Taiz, the planned alignment of the new highway is actually located about 10 km away from Taiz city and the urban air pollution does not directly affect the area of the planned road alignment.



Plate 4.1: Stone cutting Unit



Plate 4.2: Industries in Al-Ganad area

**Source: Preliminary Field Survey VSPL & YAEC*



Plate 4.3: Cement Block Manufacturing Unit



Plate 4.4: Moving vehicles creating air pollution

**Source: Preliminary Field Survey VSPL & YAEC*

Today, air pollution is not identified as a critical issue in the area of the planned road alignment since it is passing mostly through rural areas and villages without much traffic or polluting industrial or commercial activities.

The ambient air quality standards as per Annexure No. 5 of Yemen by law 148 of the year 2000 are presented below.

S. No.	Parameters	Maximum Limit	Duration
1.	Sulphur dioxide (SO ₂) µg/ m ³	250	One Hour
		150	24 Hour
		60	One Year
2.	Nitrogen oxides (NO _x) µg/ m ³	400	One Hour
		150	24 Hour
3.	Carbon monoxide (CO) mg/m ³	20	One Hour
		10	24 Hour
4.	Ozone (O ₃) µg/ m ³	200	One Hour
		120	08 Hour
5.	Suspended Particulate Matter as Black Smoke µg/ m ³	150	24 Hour
		60	One Year
6.	Particulate Matter (PM ₁₀) µg/ m ³	70	24 Hour
7.	Lead (Pb) µg/ m ³	1	One Year

Monitoring of air environment is one of the key components to assess the environmental health of any project. Hence the Air Quality monitoring was carried out for this road project in order to establish the baseline for air quality. Six different monitoring locations were selected and the monitoring was carried out during the month of March 2014 at these six locations. The selection of monitoring locations was based on the correlation of chances for pollution level with proposed and existing design, existing traffic volume, land use pattern and the micrometeorology of the area. The details such as monitoring station code, chainage, Geographical coordinates and the distance from the proposed alignment are given in **Table: 4.4**.

In this process, key pollution indices (air pollutants) like PM₁₀ (µg/m³), PM_{2.5} (µg/m³), CO (µg/m³), SO₂ (µg/m³), NO_x (µg/m³), and Ozone (µg/m³), were measured for 24 hours at designated locations during the month of March 2014. Internationally recognized methodology and techniques were used to carry out the monitoring and testing.

Table 4.4: Air Quality Monitoring Station Details

Sl. No.	Monitoring Station Code	Chainage	Name of the Location	Geographical Coordinates	Area Category	Distance from the road (approx. in m)
1.	AAQMS 1	0+000	Al Janad	13 39 54.2N 44 09 44.2 E	Rural	150
2.	AAQMS 2	30+500	Al Danaba	13 32.75.6N 44 23.33.5E	Rural cum Commercial	100
3.	AAQMS 3	72+720	Al Musmayar	13 20 56.6N 44 40 46.4E	Rural	120

Sl. No.	Monitoring Station Code	Chainage	Name of the Location	Geographical Coordinates	Area Category	Distance from the road (approx. in m)
4.	AAQMS 4	83+300	Al Anad	13 17 29.2N 44 45 05.8E	Commercial	60
5.	AAQMS 5	127+000	Al Fayush	13 00 33.2N 45 01 45.4E	Agricultural Area	200
6.	AAQMS 6	140+638	Al- Alam	12 54 41.9N 45 04 48.6E	Near Arabian Sea	200

*Source: Preliminary Field Survey VSPL & YAEC

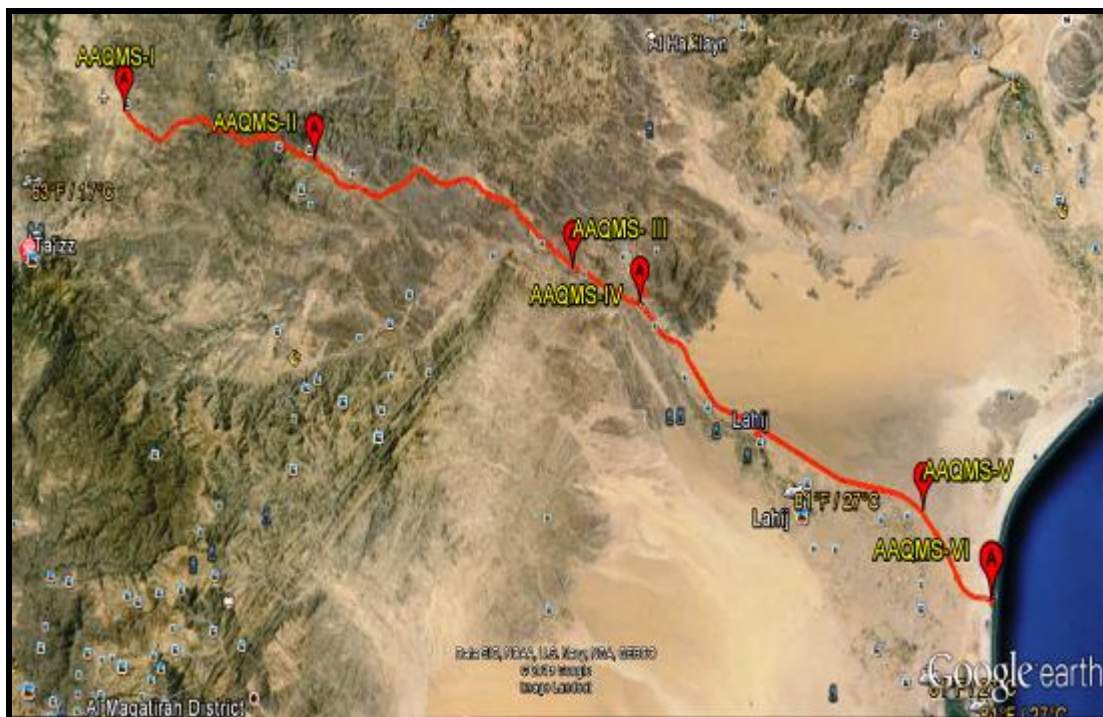


Figure 4.4: Geographical position of different AAQMS with Project Road

Table 4.5: Dates & Duration of Ambient Air Quality within study area

Sl. No.	AAQMS	Date of Sampling	Duration of Sampling
1.	Site -I	14-15 th March 2014	24 Hrs.
2.	Site -I	15-16 th March 2014	24 Hrs
3.	Site-II	14-15 th March 2014	24 Hrs
4.	Site-II	15-16 th March 2014	24 Hrs
5.	Site-III	17-18 th March 2014	24 Hrs
6.	Site-III	18-19 th March 2014	24 Hrs
7.	Site -IV	17-18 th March 2014	24 Hrs
8.	Site- IV	18-19 th March 2014	24 Hrs
9.	Site-V	19-20 th March 2014	24 Hrs
10.	Site-V	20-21 th March 2014	24 Hrs
11.	Site-VI	19-20 th March 2014	24 Hrs
12.	Site-VI	20-21 th March 2014	24 Hrs
13.	Site-VI	22-23 rd March 2014	24 Hrs
14.	Site-V	22-23 rd March 2014	24 Hrs
15.	Site- IV	23-24 th March 2014	24 Hrs

Sl. No.	AAQMS	Date of Sampling	Duration of Sampling
16.	Site-III	23-24 th March 2014	24 Hrs

The major portion of the project road is traversing through the open barren land, unpaved roads, which generally consist of weathered materials. Also, the entire gulf region predominantly the peninsular part of the region is subjected to sandstorms and dust storms, especially in the afternoon, which causes soil erosion and generation of huge dust.

The entire process is directly related to the ambient temperature and pressure. Hence, during summer, these sandstorm/dust storms take place in the project area, which ultimately increase dust concentration in atmosphere. There are many stone cutting units, construction block construction units and brick manufacturing units in the project area which also add on the particulate concentration in the atmosphere.

It is observed that large percentage of vehicles are old which are plying on roads without routine maintenance. Also due to shortage of power in the project area people use Diesel Generator (DG) sets to meet the requirement of electricity for their domestic and commercial requirements. The gaseous pollutants are generated mainly due to operation of DG sets and movement of the vehicles.

The emissions generated through above said sources easily get dispersed in the day time. However during evening hours, ground level concentration of gaseous pollutants gets increased in the absence of sunlight. Further, during winter season slightly higher concentration of these gaseous pollutants is expected due to their lesser dispersion in the ambient environment as compared to summer season; which is prevailing weather condition along the major part of the project corridor.

Table 4.6: Status of Ambient Air Quality within study area

Parameters	AAQMS I	AAQMS II	AAQMS III	AAQMS IV	AAQMS V	AAQMS VI
PM ₁₀ (in µg/m ³)	73.5	69.4	76.6	84.3	73.6	72.4
PM _{2.5} (in µg/m ³)	34.2	36.8	39.6	46.8	35.8	33.6
SO ₂ (in µg/m ³)	12.2	11.6	13.6	16.6	11.9	14.3
NO _x (in µg/m ³)	19.3	17.8	20.3	26.3	22.8	21.6
CO (in mg/m ³)	3.59	3.75	3.43	3.83	3.59	3.90
O ₃ (in µg/m ³)	22.8	24.6	25.1	28.6	21.3	31.4

*Source: Preliminary Field Survey VSPL & YAEC

The results of ambient air quality monitoring shows that all the parameters are within the prescribed limits of WHO for interim target (refer **Annexure 3.1**). Except for particulate matter especially PM₁₀ the concentration is higher than the prescribed limit of 70 µg/m³ which could be due to dusty environment and the traffic movement in the area. At monitoring site IV (AAQMS-IV) there is a road junction near the site and heavy volume of traffic movement is observed on the existing road which could be the reason for increase in PM₁₀ concentration as compared to other sites. Whereas the gaseous air pollutants are well within the prescribed limits of WHO and Yemen byelaw. Pictures of Air Quality Monitoring being carried out at different locations are placed as **Plate 4.5**.



AAQMS I



AAQMS I



AAQMS II



AAQMS II



AAQMS III



AAQMS III





Plate 4.5: Pictures of Air-quality Monitoring

4.11 Noise

Consultations with people in the area of influence of the project revealed that noise pollution is presently not considered an issue. The only significant sources of man-made noise are (i) operation of stationary motors to power pumps for drawing water from wells, and for grain mills, (ii) farm tractors used in the agriculture fields, and (iii) motorized vehicles travelling on the mostly unpaved local roads. Local people stated that noise is not a problem for them as it is momentary and during daytime only. Some sources of noise pollution are shown in **Plate 4.6** and **Plate 4.7**.

According to Annex No. 7 of the Yemen bylaw 148 of the year 2000, the following standards are applicable for the noise from road and transport infrastructure in country:

- i). As per Article 2(b): Sources of outside noise are: Transportation roads: include motor operated means of transport in towns, on highways and local roads, etc.
- ii). As per Article 6: In regard to the noise resulting from sounds explained in the items a, b, c, d of Article 2, limits are set for the noise that occurs during specific

times of the day and night in relation to working days and during holidays based on the following:

- A. Working days- daytime: after 7 am until 6 pm local time
- B. Working days -evening: after 6 pm until 11 pm local time
- C. During holidays and night: after 11 pm until 7 am local time

iii). As per Article 8: The limit of noise from sources mentioned in item (b) of Article 2 related to period of time in each of a), b), and c) of Article 6 based on continuous sound pressure level equivalent to the adjustment A (dB(A)) is as shown in the table below:

S. No.	Type of Region	Equivalent Limits & Period of Time Decibel (A) over the Period of Time		
		A	B	C
1.	Rural areas houses, recreation and observation places	60	55	55
2.	Dwelling areas in suburbs	65	60	55
3.	Urban dwelling areas	65	60	55
4.	Urban dwelling areas with workshops some and town centres	65	60	55
5.	Industrial and commercial areas	70	65	60

There are some very limited activities in the project area which causes vibrations. People generally use rocks for construction of their houses or other small structures. Since all the rock breaking activities are carried out manually the resulting vibrations are extremely limited and not a relevant issue.



Plate 4.6: Noise Source in project Area – Diesel powered water pump



Plate 4.7: Tractor in agriculture field

**Source: Preliminary Field Survey VSPL & YAEC*

Noise is an integral part of air pollution and its assessment prior to any development work becomes very important. In general, vehicular movement is main source of noise in project road and high speed winds also adds to increase in noise levels. However, physical environment and land use pattern plays a crucial role in transmission of noise from source to receptor. With the purpose of assessment of baseline for noise quality within project stretch, noise monitoring was carried out at six locations along the proposed road alignment. Monitoring of noise was carried out using hand held Sound Level Meter and the Noise levels were recorded at the regular interval of time for 24 hours in a day. The noise attributes like Leq (A), Lmax, Lday, L_{Night} and L_{DN} have been calculated for all the noise monitoring locations. The locations with details such as chainage, coordinates and distance from the proposed road are given below in **Table 4.7**. The noise monitoring results are given in **Table 4.8**

Table 4.7: Monitoring location details for project corridor

Sl. No.	Monitoring Station Code	Chainage	Name of the Location	Geographical Coordinates	Area Category	Distance from the road (approx. in m)
1.	NM Site- I	0+000	Al Janad	13 39 54.2N 44 09 44.2 E	Rural	8
2.	NM Site- II	30+500	Al Danaba	13 32.756N 44 23.335E	Rural cum Commercial	10
3.	NM Site- III	72+720	Al Musmayar	13 20 56.6N 44 40 46.4E	Rural	8
4.	NM Site- IV	83+300	Al Anad	13 17 29.2N	Commercial	9

				44 45 058E		
5.	NM Site- V	127+000	Al Fayush	13 00 33.2N 45 01 45.4E	Agricultural Area	10
6.	NM Site- VI	140+638	Al- Alam	12 54 41.9N 45 04 48.6E	Near Arabian Sea	6



Figure 4.5: Geographical position of Noise Monitoring locations

Table 4.8: Noise Monitoring Results

Parameter	NM Site- I	NM Site- II	NM Site- III	NM Site- IV	NM Site- V	NM Site- VI
Leq in dB (A)	69.15	60.98	64.38	69.72	63.96	65.6
Lday in dB (A)	70.28	59.71	64.76	69.75	64.69	66.96
LNight in dB (A)	66.19	62.52	63.66	69.76	62.36	61.48
L _{DN} in dB (A)	73.5	68.6	70.3	76.1	69.2	69.2
L _{Max} in dB (A)	79.1	74.3	78.2	81.2	72.3	79.8

**Source: Preliminary Field Survey VSPL & YAEC*

The values observed are within the permissible limits of WHO guidelines for Industrial and Commercial Areas. However when compared with residential area standards of WHO guidelines the values are slightly on higher side (refer Annexure 3.2). The main source of noise pollution is movement of vehicles. Another source of noise is high speed wind movement which could also be the cause of high noise in the ambient conditions.

4.12 Hydrology

Groundwater in the region of the project site occurs within several major (regional) hydraulically interconnected aquifer systems. The depth of the groundwater in these aquifer systems varies from a few meters in the lowland areas to more than 90m in higher areas, as obtained from information collected on existing water wells.

Due to unconformity of bedding and inter fingering of Quaternary soil formations with the underlying igneous rock formations, local perched water confined in water bearing lenses may also be found. Depth to groundwater in these local aquifers may vary from few meters to about 20m, as observed in many manually excavated wells.

The highlands are characterized by relatively high rainfall but recharge to groundwater is frequently limited by low infiltration capacity of catchments. Low permeability and steep bare mountain slopes with little vegetation to retain moisture lead to high runoff coefficients in the wadis and much of this water leaves the area to recharge the major alluvial aquifers to west, south and east. Some runoff is absorbed by wadi alluviums and this forms an important groundwater resource locally. Seepage to underlying units is furthermore thought to provide an important route for recharge to the consolidated aquifers.

One of the most important and most studied aquifers is that underlying the coastal catchments of Wadi Tuban and Wadi Bana to the east. The planned alignment of the highway runs through Wadi Tuban approximately from km 90 to km 125.

4.13 Surface Water Resources

Surface water (rivers, perennial wadis, springs, etc.) is rather rare along the project corridor. Only two perennial wadis were observed during the field visits in December 2013. One of them is Wadi Warzan which is crossed by the planned highway alignment at several locations, approximately from km 60 to km 75. The water flow in this wadi is subjected to high fluctuation between wet (summer) and dry (winter) seasons. The other is Wadi Tuban through which, as mentioned above, the planned alignment of the highway runs approximately from km 90+000 to km 125+000 (**Plate 4.8 and 4.9**).

There are many other locations where the planned road would cross small seasonal water passes which are typically dry and only carry water for short periods during and after rains. The number of such water passes in each Governorate is given in **Table 4.9**. The list of these water resources is annexed in **Annexure 4.1(a)**. The detailed engineering design includes about 500 culverts which allow water to cross the highway.

Table 4.9: Small Surface Water Resources

Sl. No.	Description	Taiz	Lahj	Aden	Total
1	Water Cross/Pass/	142	24	0	166

**Source: Preliminary Field Survey VSPL & YAEC & Data obtained from the MPWH*



Plate 4.8: Warzan Wadi



Plate 4.9: Tuban Wadi in Lahj

**Source: Preliminary Field Survey VSPL & YAEC*

4.14 Access to Groundwater Resources

There are large numbers of water wells in the area of influence of the planned highway. These are typically functioning with either motor pumps or manual pumps. The surveys showed that 22 wells (and 2 water pools) are likely to be directly affected by the planned highway construction.

During the field visit along the alignment of the planned highway road corridor the observations on groundwater depth directly in the planned highway alignment were made. The variations in groundwater depth are as follows:

- Near km 17: varies between 35m and 40m in several wells
- Near km 23: depth is 14m in a manually dug water well
- Between km 25 and km 37: varies between 45m
- Near km 39.5: 15m in manually dug water well
- Near km 42: 15m in manually dug water well
- Near km 50: 35m in deep water well and 10m in a manually dug water well

- Near km 89: 3m in manually dug water well
- Near km 120: 30m in deep water well
- Near km 130: 17m in deep water well

Moreover, there are other small seasonal water passes which will be directly affected by the proposed road construction. Any issues arising with those are being addressed by the engineering design of the highway. The number of such seasonal water resources in each Governorate which are present within the land to be acquired for Highway development is given in **Table 4.10**. The list of affected water wells is listed in **Annexure 4.1 (b)**

Table 4.10: Access to Ground Water Resources

Sl. No.	Type of Properties	Taiz	Lahj	Aden	Total
1	Wells	16	5	1	22

**Source: Preliminary Field Survey VSPL & YAEC & Data obtained from the MPWH*



Plate 4.10: Local people carrying water from well to village

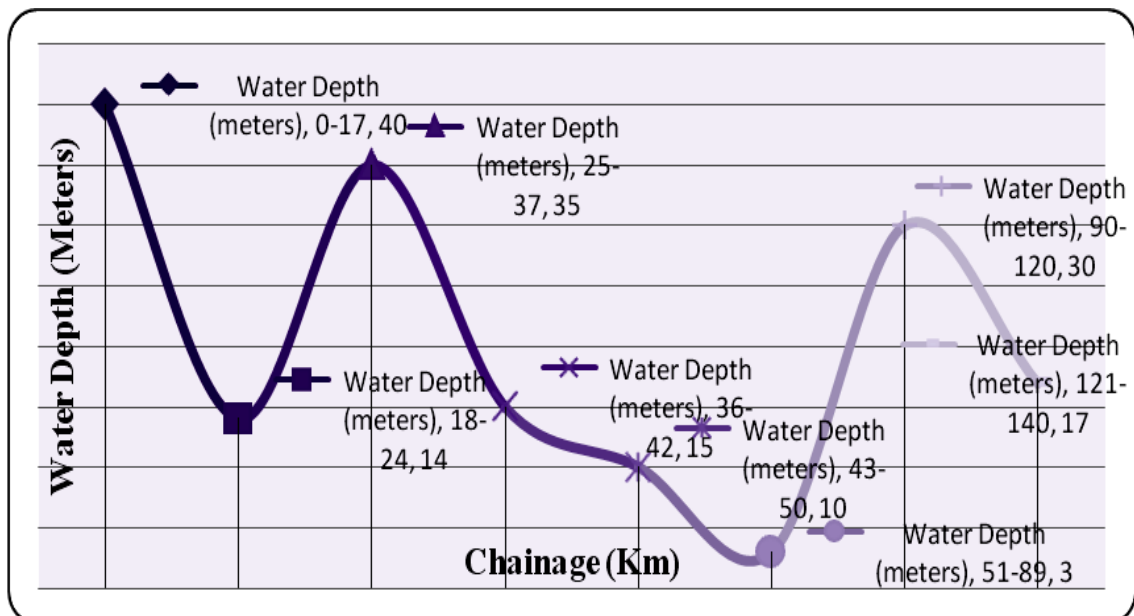
**Source: Preliminary Field Survey VSPL & YAEC*



Plate 4.11: Girls filling water in container for transport to village

**Source: Preliminary Field Survey VSPL & YAEC*

The graphical presentation of water table in the entire project area is presented below:



4.15 Availability and Quality of Ground Water

The availability of water is a vital issue in the project area. The collection of water from remote sources and their transportation to the locations of consumption (typically villages) is a major activity of the local people and especially of women and girls. Typically girls between 8 to 12 years old travel with donkeys to the nearest well often located at the foothills near their village which is located higher on the hills. The

girls fill empty water containers, load them on the donkeys and travel back to their house.

A very significant part of groundwater and surface water in the project area is used for Qat cultivation (Plate 4.12 and 4.13). The increase in Qat cultivation during recent years is having a huge impact on the groundwater resources in the project area. As confirmed by the Governor of Taiz, groundwater resources are being depleted in many locations due extensive water usage for Qat irrigation.



Plate 4.12: Qat Cultivation in Project Area



Plate 4.13: Extraction of groundwater for Qat Irrigation

**Source: Preliminary Field Survey VSPL & YAEC*

As stated above, water is a scarce resource in Yemen. Hence, water availability is an issue at least parts of the area of influence of the planned highway. Some of the villages do not have any water supply of their own and water is brought to those villages through small water pipelines that are provided through various Government programs. These pipelines are connected with nearby wells equipped with pumps.

Consultations with local residents along the highway corridor revealed that the quality of ground water in the project region is generally considered as good. Since there are no industries or other sources of contamination, ground water is usually clean where it is available. However, bacteriological contamination in the ground water has been reported in some locations during the field survey.

The current standards for water quality set by the Government of Yemen are presented in **Table 4.11** below.

Table 4.11: Water quality standards set by the Government of Yemen

S. No.	Parameters	Unit	Maximum Value
Physical Characteristics			
1.	Colour		15
2.	Turbidity,	NTU	05
3.	Temperature	°C	25
4.	pH Value		6.5-9.0
5.	Conductivity	(µmhos/cm)	2500
Chemical Characteristics			
1.	Total Dissolved Solids	mg/l	1500
2.	Total Hardness	mg/l	500
3.	Bicarbonate	mg/l	500
4.	Chloride	mg/l	600
5.	Sulphate	mg/l	400
6.	Calcium	mg/l	200
7.	Magnesium	mg/l	30-150
8.	Sodium	mg/l	400
9.	Potassium	mg/l	12
10.	Iron	mg/l	01
11.	Magnesium	mg/l	0.2
12.	Copper	mg/l	0.1
13.	Zinc	mg/l	15
14.	Aluminium	mg/l	0.2
15.	Nickel	mg/l	0.02
Toxic Organic Pollutants			
1.	Parathion	mg/l	0.0035
2.	Endrin	mg/l	0.0002
3.	Lindane	mg/l	0.004
4.	Methoxychlor	mg/l	0.01
5.	Toxaphene	mg/l	0.0002
6.	Malathion	mg/l	0.19
7.	Dimethoate	mg/l	0.0002
8.	Diazinon	mg/l	0.02

S. No.	Parameters	Unit	Maximum Value
9.	Hexachlor Cylohexan	mg/l	0.04
10.	Acetic Acid	mg/l	0.1
11.	Propionic Acid	mg/l	0.01
Toxicants			
1.	Lead	mg/l	0.05
2.	Selenium	mg/l	0.01
3.	Arsenic	mg/l	0.01
4.	Chromium	mg/l	0.05
5.	Cyanide	mg/l	0.1
6.	Cadmium	mg/l	0.005
7.	Mercury	mg/l	0.001
8.	Barium	mg/l	0.5-1.0
9.	Silver	mg/l	0.01-0.1
10.	Fluorine	mg/l	1.5-0.5
11.	Antimony	mg/l	0.005
12.	Barium	mg/l	0.3-0.1
13.	Total Trihalomethans	µg	150
Chemical Pollutants			
1.	Nitrate	mg/l	10-50
2.	Ammonium	mg/l	0.3-0.5
3.	Nitrite	mg/l	02
4.	Phosphate	mg/l	0.5
Radioactive Materials			
1.	Beta (β) emitters	Becquerel (Bq)	0.1
2.	Alpha (α) emitters	Becquerel (Bq)	01
Microbiological Contaminants			
1.	Faecal Coliforms	Cell/100 ml	10-15

The ground water quality was tested at some locations along the project corridor in the month of Jan 2014, along with the surface water found at Wadi Tuban and Wadi Aakan. The test results are shown in **Table 4.12** and **4.13**. It was found that the ground water quality of the project area is within the limits of Government-set water standards except for the concentration of potassium which is above the set standard.

Table 4.12: Ground Water Quality

Location	Unit	0+000	19+250	27+000	31+000	61+250	128+050	Yemeni Standard for Drinking Water Quality
Temperature	°C	19	19	19	19	19	18	25
pH		7	7.2	7.2	7	7.1	7.3	6.5-9.0
Turbidity	NTU	clear	Clear	clear	clear	clear	clear	5
Electrical Conductivity (EC)	(µmhos/cm)	5940	2080	1160	1240	1830	5800	2500
Colour		Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	15
TSS	mg/L	Nil	Nil	Nil	Nil	Nil	Nil	
Total Dissolved Solids (TDS)	mg/L	5346	1872	1044	11116	1171.2	3712	1500
Odour		Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	
Total Hardness	mg/L	1304.8	976.178	450.546	450.546	300.239	1251.12	500
Potassium	mg/L	104	100	100	100	80	40	12
Calcium	mg/L	240.5	190.4	120.24	120.24	120.24	120.4	200
Magnesium	mg/L	124.03	121.6	36.5	36.5	188.5	97.3	30-150
Ammonium	mg/L	0	0	0	0	0	0	0.3-0.5
Chloride	mg/L	873.3	366.7	78.1	71	1189.25	273.4	600
Sulphate	mg/L	1400	280	30	60	980	220	400
Nitrate	mg/L	26.21	89.5	31.5	26.6	14.6	8.42	50

Table 4.13: Surface Water Quality

Location	Unit	Tuban wadi	Aakan wadi
Temperature	°C	20	19
PH		7.8	7.9
Turbidity		Clear	Clear
EC		2000	1830
Cooler	Colour	Colourless	Colourless
TSS	mg/l	Nil	Nil
TDS	mg/l	1800	1647
Odour		Has a mild odour	Has a mild odour
Hardness	mg/l	650.881	520.604
Potassium	mg/l	96	80
Calcium	mg/l	100.2	90.18
Magnesium	mg/l	97.3	71.74
Chloride	mg/l	301.75	326.6
Sulphate	mg/l	310	26
Nitrate	mg/l	9.3	8.42
Dissolved Iron	mg/l	0.07	0.07

4.16 Ecology of the Project Area

4.16.1 Flora of Project Area

The flora in the entire project corridor is generally rather sparse and has been altered to various extents as a result of several types of pressure on the existing natural habitats, primarily by agriculture, grazing and habitation.

While there are trees, there is no closed forest cover or declared forest area on or near the project road alignment. The predominant over storey vegetation along the project road alignment is *Acacia abyssinica*, *Acacia asak* and *Ziziphus leucodermis* etc. In addition, *Azadirachta indica*, *Mangifera indica* and *Ficus spp.* can also be observed in small patches in the area of Lahj and Aden Governorates, especially along some agricultural fields. The predominant understorey vegetation on and near the alignment of the project road are *Calotropis procera*, *Euphorbia cactus*, *Opuntia ficus-indicus* and *Jatropha dhofarica* etc. The common plant species observed along the project road alignment and information collected from available records is shown in **Table 4.14**. No species of threatened, rare or endangered categories of IUCN (International Union for Conservation of Nature and Natural Resources) Red Data Book have been observed along the project road corridor. Most of the Species observed along the project road corridor either falls under Least Concern (LC) or Not Evaluated (NE) categories of the Red Data Book of IUCN.

Table 4.14: Important Plant Species Observed during the Field Study

S.N.	Local Name	Botanical Name	Family	Presence in Project Governorates			World IUCN Status
				Taiz	Lahj	Aden	
TREES							
1.	Asak	<i>Acacia asak</i>	Leguminosae	+	+	-	NE
2.	Harajraz	<i>Acacia edgeworthii</i>	Leguminosae	-	-	+	NE
3.	Quarad	<i>Acacia etbaica</i>	Leguminosae	+	+	-	NE
4.	Katat	<i>Acacia laeta</i>	Fabaceae	-	-	+	NE
5.	Arafat	<i>Acacia nilotica</i>	Leguminosae	+	+	+	NE
6.	Samar	<i>Acacia tortilis</i>	Leguminosae	+	+	+	NE
7.	Athbir	<i>Acokanthera schimperi</i>	Apocynaceae	-	-	+	NE
8.	Adelbert	<i>Azardica indica</i>	Meliaceae	-	+	+	NE
9.	Ahliz	<i>Balanites aegyptiaca</i>	Zygophyllaceae	+	+	+	NE
10.	Afar	<i>Buddleja polystachya</i>	Loganiaceae	+	-	-	NE
11.	Sadad	<i>Capparis deciduas</i>	Capparaceae	-	-	+	NE
12.	Mor	<i>Commiphora myrrha</i>	Burseraceae	-	-	+	NE
13.	Adad	<i>Delonix elata</i>	Fabaceae	+	+	+	NE
14.	Kharath	<i>Euphorbia balsamifera</i>	Euphorbiaceae	-	-	+	NE
15.	Sakam	<i>Ficus sycomorus</i>	Moraceae	+	+	+	NE
16.	Taulak	<i>Ficus vasta</i>	Moraceae	+	+	-	NE
17.	Arar	<i>Juniperus procera</i>	Cupressaceae	+	-	-	LC
18.	Henna	<i>Lawsonia inermis</i>	Lytheraceae	-	-	+	NE
19.	Sareh	<i>Maerua crassifolia</i>	Capparaceae	-	-	+	NE
20.	Mango	<i>Mangifera indica</i>	Anacardiaceae	+	+	+	DD
21.	Bann	<i>Moringa peregrine</i>	Moringaceae	-	-	+	NE
22.	Kaidi	<i>Pandanus odoratissimus</i>	Pandanaceae	-	-	+	NE
23.	Nakhla	<i>Phonex dactylifera</i>	Arecaceae	-	+	+	NE
24.	Amrud	<i>Psidium guajava</i>	Myrtaceae	+	+	+	NE
25.	Suak	<i>Salvadora persica</i>	Salvadoraceae	+	+	+	NE
26.	Athl	<i>Tamarix Arabica</i>	Tamaricaceae	-	-	+	NE

S.N.	Local Name	Botanical Name	Family	Presence in Project Governorates			World IUCN Status
				Taiz	Lahj	Aden	
27.	Alab	<i>Ziziphus spina-christii</i>	Rhamnaceae	+	+	+	NE
28.	Alab	<i>Zizyphus leucodermis</i>	Rhamnaceae	+	+	+	NE
SHRUBS							
1.	Sabbar	<i>Agave spp.</i>	Agavaceae	+	+	-	LC
2.	Sarreh	<i>Cadaba longifolia</i>	Capparaceae	-	-	+	NE
3.	Qathab	<i>Cadaba rotundifolia</i>	Capparaceae	-	-	+	NE
4.	Haumar	<i>Cadia purpurea</i>	Fabaceae	+	-	-	NE
5.	Ussar	<i>Calotropis procera</i>	Asclepiadaceae	+	-	+	NE
6.	Arom	<i>Carissa edulis</i>	Apocynaceae	+	-	-	NE
7.	Surphat	<i>Euphorbia cuneata</i>	Euphorbiaceae	-	-	+	NE
8.	Khadar	<i>Grewia tentax</i>	Tiliaceae	+	+	+	NE
9.	Gabir	<i>Grewia villosa</i>	Tiliaceae	+	-	-	NE
10.	Bakha	<i>Jatropha dhofarica</i>	Euphorbiaceae	-	-	+	NE
11.	Umkultham	<i>Lantana camara</i>	Verbenaceae	-	-	+	NE
12.	Ausaj	<i>Lycium shawii</i>	Solanaceae	+	+	+	NE
13.	Zedb	<i>Rhamnus staddo</i>	Rhamnaceae	+	+	-	NE
14.	Athrob	<i>Rumex nervosus</i>	Polygonaceae	+	+	-	NE
15.	Tarim	<i>Teclea nobilis</i>	Rutaceae	+	+	-	NE
GRASSES HERBS AND CLIMBERS							
1.	Halss	<i>Cissus rotundifolia</i>	Vitaceae	+	+	+	NE
2.	Kharath	<i>Euphorbia cactus</i>	Euphorbiaceae	+	+	-	NE
3.	Markh	<i>Leptadenia pyrotechnica</i>	Asclepiadaceae	-	-	+	NE
4.	Balas Turki	<i>Opuntia ficus-indicus</i>	Opuntiaceae	+	+	-	NE
5.	Sainam	<i>Saltia papposa</i>	Amaranthaceae	-	-	+	NE
6.	Swead	<i>Suaeda monoica</i>	Chenopodiaceae	-	-	+	NE
7.	Ghasa	<i>Typha angustata</i>	Typhaceae	-	-	+	NE

“+ Present”, “-Absent”

*Source: Preliminary Survey, VSPL& YAEC

Key Words: NE (Not Evaluated), DD (Data Deficient), LC (Least Concern)

<i>Tamarix Arabica</i>	<i>Phonex dactylifera</i>
<i>Mangifera indica</i>	<i>Ziziphus spina-christii</i>
<i>Azardica indica</i>	<i>Ficus vasta</i>
<i>Acacia asak</i>	<i>Acacia tortilis</i>

Plate 4.14: Over storey Vegetation (Trees) along the Project Corridor

It has emerged from the field survey that the project will require a significant number of trees cuttings including Qat plants. **Table 4.15** shows that as many as 21,025 trees

will be affected, out of which 2,146 trees are fruit bearing and the remaining 18,879 trees are non-fruit bearing. In addition, about 412,050 Qat plants will also be affected. Overall, a total of about 433,075 trees/plants will be required to be cut for the construction of proposed YCHP. Although Qat is a small plant, it is a major source of livelihood and households income of the people. Hence Qat plants are also considered for compensation and accordingly included in the compensation budget. The list of all affected trees/plants is given in **Annexure 4.1(c)**.

Table 4.15: List of Trees to be affected along the Project Road Corridor

Sl. No.	Trees	Taiz	Lahj	Aden	Total
1	Fruit bearing	926	1220	00	2146
2	Non-Fruit Bearing	11128	7751	00	18879
3	Qat	390037	22013	00	412050
Total		402091	30984	00	433075

*Source: Data obtained from MPWH & Analysed by VSPL

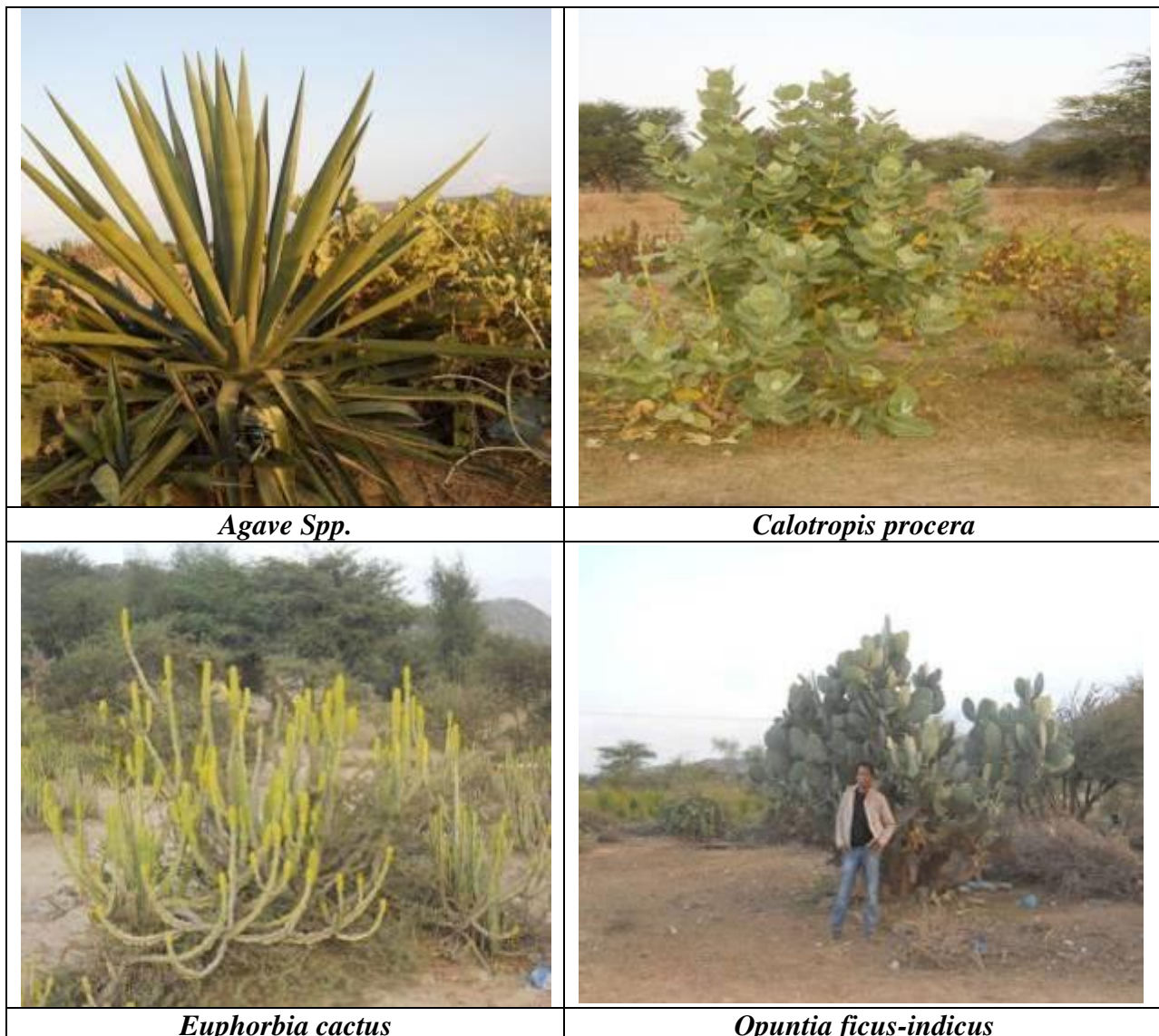


Plate 4.15: Under Storey Vegetation (Shrubs) along the Project Road Alignment

At places where soil conditions are not suitable for plant growth due to the xerophytic condition or at places where soil is over-exploited, the land is completely denuded from vegetation except for wasteland species and weeds. This type of land basically comprises plant species such as: *Calotropis procera*, *Euphorbia cactus*, *Agave Spp* and *Opuntia-ficus-indicus* etc.

4.17 Agricultural Land

The majority of the population along the project road alignment depends on agricultural activities. The principal agricultural crop observed along the project road alignment is Qat (*Catha edulis*), which is considered among one of the most profitable cash crops in the country. The highland section of the project road is further known for growing millet, sorghum and wheat crops, fruits such as grapes, nuts, apples and pomegranate, as well as pumpkins, tomatoes, onions, beans and potatoes as vegetables, and coffee as another cash crop. The coastal region of the project road has some limited cereal production and also some production of fruits like banana, papaya, dates, mango, guava, watermelon and vegetables like tomatoes and okra. The size of the agricultural land to be acquired for the project, for all types of crops, is approximately 161.00 hectares.

4.18 Fauna of Project Area

Since vegetation is mostly scarce and full forest cover absent on and along the project highway corridor, there is also very little wildlife of significance. The largest wild mammals still widespread along the project road alignment are the Hamadryas Baboon (*Papio hamadryas*), though its numbers too are said to be diminishing. Among the smaller mammals are Rock Hyrax (*Procavia capensis*), Wild Cat (*Felis silvestris*), Hyena, Fox and Common Hare. The common avifaunal species found along the project road alignment includes House Crow (*Corvus splendens*), Yemen Linnet (*Carduelis yemenensis*), Yemen Thrush (*Turdus menachensis*), Griffon vulture (*Gyps fulvus*) and Cattle Egret (*Babulcus ibis*). Some of the faunal species reported in the project highway corridor are listed in the Red Data Book of IUCN (International Union for Conservation of Nature and Natural Resources). Although some of the avian species observed are under vulnerable category, no habitats of such species were observed in the project area. The fauna reported in project area is listed in **Table 4.16**.

Table 4.16: Fauna in the project area

English Name	Zoological Name	World IUCN Status
MAMMALS		
Jackal	<i>Canis aureus</i>	LC
Wild Cat	<i>Felis silvestris</i>	LC
Common Mongoose	<i>Herpestres edwardsii</i>	NE
Hyaena	<i>Hyaena hyaena</i>	NT
Hamadryas Baboon	<i>Papio hamadryas</i>	LC
Rock Hyrax	<i>Procavia capensis</i>	LC
Fox	<i>Vulpes bengalensis</i>	LC
REPTILES		
Puff Ader	<i>Bitis arietans</i>	NE
Brown House Snakes	<i>Boaedon lineatus</i>	NE
Viper	<i>Echis borkini</i>	LC
Saudi Arabian sand boa	<i>Eryx jayakari</i>	LC

English Name	Zoological Name	World IUCN Status
Arabian Blind Snake	<i>Myriopholis burii</i>	DD
Yemen Blind Snake	<i>Myriopholis yemenicus</i>	DD
Arabian Cobra	<i>Naja arabica</i>	LC
BIRDS		
Greater Spotted Eagle	<i>Aquila clanga</i>	VU
Asian Imperial Eagle	<i>Aquila heliaca</i>	VU
Cattle Egret	<i>Babulcus ibis</i>	LC
Greater Sand-Plover	<i>Charadrius leschenaultii</i>	LC
House Crow	<i>Corvus splendens</i>	LC
Crab-plover	<i>Dromas ardeola</i>	LC
Western Reef-Heron	<i>Egretta gularis</i>	LC
Gull-billed Tern	<i>Gelochelidon nilotica</i>	LC
Caspian Tern	<i>Hydroprogne caspia</i>	LC
Black backed Gull	<i>Larus fuscus</i>	LC
Sooty Gull	<i>Larus hemprichii</i>	LC
Eurasian Spoonbill	<i>Platalea leucorodia</i>	LC
Swift Tern	<i>Thalasseus bergii</i>	LC

*Source: World Wildlife Fund for Nature (WWF)

Key Words: VU (Vulnerable), NE (Not Evaluated), DD (Data Deficient), LC (Least Concern)

4.19 Protected Area

According to the *World Database on Protected Areas*, in Yemen there is one National Park (Jabal-Bura valley forest national Park), two Marine National Parks (Zuqur islands, Ras Isa Marine Park) and five Nature Reserves. The Location of National Parks, Marine National park and reserves is provided in **Table 4.17**.

Table 4.17: List of the Declared Protected Areas in Yemen

Protected Areas	Latitude	Longitude	Distance from the Project Road
Bura Community Protected Area	14°53'10.77"N	43°22'46.02"E	153.79 km
Detwah Lagoon Ramsar Site	12°42'16.80"N	53°30'4.26"E	907.29 km
Dhamar Montane Plains Mahjur Traditional Reserve	14°31'39.59"N	44°30'39.53"E	106.57 km
Di Hamari Protected Area	12°39'5.45"N	54°11'25.11"E	984.47 km
Jabal-Bura valley forest National Park	14°55'28.76"N	43°24'32.09"E	156.81 km
Ras Isa Marine Park	15°16'54.79"N	42°42'35.58"E	235.42 km
Socotra Archipelago UNESCO-MAB Biosphere Reserve	12°37'5.02"N	54° 0'16.15"E	964.48 km
Socotra Island Protected Area	12°35'48.65"N	53°56'52.55"E	958.66 km
Zuqur islands Marine Park	13°44'32.20"N	42°45'5.54"E	145.84 km
Aden Wetland Protected Areas	12°47'51.04"N	44°51'45.18"E	8.32 km

*Source: World database on protected area

The proposed alignment for the proposed new Taiz- Aden highway section does not pass close to any of these designated protected areas.

The *Aden Wetland Protected Areas* (**Plate 4.16**) are home to many birds such as Swift Tern (*Sterna bergii*); Sooty Gull (*Larus hemprichii*) and Black backed Gull (*Larus fuscus*) and other aquatic fauna and flora. The nearest lagoon of Aden Wetland Protected Areas is however located at a distance of about 8.32 km from the end point of the project road at Al-Alam in Aden and the project therefore is unlikely to affect it in any way.



Plate 4.16: Aden Wetland Protected Sites

4.20 Demographic profile and baseline survey results

A baseline socio-economic survey on a random basis of 25 percent of the surveyed households in the proposed highway corridor was carried out. This study included a list of questions for collecting baseline data on household structures, family members, poverty, gender dimensions, sex ratio, population, occupation and employment, literacy, health, education and access to basic services etc. This data helped substantially to assess the likely positive as well as negative impacts of the project in the day-to-day life of the affected people and communities and also establishes a baseline for the for monitoring and evaluation of the project. The following sub-sections describe demographic profile of the population in the project area and baseline survey results.

4.20.1 Population

The total population of the three governorates through which the planned highway will run is nearly 4.2 million. The majority of population is in the governorate of Taiz (64.36%) followed by Lahj (19.49%) and Aden (16.15%). The population percentage of the project area governorates is presented in the following **Table 4.18**.

Table 4.18: Population of Project Governorates

Project Governorate	Population	Percentage
Taiz	2727186	64.36
Lahj	825794	19.49
Aden	684322	16.15
Total	4237302	100

*Source: Statistical Year Book 2009.

4.20.2 Male/Female Population and Sex Ratio

Table 4.19 below presents the population composition by sex of the three governorates.

Table 4.19: Male/Female Population

Project Governorates	Male	Female	Total Population
Taiz	1305946	1421240	2727186
Lahj	411578	414216	825794
Aden	364552	319770	684322
Total	2082076	2155226	4237302

*Source: Statistical Year Book 2009.

The analysis of the field survey reveals that 50.4% of the population is male and 49.6% is female. The male-female ratio is in favour of males, which seems to be a mirror image of the national figure. See Table 4.20 below.

Table 4.20: Sex Ratio in project area

Particulars	Households	
	Number	Percentage
Male	15974	50.4
Female	15721	49.6
Total	31695	100

*Source: Socio-Economic Survey, Dec 2013.

4.20.3 Distribution of Rural and Urban Population

It has been revealed from the statistical data that all project governorates rural consists rural population more relatively to urban population. A detailed breakdown is provided in the following Table 4.21.

Table 4.21: Distribution of Rural/Urban Population

Project Governorate	Urban	Rural	Total
Taiz	610,722	2116464	2727186
Lahj	71,525	754269	825794
Aden	684,322	0	684322
Total	1,366,569	2870733	4237302

*Source: Statistical Year Book 2009.

4.20.4 Household Details of Project Governorates

A detailed breakdown of households in the project area governorates in respect of rural/urban households is summarized in the following Table 4.22.

Table 4.22: Urban/Rural Households

Project Governorates	Urban Households	Rural Households	Total
Taiz	93042	325970	419012
Lahj	10643	109352	119994
Aden	105265	0	105265
Total	208950	435322	644271

*Source: Statistical Year Book 2009.

4.20.5 Household Size

The socio-economic baseline survey has revealed that the average family size along the project area is 8.2 members. However, the average size of the affected households is 11.8 members because there are several very big households among the affected. For instance, one household has 300 members, two households have over 200 members, and about another 10 households have over 100 members each.

4.20.6 Household's family type

The results of the households' survey indicate that a majority of families are Joint (93%) followed by Nuclear (5.7%) and Extended (1.3%). The details of family type are summarized in **Table 4.23**.

Table 4.23: Household's by family type

Family Type	Households	
	Number	Percentage
Joint	437	93
Nuclear	27	5.7
Extended	6	1.3
Households Interviewed	470	100

*Source: Socio-Economic Survey, Dec 2013.

4.20.7 Educational status of household members

The literacy rate in the project area is 91.7 % and thus higher in comparison with the country average. The households which have members who completed primary, secondary and university level constitute 54.7%, 9.8%, 3.6% respectively, whereas 20.8% households are only literate. The findings of household's survey are presented in **Table 4.24**.

Table 4.24: Educational status of household's members

Education	Households members	
	Number	Percentage
Technical Education	153	2.8
University Level	201	3.6
Secondary	543	9.8
Primary	3033	54.7
Just literate	1156	20.8
Illiterate	460	8.3
Total	5546	100
Household Interviews (No.)	470	

*Source: Socio-Economic Survey, Dec 2013.

4.20.8 Occupation of households members

The baseline survey revealed that a majority of households' members are engaged in agriculture (56.3%) followed by others (19.7% i.e. unemployed persons, aged family members, housewives and children), students (13.5%), labourer activities (2.7%),

business (2.6%), government service (1.6%), private service (1.4%). The details are presented in **Table 4.25**.

Table 4.25: Occupation of household members

Source of income	Household members	Percentage
Agriculture	3122	56.3
Agriculture-related (<i>Dairy, poultry, sheep, goats, camel and cattle</i>)	67	1.2
Household Industry	21	0.4
Business	144	2.6
Tourism	11	0.2
Government Service	89	1.6
Private Service	78	1.4
Mining Related work	22	0.4
Wage Labourer	150	2.7
Students	749	13.5
Others (<i>includes unemployed persons, aged family members, housewives and children</i>)	1093	19.7
Total	5546	100
Households Interviewed	470	

*Source: Socio-Economic Survey, Dec 2013.

4.20.9 Households Annual Income

In the socio-economic survey, a majority of households (72.6%) have reported their annual income in range of US\$ 500-600, followed by 9.4% households in the range US\$ 600-800. A detailed breakdown is provided in **Table 4.26**. The results seem to be overall similar to other rural areas in Yemen.

Table 4.26: Households Annual Income

Annual Income (US\$)	Households	
	Number	Percentage
0-500	38	8.1
500-600	341	72.6
600-800	44	9.4
800-1000	23	4.9
1000-5000	12	2.6
1500-2000	8	1.6
Above than 2000	4	0.8
Total	470	100

*Source: Socio-Economic Survey, Dec 2013.

4.20.10 Possession of Durable Assets

The baseline socio-economic household survey also collected data on the possession of durable assets since this to some degree reflects the living standard of people. The results are deemed to be similar to other areas of Yemen and are summarized in **Table 4.27**.

Table 4.27: Possession of durable assets

Durable Assets	Households	
	Number	Percentage
Radio	7	1.5
Mobile Phone	423	87
Television	67	14.3
Oven	2	0.4
LPG Connection	86	18.3
Computer	3	0.6
Refrigerator	42	8.9
Washing Machine	6	1.3
Motor bike	18	3.8
Car	22	4.7
Households Interviewed	470	

*Source: Socio-Economic Survey, Dec 2013.

4.20.11 Health Status

The results of the baseline survey revealed that people along the project area are typically in reasonably good health and fitness. However, during the field survey some of them have reported to be affected, or have recently been affected, by diseases such as malaria, dengue fever, polio, hepatitis, mylasis and amoebiasis. All of them preferred to have treatment in allopathic hospitals rather than traditional and other types of treatment. The details of number of households affected by diseases and the %age are presented in **Table 4.28**.

Table 4.28: Health Status along Project Area

Type of Illness	No. of Households	Percentage
Malaria	72	15.3
Dengue fever	28	6.0
Polio	3	0.6
Hepatitis	23	4.9
Mylasis	18	3.8
Amoebiasis	2	0.4
Households Interviewed	470	

*Source: Socio-Economic Survey, Dec 2013.

4.20.12 Indebtedness

None of the survey participants has reported their borrowings and indebtedness during socio-economic baseline survey.

4.20.13 Migration

It was found that people in the project area are often migrating for employment to urban areas in Yemen to enhance their socio-economic status and for better quality of life. A relatively small number of people have migrated to other countries in the region to work there and send home remittances.

4.20.14 Access to Community Infrastructure

The baseline survey has revealed that similar to other rural areas of Yemen a significant proportion of households in the project area belong to lower income groups and are further disadvantaged by relatively poor access to community infrastructure such as Hospitals, Schools, Religious schools, Drinking water, Electricity, Landline phones, Supermarket, Police station, Banks, Chemist and Internet cafes. This is evident from the results presented in **Table 4.29**.

Table 4.29: Access by households to community infrastructure along project area

Community Infrastructure	Good access		Fair access		Poor access	
	No. of HHs	%	No. of HHs	%	No. of HHs	%
Clinics/Health unit	8	1.7	6	1.3	456	97.0
School	6	1.3	12	2.6	452	96.2
Religious school	22	4.7	30	6.4	418	88.9
Drinking water	2	0.4	5	1.1	463	98.5
Electricity	2	0.4	3	0.6	465	98.9
Grocery Store	4	0.9	6	1.3	460	97.9
Police station	34	7.2	42	8.9	394	83.8
Cash exchange	13	2.8	29	6.2	428	91.1
Drug shops	6	1.3	2	0.4	462	98.3
Internet café	1	0.2	1	0.2	468	99.6
Households Interviewed	470					

*Source: Socio-Economic Survey, Dec 2013.

4.20.15 Women's Participation

The socio-economic status of women along the proposed highway corridor is generally low as evident from the socio-economic survey. Women's participation in society is typically limited to their household work and they constitute only 4.7% of the work force for agriculture. Likewise, answer to questions about women's decision making power revealed that women typically do not have a say in decisions related to financial matters, education of children, and health care, purchasing and other day-to-day activities. The findings of the women's engagement in various economic, non-economic activities and decision making power are documented in the following **Table 4.30**.

Table 4.30: Women's Participation

Activities	Households	
	Number	Percentage
Economic and non- economic activities		
Cultivation	22	4.7
Service	2	0.4
Trade and business	1	0.2
Household work	470	100
Relaxation and entertainment	14	3
Decision making		
Financial matters	6	1.3

Activities	Households	
	Number	Percentage
Education of child	3	0.6
Health care of child	8	1.7
Purchase of assets	2	0.4
Day to day activities	0	0.0
On social functions	14	3.0
Households Interviewed (No.)	470	

*Source: Socio-Economic Survey, Dec 2013.

4.21 Road Safety Aspects

Yemen has one of the poorest traffic safety records in the region with almost 6,500 reported deaths every year on the road network. Traffic police records show about 13,000 accidents with injuries each year, affecting about 17,000 people and their families⁶. The number of recorded fatal accidents⁷ is 990, 226 and 299 in Taiz, Lahj and Aden Governorates alone. Road traffic injuries rank among the top 10 causes of death in Yemen. Such high rates of road traffic injuries and fatalities, also characterized by the high share of pedestrian fatalities, disproportionately affect the economically active population in Yemen; hence, the economic and social consequences are significant. The key factors that contribute to the poor road safety records are: (i) poor road conditions and the lack of safety features in road design, (ii) unsafe driving behavior; and (iii) ineffective enforcement of traffic laws and regulations. Prevalent among drivers are speeding and the use of communication devices (cell phones), while seat belts and other safety measures are not widely used. The unstable political and governance environment has not been conducive to the measures which should normally be applied as part of a comprehensive road safety strategy, especially the non-physical measures. In practical terms, for the new Yemen Corridor Highway project the only viable and realistic measures are those related to an appropriate engineering design, which are expected to lead to safety improvements. In particular the separation of the highway into two carriageways divided by steel crash barriers is expected to produce measurable results, since the typical head-on collisions will be avoided.

4.22 Land Use

The field surveys carried out along the planned new highway corridor included collecting information about the present use of the land which is to be acquired for the project. The detailed land use map of the entire highway corridor is presented as **Annexure 4.2**. The breakdown of existing land in different categories is given in **Table 4.31** and the percentages of the land use types are shown in **Figure 4.6**. Overall, the data shows that the largest land use categories are “unused” with 486.38 hectares followed by “arid land” with 347.39 hectares, out of the total of 1,221 hectares of land to be acquired. The land used for any types of crops is approximately 177 hectares.

⁶ In Yemen, data on traffic injuries and fatalities are collected by the traffic police as part of a nationwide system (not gender-disaggregated).

⁷ Al-Horras Journal Serial No (221) issue April 2013

More detailed information about the use of the land to be acquired for the project, including separately by Governorate, is provided in the Resettlement Action Plan (RAP).

Table 4.31: Detailed breakdown of present use of the land to be acquired for the project

Category	Sum of Area in sq.m	Sum of Area in Ha.
Arid Areas	3473862.451	347.39
Cash Crop Land	410102.650	41.01
Crop Land	1474409.741	147.44
Other agricultural land	342986.383	34.30
Man Made Structures	94545.815	9.45
Parcels	433786.554	43.38
Sand	75392.446	7.54
Scattered Trees	77857.639	7.79
State roads	318921.725	31.89
Other streets	140016.297	14.00
Earth tracks	59866.636	5.99
Unknown Land use	184153.112	18.42
Unused Land	4863833.877	486.38
Water Shed	201144.914	20.11
Yard Area	59119.759	5.91
Grand Total	1,2248,000.000	1224.80

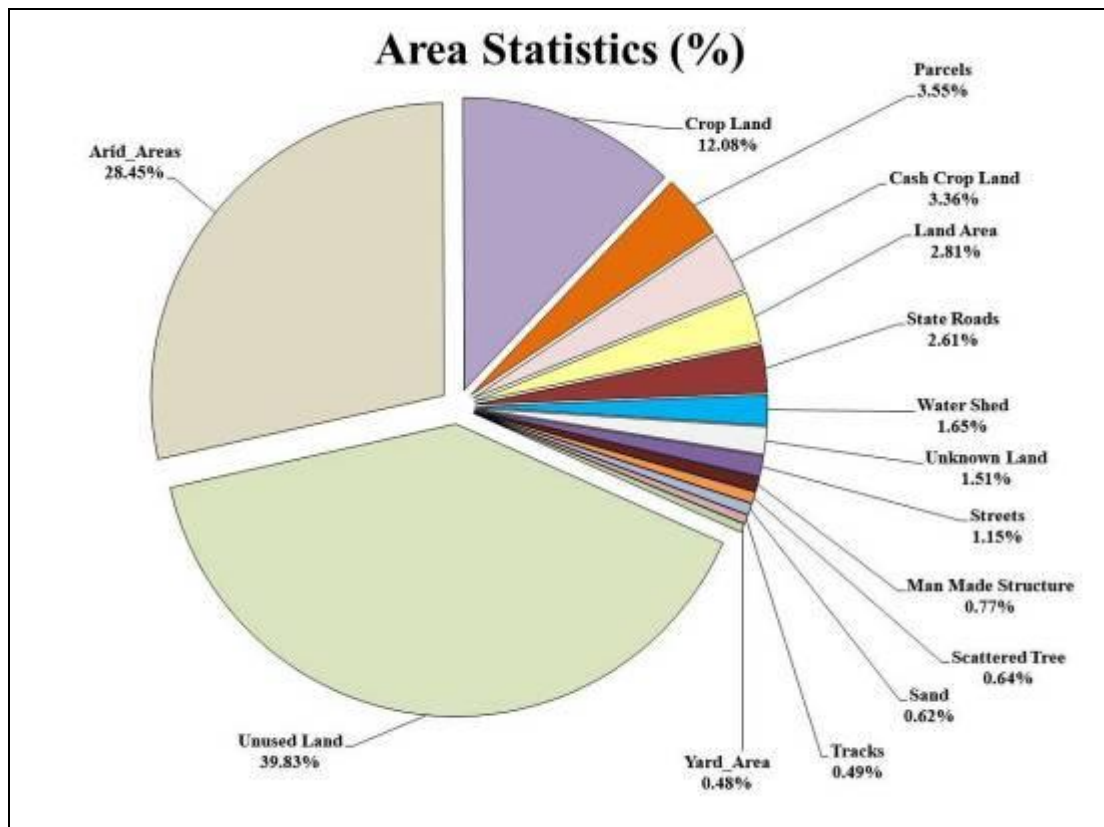


Figure 4.6: Area Statistics in %age of the Land Use by category

4.23 Planned Development Activities

Consultations with Government authorities at the central and local levels revealed that there are no major planned development activities or planned infrastructure in the vicinity of the proposed highway alignment. Some small-scale local water distribution schemes are planned or are presently being implemented which will not be affected by the project.

4.24 Recreation

There is no recreation facilities located along the proposed project corridor which could be affected by the project.

4.25 Cultural Properties

There are 10 graves and 8 small village mosques which will be directly affected by the new project and which will need to be relocated.

4.26 Indigenous People

There are no indigenous people groups defined in Yemen.

5 PUBLIC CONSULTATION, COMMUNITY PARTICIPATION AND GRIEVANCE REDRESS MECHANISM

5.1 Public Consultations Process

Extensive public consultations were carried out with various stakeholders at various locations throughout the length of the proposed highway corridor between Aden and Taiz. The main public consultations were undertaken with in groups which included government officials, PAPs, and community leaders (sheiks) in 13 villages. The location, date and time of the consultations were announced several days prior to the consultations. (Consultations with women groups were held separately in 10 villages - see section 5.3 further below). The locations, number of people that participated in these broad consultations and the consultation methods used are summarized in **Table 5.1**. **Annexure 5.1** presents the lists of participants in those consultation meetings. In addition to these formal and announced consultations, there were also many informal consultations which were carried out in villages along the proposed alignment but which are not reflected in the table below.

Table 5.1: Summary of consultation sessions

Date	Location		Number of Persons	Methods
	Governorate	Village		
12/24/2013	Taiz	Al-Moaiteep	29	Meeting and group discussion
12/24/2013	Taiz	Al-Umrur	6	Consultation and interview
12/24/2013	Taiz	Al-Kharaz	12	Group discussion
12/19/2013	Taiz	Al-Zawazer	11	Group discussion
12/19/2013	Taiz	Shaiq Mahrs	5	Consultation and interview
12/20/2013	Taiz	Al-Adeol Asrar	8	Consultation and interview
12/21/2013	Taiz	Al-Hajar/Al-Sarar	11	Group discussion
12/22/2013	Taiz	Al-Esab	15	Meeting and group discussion
12/22/2013	Taiz	Thanbeh	16	Meeting and group discussion
12/22/2013	Taiz	Shah Al-Khabsh	12	Group discussion
12/22/2013	Taiz	Thabh	13	Group discussion
12/25/2013	Lahj	Al-Duraja	10	Group discussion
12/28/2013	Lahj	Al-Mansara	8	Consultation and interview

**Source: Socio-Economic Survey, Dec 2013.*

The purpose of public participation and consultation study was to create awareness about the project and involve those persons in the study who are likely to be affected positively or negatively, and involve also other stakeholders by giving them opportunities to express their views and concerns about expected and perceived

impacts and about the most suitable ways for mitigating negative effects and enhancing positive project effects.

The consultations intended to create a sense of commitment towards implementing the ESMP for the project. With due consideration of gender, consultations were carried out through various methods including individual interviews, consultation meetings, and informal and formal group discussions. The process of consultation was conducted as follows:

1. Meetings and consultations were held with people on the RoW or in close proximity of the highway along the entire alignment. The locations of the meetings and consultations were selected in line with local land use conditions and covered both scarcely populated areas, such as dominant in Lahj Governorate, and densely populated areas, such as in Taiz Governorate. They also spanned the various economic and social activities seen along the alignment. Representatives from the news media also attended these sessions. The groups identified during the survey and consultation process included:

- People affected by land acquisition
- People to be physically displaced
- Government officials at governorate and district levels
- Community leaders
- Business owners, operators and workers in installations along the alignment of the planned expressway, including owners and employees of informal and unlicensed entities
- Residents along the alignment of the highway including women
- Farmers with land close to the planned highway alignment

2. At the start of the meetings and interviews an introduction to the project was conveyed to the subject. The introduction covered the following:

- Background and rationale of the project
- Expected works to be executed, including duration
- Expected areas to be affected by works and land acquisition
- Procedures of land acquisition and compensation standards
- WB procedures and requirements, highlighting safeguards
- Rights of people adversely affected by the Project
- Objective of the interview, namely to discuss the needs and concerns of the affected people and comply with WB guidelines in planning and project execution.
- Discussion of mitigation measures and of compensation to be provided to affected people.

A list of participants is provided in **Annexure 5.1**



Plate 5.1: Social safeguards team discussing social issues with the Sheikh and PAs representatives in Mawiya



Plate 5.2: A view of people's participation during census survey and public consultation along the proposed highway corridor



Plate 5.3: Public Consultation at starting point at Al-Ganad (Taiz)



Plate 5.4: Public Consultation Mawiya District (Taiz)

5.2 Issues raised and responses provided

Numerous topics were covered in the broad consultations with villagers, project affected people, community leaders and Sheikhs. In general, the information about the project was shared with the local people. However, most PAP's already knew about the project as the feasibility study was prepared in the year 2005, when the consultant and government representatives carried out consultations with local people. Nevertheless, there were many questions asked by PAPs; these and the responses provided are reflected in **Table 5.2**.

Table 5.2: Issues raised during consultations and responses provided

Issues raised	Responses provided
Land acquisition minimization	People were informed that within the broader corridor alignment, several alternatives were studied taking into consideration of social and environmental impacts, including the land acquisition. The option selected is with the least overall negative impacts.
Resettlement impacts mitigation measures	A resettlement action plan will be prepared in line with relevant Yemeni regulations and laws, and the World Bank Policy on Involuntary Resettlement OP 4.12.
Underpasses at schools, madrasa, religious schools and hospitals	The exact location of underpasses will be discussed with the design engineer. The final location will be selected by taking into account people's concerns and needs, as much as technically viable.
Wayside amenities and public facilities including toilets and drinking water	The locations of road side amenities and public services (rest areas and service areas for future highway users) have been incorporated in the project design.
Road safety measures	Adequate road safety measures have been incorporated in the project design. If needed, additional road safety measures can be added during construction, taking into account local people's concerns.
Pedestrian pathways	The design includes pedestrian pathways for crossing the highway at populated locations. Local people's suggestions can still be incorporated in the project if technically feasible.
Shifting of religious places at appropriate locations with community consensus	Once the need arises for any religious places to be relocated, the relocated sites will be selected based on consultations with local communities.
Resettlement assistance package	Compensation will be paid to the eligible PAPs and assistance will be given for relocation and livelihood rehabilitation as set to be forth in the resettlement action plan.
Compensation should be computed at current market price of land and structures	Compensation rate of lost assets will be determined based on the prevailing market value in the project area by the Compensation Committee.
Income and employment generation schemes should be	Contractors typically hire most unskilled workers locally for construction activities and maintenance

Issues raised	Responses provided
launched all along the project influence area	work. Other different options will be provided to PAPs for income restoration, such as land-for-land compensation, cash for land, and combination of land and cash for land. These measures would help the PAPs to restore or enhance their income and livelihood.
Special signage near schools, college and road turnings and crossings	The signage near the prominent locations has been incorporated in the road design. Additional signs can be added as needed.
Street lighting	PAPs' suggestions would be incorporated in the project design if technically feasible.
Traffic signal lights	PAPs' suggestions would be incorporated in the project design if technically feasible. However, since this is a major highway without level intersections, traffic signal lights are not foreseen.
During construction local people should be preferred for employment by the contractor	Contractors typically give priority to local people when hiring workers, both during construction and operational phases.
People were asked if they support the proposed highway or not.	Most PAPs responded that they support the proposed highway since it will improve accessibility of the area and facilitate reaching health and education facilities, markets, etc.
People were asked about the removal of trees.	People have no problems, if the trees are removed from their land. However they want proper compensation for the tree which will be removed from their land. They are particularly concerned about the Qat trees compensation as large number of Qat trees will be affected due to Highway construction.
People were asked about the air and noise pollution problem in the project area.	People told that there are no industries in the project area, also there is no other source of pollution in the project area hence there is presently no problem of air and noise pollution. It is however clear that traffic on the new highway will cause noise and vehicle emissions, but this was not considered a serious problem by the large majority of people consulted.
People were asked about the facilities of irrigation available in the project area.	People stated that they are using mostly ground water for irrigation. However agriculture also depends upon rain. People want Cross-Drainage (C-D) structures along the entire alignment so that they may not face problem for irrigation after construction of road.
People were asked about the facilities which they want along the road.	People want water facilities should be enhanced along with the road. People stated that if they have water facility which will be readily and frequently available to them, then it will reduce their efforts of water collection.
Relationship with neighbouring areas.	The local people stated that due to availability of road there will be faster interaction with the people of other villages. Hence road will play role in relationship building.

5.3 Consultations with women groups

Consultations and discussions were also held separately with women groups in 10 villages, in line with local customs and traditions. These consultation meetings were organized to get wider public input from female project affected persons. Consultations with women were conducted with the objectives including: (i) identifying women specific issues in the project; (ii) securing participation of women in definition of mitigation measures; (iii) ascertain the views of the affected women groups with reference to land acquisition and project road alignment; (iv) understand views of the women on livelihood rehabilitation options; (v) obtain opinion of the women groups on issues related to the impacts on religious and community assets and relocation of the same; (vi) hear women's opinion on problems and prospects of road related issues; and (vii) to establish an understanding by the women of the overall developmental objectives and benefits of the project.

The consultation methods followed and the numbers of women participants are presented in **Table 5.3** and the issues discussed are shown in **Table 5.4**.



Plate 5.5: Women's participation during consultations along proposed highway corridor

Table 5.3: Summary of women consultation sessions

Date	Location		Number of participants	Methods
	Governorate	Village		
27/01/2013	Taiz	Aljanad	12	Group discussion
28/01/2013	Taiz	Al-Hazm	7	Consultation and interview
29/01/2013	Taiz	Al-Zwaqr	9	Group discussion
29/01/2013	Taiz	Al- Muatiab	6	Consultation and interview
30/01/2013	Lahj	Aqan	6	Consultation and interview
30/01/2013	Lahj	Al-Srahinah	4	Consultation and interview
01/02/2013	Lahj	Gol -Mdrm	9	Group discussion
01/02/2013	Lahj	Dokim	4	Consultation and interview
02/02/2013	Lahj	Al-Anad	10	Group discussion
02/02/2013	Aden	Al-Shqa'a (Bir-Nasir)	4	Consultation and interview

Issues discussed with women during consultations and group discussions are summarised in **Table 5.4** below.

Table 5.4: Issues discussed by women groups and responses

Issues raised	Response
Adequate compensation for the loss of land and other assets	Entitlement packages have been worked out based on policy. Compensation will be made as per the entitlement of project affected persons.
Assistance	Support allowance and transitional assistance will be provided as per entitlement policy.
Adequate drainage culverts should be provided for smooth flow of water on both sides of the project road	Culverts have been provided in the project road design.
Speed barriers and breakers along habitations areas	Given that this is a main highway, speed barriers are not foreseen, but pedestrian crossings in the form of underpasses are planned as part of the design.
Underpasses/vehicular underpasses at schools, madrasa, religious schools and hospitals	The exact location of underpasses will be discussed with the design engineer. The final location will be selected by taking into account people's concerns and needs, as much as technically viable.
Shifting of religious places at appropriate locations with community consensus	Religious structures will be protected to the possible extent and once the need arises for any religious place to be relocated, the sites for relocation will be selected through consultations with local communities.

Issues raised	Response
Wayside amenities and public facilities including bus stops, toilets and drinking water	The locations of road side amenities and public services (rest areas and service areas for future highway users) have been incorporated in the project design.
Road safety, particularly day to day activities (i.e. water collection and fetching, safety of school going children)	Adequate road safety measures have been incorporated in the project design. If needed, additional road safety measures can be added during construction, taking into account local people's concerns.
Warning signage near educational institutions including religious schools, hospitals and road turnings/crossings	The signage near the prominent locations has been incorporated in the road design. Additional signs can be added as needed.
Cutting of trees along the proposed road should be minimized	Compensatory afforestation will be made through MPWH.
Lack of employment opportunities for women	Local people will be employed in the construction activities as much as possible. Preference will be given for local women in PIU and contractors office (i.e. computer operators, stenographers, reception desks etc.)
Health and sanitation	Separate toilet facility for the women staff workers is mandatory in the PIU and contractors office.

5.4 Consultations with government officials

Consultations were also carried out with government officials at different positions and locations. The government officials consulted and the topics covered are summarized in **Table 5.5**.

Table 5.5: Summary of consultations with Government officials

Name	Position	Issues discussed
Mr. Abdul Jabbar Salem	Project Director, MPWH, Sana'a	<ul style="list-style-type: none"> Information dissemination to make people aware of the very objective of the project. Resettlement, land acquisition and income restoration. Affected villages falling within the proposed highway corridor. Service lanes, and rest and service areas, including underpasses. Wayside amenities and maintenance infrastructure including petrol station, toilet facilities and drinking water.
Mr. Khaled	Sr. Highway Engineer MPWH Sana'a	
Mr. Shoke Ahmed Hail	Governor, Taiz	
Mr. Mohammed Abdullah Al-Majidi	Governor, Lahj	
Mr. Aemn Asmail	Dpty. Manager, MPWH, Lahj	
Mr Fars Ali Ahmad	Engineer, MPWH, Lahj	
Mr. Nasl-Al-Jabri	GM, Lahj Governorate	
Mr. Fiasal Al-Thalabi	GM (EPA) Lahj	
Mr. Abdul Samad Mohammed Yahiya	General Manager (Planning) NWRA, Taiz	
Dr. Mohammad Ahmed	University of Taiz	
Eng. Sulyman A. Ahmed	Asst. General Manager, Taiz Municipal	

Name	Position	Issues discussed
	Development, Taiz	
Eng. Khalid Ali Alshoga'a	Engineer in Ministry of Water and Environment, Taiz	<ul style="list-style-type: none"> • Social issues including loss of livelihood and compensation for affected people.
Mohammad Abdullah Murshid	Assistant Manager Social Development Fund, Taiz	<ul style="list-style-type: none"> • Relocation of the potential project displaced families and households.
Marwan Al- Maktari	Manger Social Development Fund, Taiz	<ul style="list-style-type: none"> • Facilities for pedestrians and non-motorized transport (e.g. donkey and camel carts).
Mrs. Ahsam Anwar	Officer Social Development Fund, Taiz	<ul style="list-style-type: none"> • Highway safety measures.
Mr. Faisal Mash-Al	General Manager, MPWH Taiz	<ul style="list-style-type: none"> • Information on socio-economic and demographic features of the project influence area and potential PAPs.
Mr. Waheed Al-Sarari	Survey Engineer, MPWH Taiz	<ul style="list-style-type: none"> • Ongoing developmental schemes and programs in project influence Governorate.
Engr. Nasir Al-Jabri	Survey Engineer, MPWH Taiz	<ul style="list-style-type: none"> • Minimization of adverse social impacts.
Engr. Sabri Al-Saleh	Road Supervisor, MPWH, Taiz	

The photographs of some of these consultations are shown on **Plate 5.6 to 5.9.**



Plate 5.6: Consultation with the Governor of Taiz



Plate 5.7: Consultation with the Governor of Lahj



Plate 5.8: Consultation with the Local Council in Taiz



Plate 5.9: Local persons indicating their support to the project by raising their hands.

Consultations were also carried out with various Government Officers at the central government level, such as at the Ministry of Water and Environment, Environmental Protection Authority, Ministry of Public Works and Highways, Social Development fund etc. The pictures of some of those consultations are shown in **Plate 5.10 to 5.12**.



Plate 5.10: Consultation with the Officer of Social Development Fund in Taiz



Plate 5.11: Consultation with Officers of Ministry of Water & Environment (Taiz)



Plate 5.12: Consultation with the Officers of Environmental Protection Agency of Taiz and Aden.

The project-related issues discussed with government officials are shown in **Table 5.6**.

Table 5.6: Issues Discussed with Government Officials and Their Response

S. No	Issues Raised	Response
1.	Consultant asked about the Resettlement and Rehabilitation (R&R) Policy of Yemen through which compensation will be decided for affected persons.	There is no R&R policy in Yemen. The compensation will be decided by the Compensation Committee (CC) at each Governorate level.
2	Consultant asked about the compensation of trees which will be removed for Highway construction.	The technical committee decides the compensation for all fruit bearing trees and Qat trees. However there will be no compensation for non-fruit bearing trees.
3	Consultant asked about if any permission is required for tree felling.	No permission is required for tree felling
4.	The solution of religious properties like Graves and Mosques coming within the alignment.	The graves and Mosques will be shifted to some other location after consultation with local people. However compensation will be given for land and construction of these religious structures.
5.	The consultant asked about the solution for the Water wells which will be affected due to road construction.	All these water well will be shifted to some other locations with the consultation of local people. However cost for land and well construction will be compensated.
6.	Consultant asked about the availability of local labour for construction.	Skilled and unskilled labour is available in the project area; hence local labour should be given preference during selection.
7	Consultant asked about the quality of drinking water in the project area.	As far as quality of drinking water is concern, it is normally fit for drinking purposes, except at some locations where there is some level of bacteriological (total coliforms and faecal coliforms) contamination.
8	The quality of air in the project area.	The air quality is not an issue in the project area as there are no major industries in the project area except cement industry in Lahj and iron recycling industries in Lahj and Aden.
9.	The quality of noise in project area.	The noise is also not an issue in the project area. There are few sources of noise.
10.	The prevalent water borne diseases and other diseases in the project area.	The prevalent water borne and other diseases are Hepatitis; Bilharisia; Malaria; Dysentery; Enteritis; Typhoid; Measles; Rabies; Polio; whooping cough and Tuberculosis. Out of these Disease Malaria, Dysentery and Enteritis are most prevalent diseases.
11.	Irrigation facilities during construction and operation stage.	In order to maintain the existing irrigation facilities within the project area, there should be sufficient number of pipes on both side of the Highway so that there is no interruption in irrigation of agriculture land

S. No	Issues Raised	Response
		which is divided by the road construction. Also the natural water drainage should be maintained by providing sufficient cross drainage structures.
12	The other facilities required along the Highway.	There should be facilities of Mosques, Hamam (Toilet), telephone, Police booths, Emergency Centers, and Ambulance along the proposed Highway.
13	The source of water during construction.	The water is available in Wadis (River), which can be used for construction. Also the rain water can be stored in small dams along the road. The ground water also may be used if required.
14	The major environmental issues in the project area.	There are issue like desertification; soil erosion by wind and water; overgrazing; aridification of land (increasing barren land due to less rain); and forest fires.

5.5 Strategy for Consultations during post-ESIA and project implementation phase

Consultations will continue until into the implementation phase of the project, especially with the objective to redress any environmental and social issues likely to come up during construction and operational phases of the project. Regular communication processes shall established with the affected communities. Prior to and during the construction activities, the staff of the Project Implementation Unit (PIU) of MPWH staff will organize consultations in various locations along the project corridor, with participation of civil works contractors and the supervision consultants. These meetings will be the occasion to inform local people about the construction activities, traffic management plans, siting of labour and construction camps, locations of dumping sites for excess materials etc. and to invite their suggestions and hear their grievances.

The Project Implementation Unit (PIU) at MPWH recognizes that facilitating the exchange of information and views between project entities and the affected persons and communities during the planning and implementation process will help to achieve smooth project implementation. In the project area, direct interaction between the project staff and affected communities is especially important, because the usefulness of dissemination of written and published information is sometimes limited. The project implementation process provides three primary means for such interaction:

- a) A field-based external monitoring process will occur twice in each year of implementation. The external monitoring process includes solicitation of information and views from affected persons (on a sample basis) and from local leaders regarding the effectiveness of the implementation of the Environmental and Social Management Plan. Affected persons may also bring implementation issues to the attention of project management through interaction with the external monitors.
- b) Affected persons may bring implementation issues or problems to management attention through the grievance management system.

- c) The PIU, in collaboration with governorate and district officials, will also take steps to directly consult with affected persons and communities during the project implementation process. Prior to the initiation of the land acquisition process, the PIU will conduct meetings within each affected village or settlement. This meeting is to inform residents again about the project and its proposed timetable for implementation, expected local impacts, compensation arrangements and rates, eligibility of affected persons for other forms of assistance, and the grievance redress mechanism, and to respond to concerns or preferences expressed by local residents. Within the first two years of project implementation, the PIU will meet again with affected persons in each affected village or settlement. In this meeting, the PIU will solicit views regarding the status of project implementation (especially with regard to resettlement-related activities), and will respond to issues or concerns raised by residents. For each meeting, the PIU will maintain a written summary of proceedings and issues raised, and the necessary follow-up actions that may have become necessary as a result.

The Grievance redress mechanism is presented in the Resettlement Action Plan and the Grievance management system is described in detail in chapter on Institutional Arrangements.

6 ANALYSIS OF PROJECT ALTERNATIVES

6.1 Definition of Highway Alignment Alternatives

As part of the project feasibility study, several alternative corridors for the new highway between Taiz and Aden were defined, studied and compared.

Following extensive field work in order to identify possible alignments that are technically feasible, Dorsch Consult focussed on the detailed investigation of three alternative corridors for the new highway, each with its own character:

- The “Green Corridor” with a length of 143.6 km. This is a relatively short alignment located near to the axis of the existing road.
- The “Yellow Corridor” with a length of 153.3 km. This corridor would maximise economic and social development along the alignment, by providing access to a large area which is now relatively isolated.
- The “Blue Corridor” with a length of 135.3 km. This corridor would be a compromise solution between a short route and nevertheless facilitating improved development along the alignment by integrating some areas that are presently rather isolated.

The alignments are shown in **Figures 6.1 to 6.3** further below and can be roughly described by their interchanges:

- Green Corridor: Taiz, NaqilIbil, Ad Dimnah, ArRahida, Nawbat Dukaym, Al Hutah, Aden
- Yellow Corridor: Taiz, NaqilIbil, Ad Dimnah, ArRahida, NawbatDukaym, Al Hutah, Aden
- Blue Corridor: Taiz, Mawiyah, Ad Durayjah, Musaymir, Aqan, NawbatDukaym, Al Hutah, Aden.

These three alternative corridors were defined as technically possible and verified in the field. They were then evaluated based on various criteria, some of which are linked to each other:

- Traffic and development impact – the aspects of providing access to areas, connection with the existing road network, overall development impact and journey times were evaluated.
- Design – here the difficulty of design and construction, and the likely cost of construction and maintenance were evaluated, taking into account the volumes of earth movements, the percentage of flat/rolling/mountainous terrain, rise and fall, curvature, number and volume of structures needed, etc.



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- Geology – here the availability of suitable road construction material in the area of the road was considered, the bearing capacity of subsoil, etc.
- Hydrology – here the main considerations were the issues of catchment areas, water run-off, dimensions of required structures, number and difficulty of wadi crossings, etc.
- Environment and Social – here the impacts on human settlements, agricultural land, natural environment, groundwater, cultural heritage etc. were considered.
- Cost and initial economic feasibility evaluation – here the total likely cost of the alternatives were considered, mostly for construction and maintenance, and the economic feasibility using the typical quantifiable benefits such as savings in time and vehicle operating costs.

6.2 Criteria for Environmental And Social Evaluation Of Alternatives

This sub-section describes the likely environmental and social impacts which were identified and taken into consideration during the evaluation of alternative corridors of the new highway. The evaluation included the biophysical, ecological, social and cultural environment.

Taking into consideration the general environmental issues in Yemen and the particular environmental conditions in the project area, the main impacts that were evaluated for the various alternative corridors were impacts on:

- settlement areas, social infrastructure and human health, caused by noise, by air pollution, and by traffic accidents;
- land resources and agriculture, caused by loss or severance of land resources and agricultural soil, together with the social impact on the rural population (loss or reduction of their main source of income);
- the natural environment, vegetation, forests and habitats, due to habitat degradation and loss of biodiversity;
- groundwater resources and wadis, by pollution of sensitive aquifers or surface waters (such as by spillage accidents) or by a change of natural flow of surface waters;
- cultural heritage, landscape resources and tourism potential, by loss or severance of traditional hillside terraces, of traditional architecture, or of landscape attractive to tourism and ecotourism.

Besides the potential social and environmental threats, it was found that the new highway would also bring some environmental and social benefits. In particular, the diversion of an important share of the traffic on the existing road to the new highway will certainly reduce the noise impact, air pollution and the risk of accidents for people living along the on the existing Aden – Taiz road and also on some other roads in the area. The new road will also give easier access to locations that are attractive



for tourism, and may attract the foundation of new markets or facilities near highway exits, thus giving business and employment opportunities.

For the three alternative route corridors, the potential social and environmental impacts were studied and compared. Given the scale of data sources available, and the yet rough alignment of alternative corridors at that stage of the project, a belt of 300 meters on both sides of the alignment was considered appropriate for the assessment. For each alternative, the impacts are listed in **Tables 6.1 and 6.2** further below. Where applicable, the lateral extent (in km) or locations (at km) of individual impacts are noted. **Tables 6.3 to 6.5** show the likely environmental and social impacts that were identified for the Green, Yellow and Blue alternatives.

Regarding the productivity of aquifers (this feature is the starting point for comparing the risk of groundwater pollution) there are several highly productive aquifers in the wadis, in the coastal plain and in the cretaceous Tawilah Group. Moderately to poorly productive aquifers are the tertiary volcanic. A risk to groundwater pollution was taken into consideration wherever the corridor under study traverses highly productive aquifers.

For all alternative route corridors studied, the main impacts on areas of environmental interest will be the loss and severance of agricultural land resources together with social impacts, and the risk for water resources. For comparison of alternative corridors, the main impacts of the different alternatives have been compiled in the table below.

Table 6.1: Summary of likely impacts for the three alternative corridors

Impacts	Alternative		
	Green	Yellow	Blue
Settlement areas (km within 300 m corridor)	11	7	7
Schools (number within 300 m corridor)	9	6	33
Hospitals (number within 300 m corridor)	1	1	5
Intensively used agricultural areas (km)	20	14	7
Extensively used agricultural areas (km)	24	21	15
Natural environment, forests (km)	36	39	57
Groundwater resources (km)	89	71	73
Wadis (number)	5	7	8
Cultural heritage, tourism potential (km)	21	21	5
Length (km)	143,6	154,9	135,3
Area covered, land consumption (km²)	6,00	6,47	5,66

The Green alternative was found to have the strongest impacts on settlements and agricultural land, while the Yellow and Blue corridor alternatives were found to have less negative impacts. The same result was found concerning the impacts on groundwater resources the Yellow and the Blue alternatives would cause less impact than the Green alternative.

6.3 Result of Evaluation of Corridor Alternatives

The result of the overall evaluation of the three potential corridors (Green, Yellow and Blue) showed that a fourth possible alternative composed of a combination of two of



the alternatives would compound their respective advantages and provide the best results - - this would be the combination of the Blue alternative for the northern part (to the North of Noubat Dokaim) and the Yellow alternative for the Southern part of the highway. This combination was denominated as the Purple corridor, which showed the most advantages and the best results. The eight interchanges on this Purple alternative are at: Taiz, Mawiyah, Ad Durayjah, Musaymir, Aqan, Noubat Dokaim, and Al Hutahand Aden.

Based on the results of the multi criteria analysis, the Purple corridor alternative was then selected for the detailed engineering design and feasibility studies. To increase access of local populations to the new highway in the more populated areas, several additional access/exit points were added. The main advantages of the adopted Purple alternative are:

- The Purple corridor connects well with the existing and planned road network, thus improving the accessibility of the most important towns in the wider area of influence of the highway, as well as the journey times between them.
- Considering the likely social impacts, the Purple Corridor has a relatively low amount of land acquisition and resettlement, and the highest development prospects in terms of providing access to previously isolated areas. It is thus the alternative with the most positive social impacts.
- The key advantage of the purple corridor is the very high likely positive impact on the development of a large area to the south-east of Taiz which is presently far away from the existing road network of Yemen and which will be integrated by the highway into the transportation network, and thus gain access to markets and social and administrative services for the population.
- A further advantage is the improvement of long-distance journey times due to the shortcut from Aqan to the North.
- The southern part of the corridor (to the South of Noubat Dokaim) is the only realistic route because of the widespread existence of landmines on the western side of the existing axis. This area was mined during the earlier civil war between the North and the South of Yemen. Clearing the landmines in this desert area would be very expensive. Given the availability of land to the east of the existing road, the expense of clearing the landmines would not be justified.

6.4 List of Baseline Information Material Used During Evaluation of Alternative Corridors

During the evaluation of corridor alternatives, extensive use was made of numerous materials.

The following maps or digital map data with environmental context were used:

- KVR-1000 satellite images 1:10,000, Soviet form sputnik
- Landsat 7 ETM+ satellite multispectral data 1:100,000, USGS/EDC
- Topographical Maps of the Yemen Arabic Republic, Series YAR 50, 1:50,000



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- Topographical Maps of the former People's Democratic Republic of Yemen, 1:100,000
- Vegetation Map of Yemen 1:500,000, EPC/DHV
- Land use Map of Yemen 1:250,000, Sheet Sanaa
- Soil Map of Saudi Arabia, 1:1 500,000
- Geological Map of Yemen 1:1 000,000 and 1:250,000, 4 sheets (Robertson)
- Hydrogeological Map of Yemen, 1: 1 000,000 and 1:250,000, 4 sheets (Robertson)
- Geo-Environmental Map of Sanaa, 1:50,000, BGR & GSMRB 2003
- Volcanic and Earthquake Hazard Maps, 1:1 000,000, Western sheet
- Demography and administration statistical data, Central Statistical Organisation
- Tourist Map of Yemen 1:1 5 000,000.

The following environmental reports and literature, including map materials of environmental aspects were used:

- AREA 2000: Agro-climate and production systems in Dhamar Governorate
- British-Yemeni Society, R. Potter 1993: Birds of Yemen
- DHV Consultants / EPC 1991: The vegetation of the Republic of Yemen (Western Part)
- FAO 1996: Yemen Country report
- FAO / AREA 1997: Environmental resource assessment for rural land use planning, field document 4b – Crop and farm budgets, land utilization aspects
- FAO / AREA 1997: Environmental resource assessment for rural land use planning, field document 11 - Agro-climatic resources of Yemen
- GSMRB 2000: Geological & geophysical data
- Herzog, M. 2001 – Forests of Yemen
- International Fund for Agricultural Development 2003: Tihama environment protection project. Interim evaluation report
- UNDP / EPC 2000: Flora of Yemen. Sustainable Environmental Management Programme YEM/97/100, Draft Report
- numerous additional materials (on wildlife, vegetation, forests, agriculture, climate, social issues) from literature and the world wide web.

The following Yemen environmental legislation, guidelines, and EIA resources were used:

- Republic of Yemen. Council of Ministers. Environmental Protection Council: Environmental protection Law No. (26) of 1995. English Translation of the original Arabic text
- Republic of Yemen. Ministers Council. Environmental protection Council. National Environmental Action Plan, Sanaa, 1996
- Republic of Yemen. Ministry of Tourism and Environment. Environment and sustainable development investment program 2003-2008
- Republic of Yemen. Ministry of Agriculture and irrigation / FAO / UNCCD / UNDP. National action plan to combat desertification (draft 2000)
- Environmental Protection Council 1996: Environmental Impact policy for the Republic of Yemen. EPC / 96 / 089, Euroconsult



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- Ministry of Tourism and Environment / EPA 2003: Work-shop on Environmental Impact Assessment for road network in Yemen, 14. April 2003, Sana'a, Yemen. Tihama Coastal Road (Hudayda – Mokha.)
- METAP EIA Strengthening Project 2001: Evaluation of the EIA system in Yemen
- UNEP EIA Training resource Manual, Case Study 2: Environmental assessment study of the Safir-Hadramout Road project.

Table 6.2: Areas of likely impacts identified during study of corridor alternatives

From/to km	Settlement and human health, social infrastructure (noise impact, air pollution, hazard)	Land resources, agriculture (loss of land resources, social impact)	Natural environment, vegetation, forests, habitats, (habitat degradation and loss of biodiversity); on soil (erosion)	Ground-water resources, surface waters/ wadis (water pollution)	Cultural heritage, traditional architecture, landscape, ecotourism
Alternative (green)					
0 - 10	Settlement 3km	Extensive agriculture 5km	Trees, dwarf shrubs, erosion risk km 5-10		5 km
10 - 20	Settlement 4km	Intensive agriculture 5km; extensive agriculture 3km		Wadi at km 19; highly productive aquifer 0,4km	5 km
20 - 30	Settlement 3km	Intensive agriculture 5km; extensive agriculture 2km		Wadi at km 29; highly productive aquifer 1,6km	2 km
30 - 40		Intensive agriculture 2km; extensive agriculture 3km		Wadi at km 32/34 - 35/37; highly productive aquifer 2,8km	7 km
40 - 50		Extensive agriculture 4km	Erosion risk km 45-50	Wadi at km 44; highly productive aquifer 3,2km	2 km
50 - 60		Extensive agriculture 4km	Wadi vegetation 4km; erosion risk km 50 - 60	Wadi from km 50 - 57; highly productive aquifer 4km	
60 - 70			Wadi vegetation 4km; erosion risk km 60 - 63	Wadi from km 63 - 67/69 - 70; highly productive aquifer 7km	
70 - 80	Settlement 1km		Wadi vegetation 10km	Wadi from km 70 - 80; highly productive aquifer 10km	
80 - 90			Wadi vegetation 1km	Wadi from km 86 - 87; highly productive aquifer 10km	
90 - 100			Wadi vegetation 2km	Wadi from km 90 - 92/at km 96; highly productive aquifer 5,4km	
100 - 110		Intensive agriculture 4km		Highly productive aquifer 10km	
110 - 120		Intensive agriculture 4km		Highly productive aquifer 10km	
120 - 130				Highly productive aquifer 10km	
130 - 143		Extensive agriculture 3km		8km	

From/to km	Settlement and human health, social infrastructure (noise impact, air pollution, hazard)	Land resources, agriculture (loss of land resources, social impact)	Natural environment, vegetation, forests, habitats, (habitat degradation and loss of biodiversity); on soil (erosion)	Ground-water resources, surface waters/ wadis (water pollution)	Cultural heritage, traditional architecture, landscape, ecotourism
Alternative (yellow)					
0 - 10	Settlement 1km	Intensive agriculture 5km; extensive agriculture 2km	Erosion risk km 6 - 10	Wadi at km 6	Typical terrace fields 5km
10 - 20	Settlement 4km	Intensive agriculture 5km; extensive agriculture 3km	Erosion risk km 10 - 12	Wadi at km 20; highly productive aquifer 0,4km	5km
20 - 30	Settlement 1km	Intensive agriculture 1km; extensive agriculture 4km	Wadi vegetation 1km	Highly productive aquifer 1,3km	3km
30 - 40		Intensive agriculture 3km; extensive agriculture 3km		Wadi at km 31/33/35 - 37; highly productive aquifer 1,6km	6km
40 - 50		Extensive agriculture 2km	Erosion risk km 46 - 50	Wadi at km 41/45; highly productive aquifer 2,6km	2km
50 - 60		Extensive agriculture 5km	Wadi vegetation 5km; erosion risk km 50 - 60	Wadi from km 50 - 58; highly productive aquifer 3,9km	
60 - 70			Wadi vegetation 4km; erosion risk km 60 - 64	Wadi from km 64 - 68; highly productive aquifer 5,9km	
70 - 80			Wadi vegetation 10km	Wadi from km 70 - 80; highly productive aquifer 10km	
80 - 90	Settlement 1km		Wadi vegetation 1km	Wadi from km 87 - 88; highly productive aquifer 10km	
90 - 100			Wadi vegetation 1km	Wadi from km 91 - 93; highly productive aquifer 3km	
100 - 110			Wadi vegetation 2km	3,3km	
110 - 120				Highly productive aquifer 3km	
120 - 130				Highly productive aquifer 1km	
130 - 140		Extensive agriculture 1km		Highly productive aquifer 10km	
140 - 154		Extensive agriculture 1km		Highly productive aquifer 5,4km	



From/to km	Settlement and human health, social infrastructure (noise impact, air pollution, hazard)	Land resources, agriculture (loss of land resources, social impact)	Natural environment, vegetation, forests, habitats, (habitat degradation and loss of biodiversity); on soil (erosion)	Ground-water resources, surface waters/ wadis (water pollution)	Cultural heritage, traditional architecture, landscape, ecotourism
Alternative (blue)					
0 - 10	Settlement 3km	Intensive agriculture 7km			Typical terrace fields 5km
10 - 20	Settlement 1km	Extensive agriculture 3km	Wadi vegetation 3km	Wadi from km 10 - 13/14/16 - 18	
20 - 30		Extensive agriculture 4km	Wadi vegetation 4km; erosion risk km 23 - 30	Wadi from km 25 - 30	
30 - 40	Settlement 1km	Extensive agriculture 4km	Wadi vegetation 7km	Wadi from km 30 - 34/38 - 40	
40 - 50		Extensive agriculture 3km	Wadi vegetation 4km; erosion risk km 41 - 50	Wadi at km 41/48 - 50; highly productive aquifer 4,8km	
50 - 60		Extensive agriculture 1km	Wadi vegetation 1km; erosion risk km 50 - 51/55 - 60	Wadi at km 52/55/60; highly productive aquifer 4,9km	
60 - 70	Settlement 2km		Wadi vegetation 3km; erosion risk km 60 - 64	Wadi at km 60 - 63; highly productive aquifer 10km	
70 - 80			Wadi vegetation 4km	Wadi at km 72 - 73/74/77 - 80; highly productive aquifer 10km	
80 - 90			Wadi vegetation 2km	Wadi at km 84; highly productive aquifer 6,5km	
90 - 100	Airport 1km			Highly productive aquifer 10km	
100 - 110			Open woodland 8km	Alluvial fans km 102 - 110; highly productive aquifer 10km	
110 - 120			Open woodland 8km	Alluvial fans km 110 - 118; highly productive aquifer 10km	
120 - 134		Extensive agriculture 3km		Highly productive aquifer 6,8km	

*Source: Feasibility Report Amran-Aden Road, Section III, Taiz-Aden, DORSCH Consult, 2003

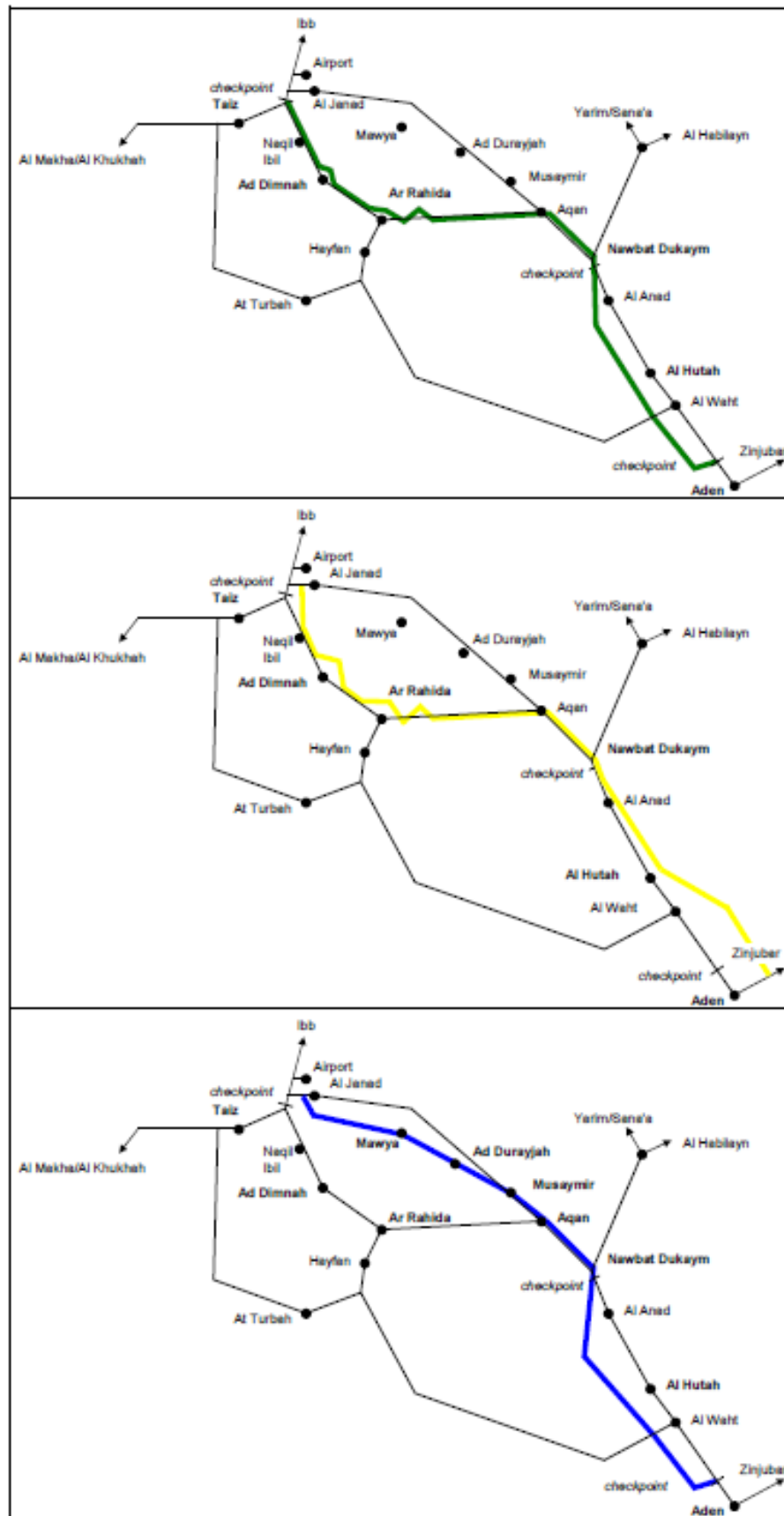


Figure 6.1: Schematic plan of Green, Yellow and Blue alignments

**Source: Feasibility Report Amran-Aden Road, Section III, Taiz-Aden, DORSCH Consult, 2003*

Table 6.3: Green Corridor – environmental and social baseline information

From/to Km	Length Km	Natural geographic Unit	Vegetation	Land use, Agriculture	Climate	Water, irrigation	Soil	Environmental Sensitivity & problems	Cultural heritage, Tourism
Alternative b (green)									
15	15	Medium altitude Western Mountains (WM)	Euphorbia dwarf-shrub land, WM1	<ul style="list-style-type: none"> • Most of the flatter and less rocky parts are cultivated • Slopes are dominated by succulents as a result of overgrazing and firewood cutting • Little use for farming 	<ul style="list-style-type: none"> • Rainfall 400-800 mm • Air humidity moderate • Temperature range from 12 to 35°C 	<ul style="list-style-type: none"> • More rainfall in higher altitudes 	<ul style="list-style-type: none"> • Volcanic, schist, limestone and sandstone rock • Soil class: EHO, EHU, RCC 	<ul style="list-style-type: none"> • Few trees remained in the intensively cultivated wadis • Euphorbia shrub lands no longer useful for grazing but protect the slopes from erosion • Regeneration of grasses and shrubs under the protection of succulents is recommended 	
25	10	Highland plains	Ziziphus open woodland (1000-1800m), h1	<ul style="list-style-type: none"> • Large areas without any cultivation • Most of the trees • Are important for fodder production 	<ul style="list-style-type: none"> • Rainfall 200-400 mm • Rainfall rather low • Because of lying in the rain shadow of mountains • Air humidity low • Temperature range from frost to 32 °c 	<ul style="list-style-type: none"> • Rainfed agriculture and using of run-off from adjacent slopes 	<ul style="list-style-type: none"> • Larger plains: soils are formed from deposits of loess (fairly productive) • Soil class: EHU, RUO 	<ul style="list-style-type: none"> • Partly covered with dense shrubland • Grazing intensity high • But not out of balance • Increase of arable land in the future expected 	

From/to Km	Length Km	Natural geographic Unit	Vegetation	Land use, Agriculture	Climate	Water, irrigation	Soil	Environmental Sensitivity & problems	Cultural heritage, Tourism
33	8	Medium altitude Western Mountains (WM)	Euphorbia dwarf-shrub land, WM1	<ul style="list-style-type: none"> • Most of the flatter and less rocky parts are cultivated • Slopes are dominated by succulents as a result of overgrazing and firewood cutting • Little use for farming 	<ul style="list-style-type: none"> • Rainfall 400-800 mm • Air humidity moderate • Temperature range from 12 to 35°C 	<ul style="list-style-type: none"> • More rainfall in higher altitudes 	<ul style="list-style-type: none"> • Volcanic, schist, limestone and sandstone rock • Soil class: EHU, RCC 	<ul style="list-style-type: none"> • Few trees remained in the intensively cultivated wadis • Euphorbia shrublands no longer useful for grazing but protect the slopes from erosion • Regeneration of grasses and shrubs under the protection of succulents is recommended 	
35	2	Highland plains	Ziziphus open woodland (1000-1800m), h1	<ul style="list-style-type: none"> • Large areas without any cultivation • Most of the trees are important for fodder production 	<ul style="list-style-type: none"> • Rainfall 200-400 mm • Rainfall rather low because of lying in the rain shadow of mountains • Air humidity low • Temperature range from frost to 32 °c 	<ul style="list-style-type: none"> • Rainfed agriculture and using of run-off from adjacent slopes 	<ul style="list-style-type: none"> • Larger plains: soils are formed from deposits of loess (fairly productive) • Soil class: EHU 	<ul style="list-style-type: none"> • Partly covered with dense shrubland • Grazing intensity high but not out of balance • Increase of arable land in the future expected 	

From/to Km	Length Km	Natural geographic Unit	Vegetation	Land use, Agriculture	Climate	Water, irrigation	Soil	Environmental Sensitivity & problems	Cultural heritage, Tourism
43	8	Medium altitude Western Mountains (WM)	Acacia asak-grewia shrubland, WM2	<ul style="list-style-type: none"> Area is major source of firewood Livestock grazing Trees for animal fodder 	<ul style="list-style-type: none"> Rainfall 400-800 mm Air humidity moderate Temperature range from 12 to 35°C 	<ul style="list-style-type: none"> more rainfall in higher altitudes 	<ul style="list-style-type: none"> Volcanic, schist, limestone and sandstone rock Soil class: SP, RTT, RUO 	<ul style="list-style-type: none"> Degradation due to overcutting Protection of trees recommended 	
108	65	Medium altitude Western Mountains (WM)		<ul style="list-style-type: none"> Least populated areas in Yemen Fuel collection and Grazing activities 	<ul style="list-style-type: none"> Rainfall 100-600 mm Air humidity high Temperature range from 12 to 35°C 	<ul style="list-style-type: none"> precipitation varies considerably 	<ul style="list-style-type: none"> Precamb. Gneisses and schists (north) Granits (south) Soil class: SP, RTT 		
143	35	Tihama coastal plain (t)	Mainly desert, partly salt bush lands	<ul style="list-style-type: none"> Most woodland cleared for agriculture Scattered trees left Green and productive part of Yemen Valuable agricultural land 	<ul style="list-style-type: none"> Low rainfall 200 mm Air humidity very high Temperature range from 18 to 45 °c 	<ul style="list-style-type: none"> Receives water from the mountains Use of groundwater for irrigation 	<ul style="list-style-type: none"> Mountains covered by silty, clayey sediments Gravel and sand in wadi beds 	<ul style="list-style-type: none"> Agriculture depends on use of groundwater Management of water resources necessary 	

*Source: Feasibility Report Amran-Aden Road, Section III, Taiz-Aden, DORSCH Consult, 2003

Table 6.4: Yellow Corridor – environmental and social baseline information

from/to km	length km	Natural geographic unit	Vegetation	Land use, agriculture	Climate	Water, irrigation	Soil	Environmental sensitivity & problems	Cultural heritage, tourism
Alternative (Yellow)									
2	2	Highland Plains	Ziziphus Open Woodland (1000-1800m), H1	<ul style="list-style-type: none"> • large areas without any cultivation • most of the trees are important for fodder production 	<ul style="list-style-type: none"> • rainfall 200-400 mm • rainfall rather low because of lying in the rain shadow of mountains • air humidity low • temperature frost-32 °C 	<ul style="list-style-type: none"> • rainfed agriculture and using of run-off from adjacent slopes 	<ul style="list-style-type: none"> • larger plains: soils are formed from deposits of loess (fairly productive) • soil class: EHU, RCC 	<ul style="list-style-type: none"> • partly covered with dense shrubland • grazing intensity high but not out of balance • increase of arable land in the future expected 	market/souk at Al Qa'idah
15	13	Medium Altitude Western Mountains (WM)	Euphorbia Dwarf-Shrub Land (WM1)	<ul style="list-style-type: none"> • most of the flatter and less rocky parts are cultivated • slopes are dominated by succulents as a result of overgrazing and firewood cutting • little use for farming 	<ul style="list-style-type: none"> • rainfall 400-800 mm • air humidity moderate • temperature range from 12 to 35°C 	<ul style="list-style-type: none"> • more rainfall in higher altitudes 	<ul style="list-style-type: none"> • volcanic, schist, limestone and sandstone rock • soil class: EUO, EHU 	<ul style="list-style-type: none"> • few trees remained in the intensively cultivated wadis • Euphorbia shrublands no longer useful for grazing but protect the slopes from erosion • regeneration of grasses and shrubs under the protection of 	

from/to km	length km	Natural geographic unit	Vegetation	Land use, agriculture	Climate	Water, irrigation	Soil	Environmental sensitivity & problems	Cultural heritage, tourism
								succulents is recommended	
23	8	Highland Plains	Ziziphus Open Woodland (1000-1800m), H1	<ul style="list-style-type: none"> • large areas without any cultivation • most of the trees are important for fodder production 	<ul style="list-style-type: none"> • rainfall 200-400 mm • rainfall rather low because of lying in the rain shadow of mountains • air humidity low • temperature range from frost to 32 °C 	<ul style="list-style-type: none"> • rainfed agriculture and using of run-off from adjacent slopes 	<ul style="list-style-type: none"> • larger plains: soils are formed from deposits of loess (fairly productive) • soil class: RUO, EHU 	<ul style="list-style-type: none"> • partly covered with dense shrubland • grazing intensity high but not out of balance • increase of arable land in the future expected 	
44	21	Medium Altitude Western Mountains (WM)	Acacia Asak-Grewia Shrubland, WM2	<ul style="list-style-type: none"> • area is major source of firewood • livestock grazing • trees for animal fodder 	<ul style="list-style-type: none"> • rainfall 400-800 mm • air humidity moderate • temperature range from 12 to 35°C 	<ul style="list-style-type: none"> • more rainfall in higher altitudes 	<ul style="list-style-type: none"> • volcanic, schist, limestone and sandstone rock • soil class: RTT, RUO 	<ul style="list-style-type: none"> • degradation due to overcutting • protection of trees • recommended 	
105	61	Medium Altitude Western Mountains (WM)		<ul style="list-style-type: none"> • least populated areas in Yemen • fuel collection and • grazing activities 	<ul style="list-style-type: none"> • rainfall 100-600 mm • air humidity high • temperature range from 12 to 35°C 	<ul style="list-style-type: none"> • precipitation varies considerably 	<ul style="list-style-type: none"> • Precamb gneisses and schists (north) • granits (south) • soil class: 		

from/to km	length km	Natural geographic unit	Vegetation	Land use, agriculture	Climate	Water, irrigation	Soil	Environmental sensitivity & problems	Cultural heritage, tourism
							SP, RTT		
153	48	Tihama Coastal Plain (T)	mainly desert, partly salt bush lands	<ul style="list-style-type: none"> • most woodland cleared for agriculture • scattered trees left on the fields • green and productive part of Yemen • valuable agricultural land 	<ul style="list-style-type: none"> • low rainfall 200 mm • air humidity very high • temperature range from 18 to 45°C 	<ul style="list-style-type: none"> • receives water from the mountains • use of groundwater for irrigation 	<ul style="list-style-type: none"> • mountains covered by silty, clayey sediments • gravel and sand in wadi beds • soil class: SP 	<ul style="list-style-type: none"> • agriculture depends on use of groundwater • management of water resources necessary 	
5	5	Highland Plains	Ziziphus Open Woodland (1000-1800m), H1	<ul style="list-style-type: none"> • large areas without any cultivation • most of the trees are important for fodder production 	<ul style="list-style-type: none"> • rainfall 200-400 mm • rainfall rather low because of lying in the rain shadow of mountains • air humidity low • temperature range from frost to 32 °C 	<ul style="list-style-type: none"> • rainfed agriculture and using of run-off from adjacent slopes 	<ul style="list-style-type: none"> • larger plains: soils are formed from deposits of loess (fairly productive) • soil class: EHU 	<ul style="list-style-type: none"> • partly covered with dense shrubland • grazing intensity high but not out of balance • increase of arable land • in the future expected 	

*Source: Feasibility Report Amran-Aden Road, Section III, Taiz-Aden, DORSCH Consult, 2003

Table 6.5: Blue Corridor – environmental and social baseline information

from/to km	length km	Natural geographic unit	Vegetation	Land use, agriculture	Climate	Water, irrigation	Soil	Environmental sensitivity & problems	Cultural heritage, tourism
Alternative (Blue)									
25	20	Medium Altitude Western Mountains (WM)	Euphorbia Dwarf-Shrub Land, WM1	<ul style="list-style-type: none"> • most of the flatter and less rocky parts are cultivated • slopes are dominated by succulents as a result of overgrazing and firewood cutting • little use for farming 	<ul style="list-style-type: none"> • rainfall 400-800 mm • air humidity moderate • temperature range from 12 to 35 °C 	<ul style="list-style-type: none"> • more rainfall in higher altitudes 	<ul style="list-style-type: none"> • volcanic, schist, limestone and sandstone rock • soil class: EUR, EHU 	<ul style="list-style-type: none"> • few trees remained in the intensively cultivated wadis • Euphorbia shrublands no longer useful for grazing but protect the slopes from erosion • regeneration of grasses • and shrubs under the protection of succulents is recommended 	market/souk at Al Qa'idah
33	8	Medium Altitude Western Mountains (WM)	Acacia asak-Grewia Shrubland, WM2	<ul style="list-style-type: none"> • area is major source of firewood • livestock grazing • trees for animal fodder 	<ul style="list-style-type: none"> • rainfall 400-800 mm • air humidity moderate • temperature range from 12 to 35 °C 	<ul style="list-style-type: none"> • more rainfall in higher altitudes 	<ul style="list-style-type: none"> • volcanic, schist, limestone and sandstone rock • soil class: RTT, EUR 	<ul style="list-style-type: none"> • degradation due to overcutting • protection of trees recommended 	market/souk at Jabal Ama'imah

from/to km	length km	Natural geographic unit	Vegetation	Land use, agriculture	Climate	Water, irrigation	Soil	Environmental sensitivity & problems	Cultural heritage, tourism
95	62	Medium Altitude Western Mountains (WM)		<ul style="list-style-type: none"> least populated areas in Yemen fuel collection and grazing activities 	<ul style="list-style-type: none"> rainfall 100-600 mm air humidity high temperature range from 12 to 35 °C 	<ul style="list-style-type: none"> precipitation varies considerably 	<ul style="list-style-type: none"> precamb gneisses and schists (north) granits (south) soil class: SP, RTT 		market/souk at Jabal Ama'imah and Al Musaymir
135	40	Tihama Coastal Plain (T)	mainly desert, partly salt bush lands	<ul style="list-style-type: none"> most woodland cleared for agriculture scattered trees left on the fields productive part of Yemen valuable agricultural land 	<ul style="list-style-type: none"> low rainfall 200 mm air humidity very high temperature range from 18 to 45 °C 	<ul style="list-style-type: none"> receives water from the mountains use of groundwater for irrigation 	<ul style="list-style-type: none"> mountains covered by silty, clayey sediments gravel and sand in wadi beds soil class: SP 	<ul style="list-style-type: none"> agriculture depends on use of groundwater management of water resources necessary 	

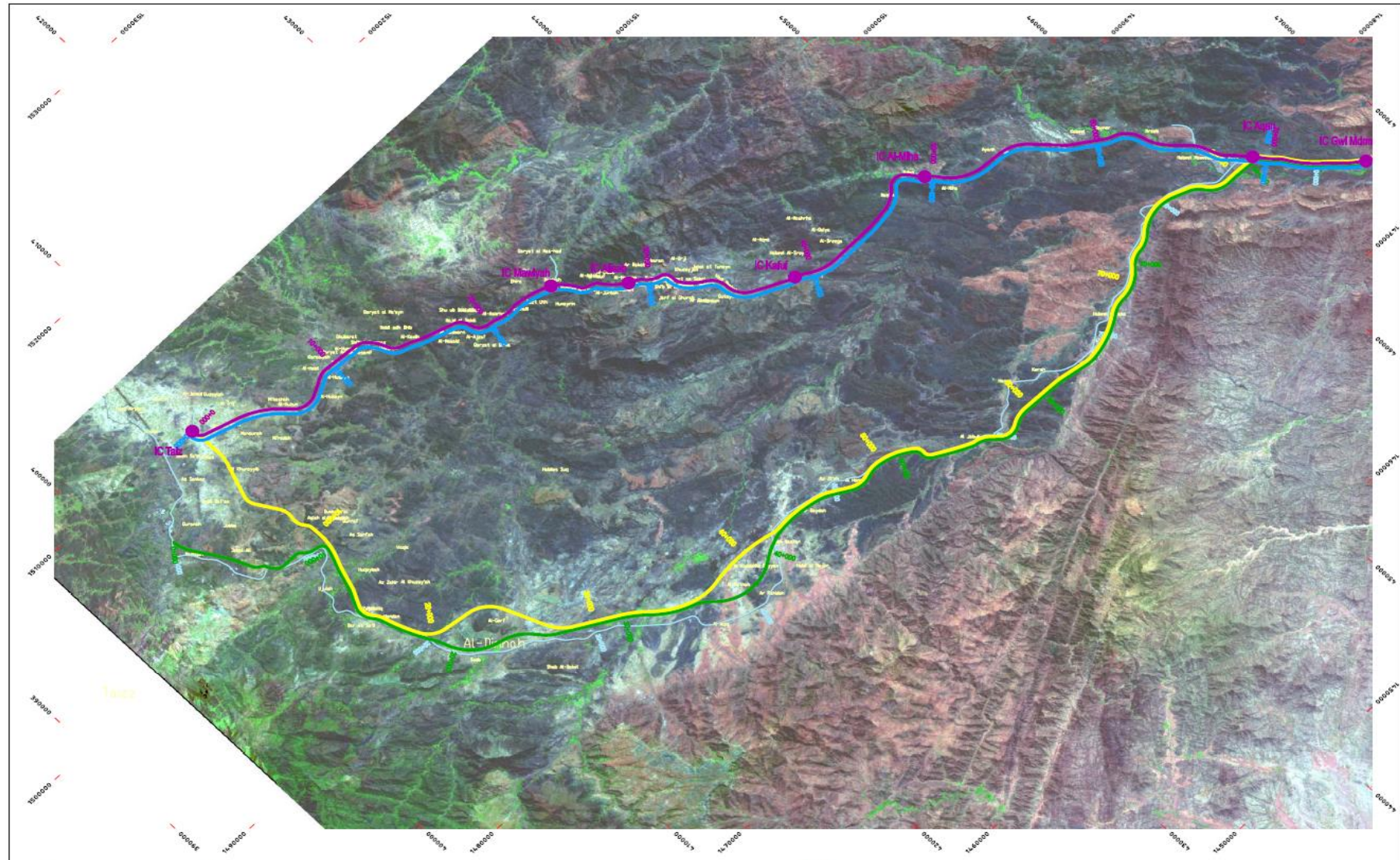


Figure 6.2: Location of Blue, Green, Yellow and Purple alignments between Taiz and Noubat Dokaim

*Source: Feasibility Report Amran-Aden Road, Section III, Taiz-Aden, DORSCH Consult, 2003

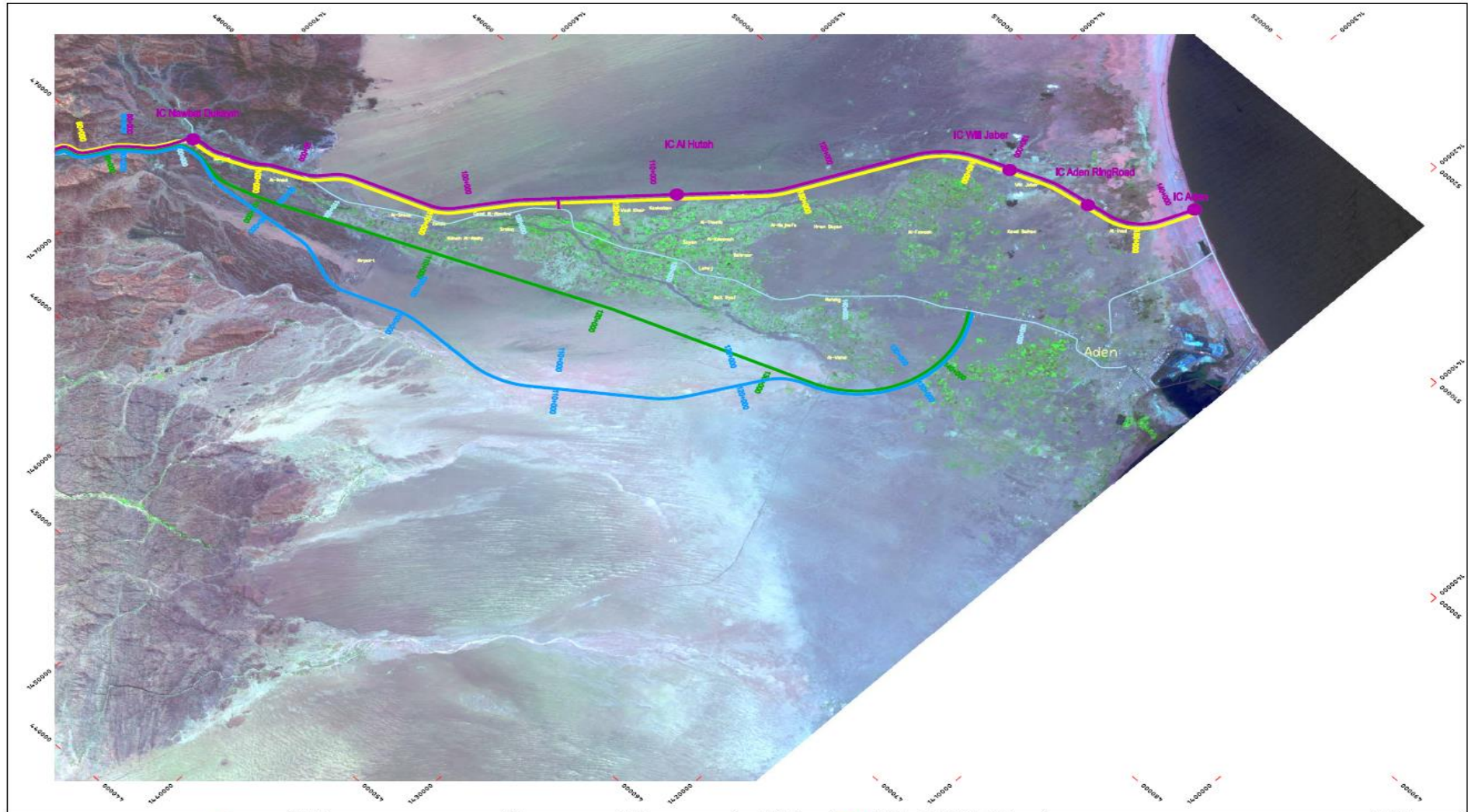


Figure 6.3: Location of Blue, Green, Yellow and Purple alignments between Noubat Dokaim and Aden

**Source: Feasibility Report Amran-Aden Road, Section III, Taiz-Aden, DORSCH Consult, 2003*



7 POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS

7.1 Introduction

This chapter identifies the potential impacts of the project that are likely to occur, before and during construction, and during the operational/maintenance phase. The project activities (construction of a new highway between Aden and Taiz) are analysed for their potential impacts on environmental resources and socio-economic issues. The magnitude and significance of the expected impacts are also analyzed. The impacts are classified as direct or indirect, reversible or irreversible, immediate or long-term.

The chapter also identifies the mitigation measures which are designed to help reducing the magnitude of adverse impacts and to keep them at acceptable levels, thereby combining the goal of long term sustainable development of a region with sound environmental and social considerations. The analysis identifies mitigation measures that are feasible and reasonable in the specific Yemeni context, that are cost-effective and that can be included in the Environmental and Social Management Plan. For the implementation of the mitigation of the social impacts, a separate Resettlement Action Plan has been prepared which is based on the social impact analysis presented in this ESIA.

The impact assessment and mitigation measures are analyzed for :

- Construction and pre-construction stage
- Operational / Maintenance stage

7.2 Environmental Impacts

The environmental impact assessment is divided in two areas, namely (i) impacts of the physical environment and (ii) impacts on the ecology (flora and fauna).

The impacts on the *physical environment* cover the direct and local impacts of the highway construction and operation, such as noise, water pollution, habitat destruction/disturbance, local air quality, landscape, soil contamination, etc.

The *ecological impacts* cover the effects of the construction of the highway on flora and fauna. The wider impacts ecological effects of the new highway may include long-term climate change from vehicle emissions, which is however not covered in this assessment due to the absence of a sound and commonly accepted methodology for forecasting such climate change.

7.3 Impacts on Physical Environment

7.3.1 Micro Climate

The climate of the project area is of the semi-arid type. Though no change in the macro-climatic setting (precipitation, temperature and wind) is envisaged due to the project, the microclimate in the immediate area of the new highway is likely to be affected. During the construction stage there will be temporary heat output wherever heavy machinery is operated, including earthmoving equipment and asphalt plants.



This is however not expected to lead to any significant change in the climatic condition of the project area.

During the operation of the highway, local temperature condition will be slightly modified due to the replacement of vegetation and natural soil/sand by asphalt pavement surface. There will be an increase in daytime temperature on the newly constructed road surface and on the nearby soil due to the loss of some shade trees, which in turn might lead to formation of heat islands. In addition, the removal of trees / vegetation will increase the amount of direct sunlight, resulting in higher temperatures along the Highway. Overall, these effects are limited to the immediate area of the highway and are not expected to cause any significant change in the micro climate of the area of influence of the highway.

Mitigation Measures: Roadside vegetation including trees will be planted in those areas where sufficient water is available and where roadside plants can grow. It was observed during the field visits that this will be the case in some parts of Taiz Governorate, especially in higher elevations. It is expected that the planted roadside vegetation will help mitigating some of the impact in the area adjacent to the road.

7.3.2 Air Quality

The air quality along the proposed highway corridor will be affected due to significant change in land use pattern of the area. The direct influence area will be impacted by air pollution during construction and operation stages due to generation of dust and exhaust gases. During the construction stage, negative impacts on air quality will be temporary and will affect the health of construction workers and the residents in the settlements adjacent to the ROW, especially those in the downwind direction. During the operation phase, air pollution will be caused mostly by exhaust gases from moving traffic but also by road maintenance activities, although to a much smaller extent. This will affect local residents in the close proximity of the highway on a long-term basis for as long as there is traffic on the new highway. However, since the new road alignment was defined to avoid proximity to settlements as much as possible, there are relatively few sensitive receptors close to the road alignment or within direct impact area.

7.3.3 Dust

The presence of dust is expected to have a negative temporary impact especially on the health of road construction workers. Dust is likely to have a more serious impact than exhaust gases during the construction stage due to the large volumes of excavation and earth moving with heavy equipment in mostly dry conditions. Other dust generating construction activities include stone crushing operations, handling and storage of sand and aggregates in the asphalt plants, concrete mixing plants and asphalt hotmix plants due to the movement of aggregates. The impacts of dust will mostly be concentrated on the construction sites and stone crushing sites. The impact of dust will spread downwind of the site for a considerable distance of up to 1000 m on windy days. During the operation stage, dust will not be generated since the vehicles move on paved surfaces only.



Dust mitigation measures:

- Water will be sprinkled regularly twice a day on haulage roads on the construction site.
- Stone crushers, asphalt plants and concrete mix plant will be located at least 1 km away from populated areas and human settlements, and downwind of those based on the prevailing wind direction.
- Water will be sprinkled on the lime/cement/asphalt mixing sites and their access roads.
- To avoid dust emissions from moving trucks, the loaded trucks will be covered when operating near populated areas/villages.
- The Environmental Management Plan will ensure that adequate measures are taken especially for health and safety of workers such as providing them with breathing masks during work.

7.3.4 *Vehicle Emissions*

During the construction stage, the generation of exhaust gases will occur due to the operation of various types of heavy machinery with internal combustion engines, mostly for earth movement and for laying of pavement. This impact is envisaged to be significant, but temporary during the construction stage only. Pollutants like SO₂, HC and NO_x are likely to be generated from the operations of such machinery. In addition, toxic gases will be released during the operation of the asphalt mixing plant, due to the heating of bitumen. Although the impact is normally restricted to the working area and its vicinity, exhaust gases can spread downwind.

During the operation/maintenance stage, moving motor vehicles will produce exhaust emissions and thus create air pollution. The HDM4 model has been used to predict the volumes of annual emission quantities of Hydrocarbons (HC); Carbon Monoxide (CO); Nitrogen Oxide (NO_x); Sulphur Dioxide (SO₂); Carbon Dioxide (CO₂) Particulate Matter and Lead. The HDM4 model uses input data on projected traffic levels, rise and fall of the road, the composition of traffic, fuel quality and average traffic speed. The HDM4 analysis compares the “without project” scenario under which traffic will continue to flow on the existing road only, with the “with project” scenario in which the traffic is using both the existing and the new road. In the “with project” scenario, higher emission volumes are caused by (i) higher traffic levels, due to traffic generated by the new road, (ii) higher average traffic speeds and (iii) by the slightly higher length of the new road which is used by a large part of the traffic. The new highway is eight km longer than the existing highway. The higher emission levels which are due to the reasons stated above are however offset to a small degree by the smoother traffic flow and resulting lower fuel consumption on both the existing and new road.

The exhaust emission generation modeling was carried out separately for the two sub-sections of the road, namely (i) Aden to Noubat Dokaim, and (ii) Noubat Dokaim to Taiz. The results are presented in **Table 7.1 to 7.4**. The unit of measurement for all pollutants is **tonnes per year**.

Table 7.1: Predicted vehicle emissions - without project (Aden - Noubat Dokaim).

Year	Traffic (AADT Vehicle per day)	HC	CO	NO _x	SO ₂	CO ₂	Particulate Matter	Lead
2015	17722	383	486	1462	66	115701	259	5
2020	21978	477	606	1824	82	144377	323	6
2025	26739	559	708	2136	96	169432	378	8
2030	32532	681	863	2604	117	206485	461	9
2035	39581	830	1051	3171	142	251483	562	11
2040	48156	1013	1281	3875	174	307212	686	14

Table 7.2: Predicted vehicle emissions with project (Aden – Noubat Dokaim)

Year	Traffic (AADT Vehicle per day)	HC	CO	NO _x	SO ₂	CO ₂	Particulate Matter	Lead
2015	17722	382	486	1460	66	115601	259	5
2020	28571	880	1365	3242	142	255716	252	12
2025	42783	1304	2010	4815	211	379699	835	18
2030	52052	1571	2399	5809	255	457819	1008	21
2035	63329	1869	2785	6937	306	545611	1208	25
2040	77049	2249	3243	8379	372	656869	1466	30

Table 7.3: Predicted vehicle emissions without project (Taiz to Noubat Dokaim)

Year	Traffic (AADT Vehicle per day)	HC	CO	NO _x	SO ₂	CO ₂	Particulate Matter	Lead
2015	17722	592	752	2259	101	178811	400	8
2020	21978	738	937	2819	127	223129	499	10
2025	26739	864	1094	3302	148	261850	585	12
2030	32532	1053	1334	4024	181	319113	713	14
2035	39581	1282	1624	4901	220	388655	868	17
2040	48156	1566	1980	5988	269	474781	1061	21

Table 7.4: Predicted vehicle emissions with project (Taiz to Noubat Dokaim)

Year	Traffic (AADT Vehicle per day)	HC	CO	NO _x	SO ₂	CO ₂	Particulate Matter	Lead
2015	17722	591	751	2257	101	178656	400	8
2020	28571	1359	2109	5011	220	395198	868	18
2025	42783	2016	3106	7441	327	586807	1290	27
2030	52052	2428	3708	8977	395	707563	1558	33
2035	63329	2889	4304	10721	473	843217	1867	39
2040	77049	3476	5011	12950	575	1015161	2265	46

The results of the vehicle emission generation modeling indicates that the project will cause a significant increase in air pollution load. The difference in pollution load between the “without project” and “with project” scenarios widens over time due to the significant difference in expected traffic levels between the two scenarios.

The increase in pollutant load by the year 2040 for both sections is as follows: Vehicle traffic levels in the “with project” scenario are about 1.59 times higher than in the “without project” scenario. The increases in pollutants are as follows: HC – 2.21 times, CO – 2.53 times, NO_x – 2.15 times, SO₂ - 2.13 times, CO₂ – 2.13 times, Particulate Matter – 2.13 times, Lead – 2.19 times higher.

While the HDM4 model was used to predict the overall load of airborne vehicle emissions (exhaust gases), the dispersion of those emissions and their presence at the level of receptors along the highway was done using **CALINE-4**, a line source model developed by the California Department of Transport. The AADT traffic volume provided for the HDM4 model was converted into the hourly traffic volumes needed as input to the CALINE-4 model. The model provides a prediction of 1-hourly increments in CO and PM concentrations for the year 2015, 2020, 2025, 2030, 2035 and 2040 for the receptor locations along the highway, from 5 meters to 150 meters distance. The CALINE-4 modelling only focuses on the CO and PM dispersion, generated from the traffic on the proposed highway.

Traffic data utilised for CALINE -4 modelling: CALINE 4 model requires the input of hourly average traffic volume. Therefore, the AADT value was converted into hourly average values. The model was set up assuming that peak traffic hours will be 3 times higher than average hourly traffic. The traffic volumes are categorized into various types of vehicles (motorcycles – 2W, cars – 4W, light commercial vehicles - LCV, buses and heavy trucks) based on the traffic survey at fuel stations during the traffic survey in December 2013. The composition of traffic in December 2013 is shown below in **Figure 7.1**.

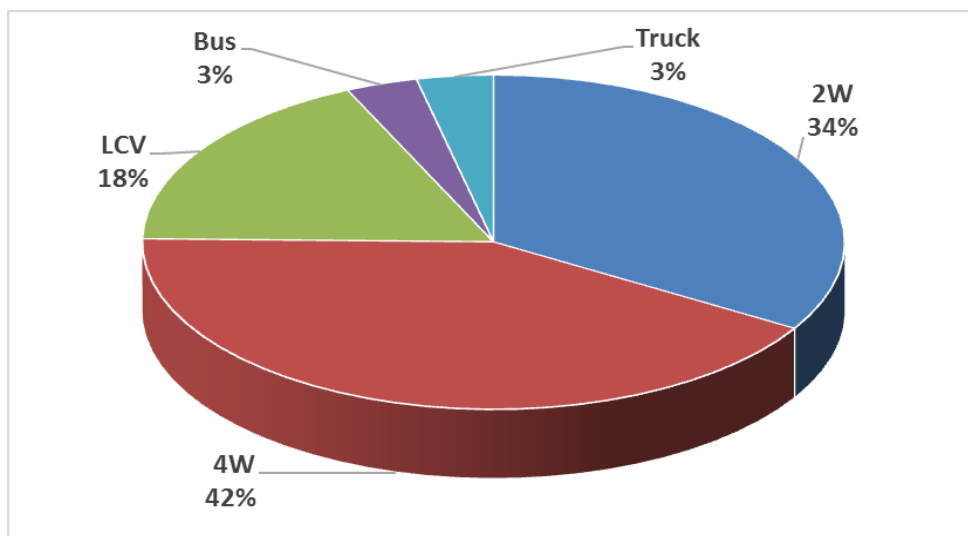


Figure 7.1: Composition of Traffic

The traffic data for with project and without project utilised in CALINE-4 modelling is given below in **Table 7.5 and 7.6**.

Table 7.5: Annual average hourly traffic volume during peak hours without project

Year	Traffic volume for peak traffic hour					
	2W	Car	LCV	Bus	HCV	Total
2015	745	923	396	73	78	2215
2020	924	1144	491	90	97	2747
2025	1125	1392	598	110	118	3342
2030	1368	1694	727	134	144	4067
2035	1665	2061	885	163	175	4948
2040	2025	2507	1076	198	212	6020

Table 7.6: Annual average hourly traffic volume during peak hours with project

Year	Traffic volume for peak traffic hour					
	2W	Car	LCV	Bus	HCV	Total
2015	745	923	396	73	78	2215
2020	1202	1487	639	118	126	3571
2025	1799	2227	956	176	189	5348
2030	2189	2710	1164	214	230	6507
2035	2664	3297	1416	261	279	7916
2040	3241	4011	1722	317	340	9631

Note on “with project” and “without project” scenarios: It is important to remember that the project consists of the construction of a new highway which is located roughly parallel to the existing road, but a varying distances to each other. Therefore, the “without project” scenario assumes that all traffic remains on the existing road, while under the “with project” scenario most of the traffic moves on the new highway and only a smaller portion remains on the existing highway. However, at three points along the corridor, the old road and the new highway are close to each other. These points (Taiz, Noubat Dokaim and Aden) were selected to show concentrations of CO and PM at receptors located at specific distances from the highway.

Road geometry: In the **CALINE-4** model the entire length of the selected road section is divided into various links. The division of sections into links has been done in such way, so that the link can be fairly considered as straight stretch of road having homogenous geometry with uniform road width, height, route alignment and traffic volume. The coordinates of end points of links specify the location of the links in the model. The maximum numbers of link in each road section can be 20. The mixing zone width calculated for selected highway corridor is 37.2m (15.6 m+ 15.6 m + 6 m).

Emission factors: Emission factor is one of the important input parameters in the Caline-4 model. In the present study, the emission factors expressed in g/mile (converted from gm/km) for the present study and are given in **Table 7.7**.

Table 7.7: Emission factors in (gm/km) for different types of vehicles

Vehicle type	Emission factor (gm/km)	
	CO	PM
Two wheeler(2W)	3.08	0.03
Cars/Jeep	1.53	0.06
LCV	2.02	0.49
Bus	8.40	1.08
HCV	12.65	1.60

Meteorological data: The analysis was conducted to predict concentration of CO and PM for the worst meteorological conditions. The meteorological parameters such as wind speed, wind direction standard deviation, temperature, mixing height and stability condition are used in model. The wind direction standard deviation was calculated to know the flexibility of wind direction and used as input parameters in worst case run condition.

Receptors: A set of link receptors were taken at various receptor locations within each section at a distance of 5 m, 10 m, 20 m, 40 m, 70 m, 100 m and 150 m both sides from the edge of the carriageway to know the dispersion of pollutant from the road. Further, model has been run with receptor grid to explore the spatial distribution of CO and PM concentrations.

Results: The estimated increase in the concentration of CO and PM for the years 2015, 2020, 2025, 2030, 2035 and 2040 are shown in **Tables 7.8 and 7.9**. The predicted concentration of CO is shown in **Tables 7.10 and 7.11** for the “without project” and “with project” scenarios, respectively at three selected receptor locations namely Taiz, Aden and Noubat Dokaim. Similar, the predicted concentrations of PM are shown in **Tables 7.12 and 7.13** further below. The predicted concentrations have been compared between the “with project” and “without project” scenarios. The results show that increases are roughly in line with the differences in traffic volumes between the “with project” and “without project” scenarios. The total emission levels under the “with project” scenario are not considered as critical in line with international standards.

Table 7.8: Increment in CO concentrations

Year	CO Concentration (ppm) at kerb side of the road (5 m)		
	Without Project	With Project	Increment (%age)
2015	0.2	0.2	0.00%
2020	0.3	0.4	33.33%
2025	0.4	0.5	25.00%
2030	0.4	0.6	50.00%
2035	0.5	0.8	60.00%
2040	0.6	0.9	50.00%

Table 7.9: Increment in PM concentrations

Year	PM Concentration ($\mu\text{g}/\text{m}^3$) at kerb side of the road (5 m)		
	Without Project	With Project	Increment (%age)
2015	6.8	6.8	0.00%
2020	8.2	10.4	26.83%
2025	9.8	14.8	51.02%
2030	11.7	17.3	47.86%
2035	13.9	20.4	46.76%
2040	16.3	23.9	46.63%

Figures 7.2 to 7.7 further below show the predicted concentrations of CO and PM at three locations along the highway corridor, at specific distances from the highway.

Table 7.10: CO predicted concentrations along the highway for peak traffic hour (Without Project)

Receptor Location	Year	CO concentrations (ppm)														
		Distance from the edge of the road, m. (Left side)							Distance from the edge of the road, m. (Right side)							
		-150	-100	-70	-40	-20	-10	-5	5	10	20	40	70	100	150	
Taiz	2015	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1
	2020	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1
	2025	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2
	2030	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2
	2035	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.2
	2040	0.3	0.3	0.3	0.4	0.5	0.5	0.6	0.6	0.5	0.5	0.4	0.3	0.3	0.3	0.3
Noubat Dokaim	2015	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	
	2020	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	
	2025	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	
	2030	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.2	0.2	0.2	
	2035	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.2	
	2040	0.3	0.3	0.3	0.4	0.5	0.5	0.6	0.6	0.5	0.5	0.4	0.3	0.3	0.3	
Aden	2015	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	
	2020	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	
	2025	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	
	2030	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.4	0.3	0.3	0.2	0.2	0.2	
	2035	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.2	
	2040	0.3	0.3	0.3	0.4	0.5	0.5	0.6	0.6	0.5	0.5	0.4	0.3	0.3	0.3	



Table 7.11: CO predicted concentrations (ppm) along the highway corridor for peak traffic hour (With Project)

Receptor Location	Year	Distance from the edge of the road, m. (Left side)							Distance from the edge of the road, m. (Right side)							
		-150	-100	-70	-40	-20	-10	-5	5	10	20	40	70	100	150	
Taiz	2015	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	
	2020	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.4	0.3	0.3	0.2	0.2	0.2	
	2025	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.2	
	2030	0.3	0.3	0.4	0.4	0.5	0.6	0.6	0.6	0.6	0.5	0.4	0.4	0.3	0.3	
	2035	0.3	0.4	0.4	0.5	0.6	0.7	0.7	0.7	0.8	0.7	0.6	0.5	0.4	0.4	0.3
	2040	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.9	0.9	0.8	0.7	0.6	0.5	0.4	0.4
Noubat Dokaim	2015	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	
	2020	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.4	0.3	0.3	0.2	0.2	0.2	
	2025	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.2	
	2030	0.3	0.3	0.4	0.5	0.5	0.6	0.6	0.6	0.6	0.5	0.4	0.4	0.3	0.3	
	2035	0.3	0.4	0.4	0.5	0.6	0.7	0.8	0.7	0.7	0.6	0.5	0.4	0.4	0.3	
	2040	0.4	0.4	0.5	0.6	0.7	0.8	0.9	0.9	0.8	0.7	0.6	0.5	0.4	0.4	
Aden	2015	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	
	2020	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.2	0.2	0.2	
	2025	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.2	
	2030	0.3	0.3	0.3	0.4	0.5	0.6	0.6	0.6	0.6	0.5	0.4	0.3	0.3	0.3	
	2035	0.3	0.4	0.4	0.5	0.6	0.7	0.7	0.7	0.7	0.6	0.5	0.4	0.4	0.3	
	2040	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.9	0.8	0.7	0.6	0.5	0.4	0.3	

Table 7.12: PM predicted concentrations ($\mu\text{g}/\text{m}^3$) along the highway corridor for peak traffic hour (Without Project)

Receptor Location	Year	PM Concentrations ($\mu\text{g}/\text{m}^3$)													
		Distance from the edge of the road, m. (Left side)							Distance from the edge of the road, m. (Right side)						
		-150	-100	-70	-40	-20	-10	-5	5	10	20	40	70	100	150
Taiz	2015	3.2	3.7	4	4.9	5.5	6.2	6.7	6.8	6.3	5.5	5	4.1	3.8	3.3
	2020	3.8	4.4	4.8	5.9	6.6	7.6	8.1	8.2	7.6	6.6	6	4.9	4.6	3.9
	2025	4.5	5.2	5.7	7	7.8	9	9.7	9.8	9	8	7.1	5.8	5.4	4.6
	2030	5.2	6.2	6.7	8.2	9.2	10.7	11.5	11.7	10.7	9.4	8.4	6.8	6.3	5.4
	2035	6.1	7.2	7.8	9.7	11.1	12.6	13.7	13.9	12.7	11.2	9.9	8	7.4	6.3
	2040	6.9	8.3	9	11.2	12.9	14.7	16.1	16.3	14.8	13	11.4	9.2	8.5	7.1
Noubat Dokaim	2015	3.3	3.8	4.1	5	5.6	6.3	6.8	6.7	6.2	5.4	4.9	4	3.7	3.2
	2020	4	4.6	5	6.1	6.8	7.6	8.3	8.2	7.5	6.6	5.9	4.8	4.5	3.8
	2025	4.6	5.4	5.9	7.2	8.1	9.1	9.8	9.7	9	7.8	7	5.7	5.3	4.5
	2030	5.4	6.4	6.9	8.5	9.6	10.8	11.7	11.6	10.6	9.3	8.2	6.7	6.2	5.3
	2035	6.3	7.5	8.1	10	11.3	12.7	13.9	13.8	12.6	11	9.7	7.9	7.3	6.2
	2040	7.2	8.5	9.3	11.6	13.2	14.9	16.3	16.1	14.7	12.8	11.2	9	8.3	7
Aden	2015	3.2	3.7	4	4.8	5.4	6.2	6.7	6.7	6.3	5.5	4.9	4	3.7	3.2
	2020	3.8	4.4	4.8	5.8	6.6	7.5	8.1	8.1	7.6	6.6	5.9	4.8	4.4	3.8
	2025	4.5	5.2	5.6	6.9	7.8	8.9	9.7	9.7	9	7.8	7	5.7	5.2	4.4
	2030	5.2	6.1	6.6	8.2	9.2	10.6	11.5	11.6	10.7	9.3	8.2	6.6	6.1	5.2
	2035	6.1	7.2	7.8	9.7	10.9	12.6	13.7	13.7	12.7	10.9	9.7	7.8	7.2	6
	2040	6.9	8.2	9	11.2	12.7	14.7	16	16.1	14.8	12.8	11.2	8.9	8.2	6.9

Table 7.13: PM predicted concentrations ($\mu\text{g}/\text{m}^3$) along the highway corridor for peak traffic hour (With Project)

Receptor Location	Year	PM Concentration ($\mu\text{g}/\text{m}^3$)													
		Distance from the edge of the road, m. (Left side)							Distance from the edge of the road, m. (Right side)						
		-150	-100	-70	-40	-20	-10	-5	5	10	20	40	70	100	150
Taiz	2015	3.2	3.7	4	4.9	5.5	6.2	6.7	6.8	6.3	5.5	5	4.1	3.8	3.3
	2020	4.7	5.5	6	7.4	8.3	9.5	10.3	10.4	9.6	8.4	7.5	6.1	5.7	4.9
	2025	6.4	7.6	8.3	10.3	11.7	13.4	14.6	14.8	13.5	11.9	10.5	8.5	7.8	6.6
	2030	7.3	8.7	9.5	11.9	13.7	15.6	17.2	17.3	15.7	13.8	12.1	9.7	8.9	7.5
	2035	8.3	10	10.9	13.8	15.9	18.3	20.2	20.4	18.4	16.1	14	11.1	10.2	8.5
	2040	9.5	11.5	12.5	15.9	18.5	21.3	23.7	23.9	21.4	18.7	16.2	12.8	11.6	9.7
Noubat Dokaim	2015	3.3	3.8	4.1	5	5.6	6.3	6.8	6.7	6.2	5.4	4.9	4	3.7	3.2
	2020	4.9	5.7	6.2	7.6	8.6	9.6	10.4	10.3	9.5	8.3	7.4	6	5.6	4.8
	2025	6.6	7.9	8.5	10.6	12	13.5	14.8	14.6	13.4	11.7	10.3	8.3	7.7	6.5
	2030	7.6	9	9.7	12.2	14	15.8	17.4	17.2	15.6	13.7	11.9	9.5	8.8	7.4
	2035	8.6	10.2	11.2	14.2	16.2	18.4	20.4	20.1	18.2	15.9	13.8	11	10	8.4
	2040	9.8	11.7	12.9	16.4	18.9	21.6	23.9	23.6	21.2	18.6	15.9	12.6	11.4	9.5
Aden	2015	3.2	3.7	4	4.8	5.4	6.2	6.7	6.7	6.3	5.5	4.9	4	3.7	3.2
	2020	4.7	5.5	6	7.3	8.2	9.5	10.2	10.3	9.5	8.3	7.4	6	5.5	4.7
	2025	6.4	7.6	8.2	10.2	11.6	13.4	14.6	14.6	13.4	11.6	10.3	8.2	7.5	6.3
	2030	7.3	8.7	9.5	11.8	13.5	15.6	17.1	17.2	15.7	13.6	11.9	9.4	8.6	7.2
	2035	8.3	9.9	10.9	13.7	15.7	18.2	20.1	20.2	18.3	15.9	13.8	10.8	9.8	8.2
	2040	9.4	11.4	12.5	15.9	18.3	21.2	23.6	23.7	21.3	18.5	15.9	12.4	11.2	9.3

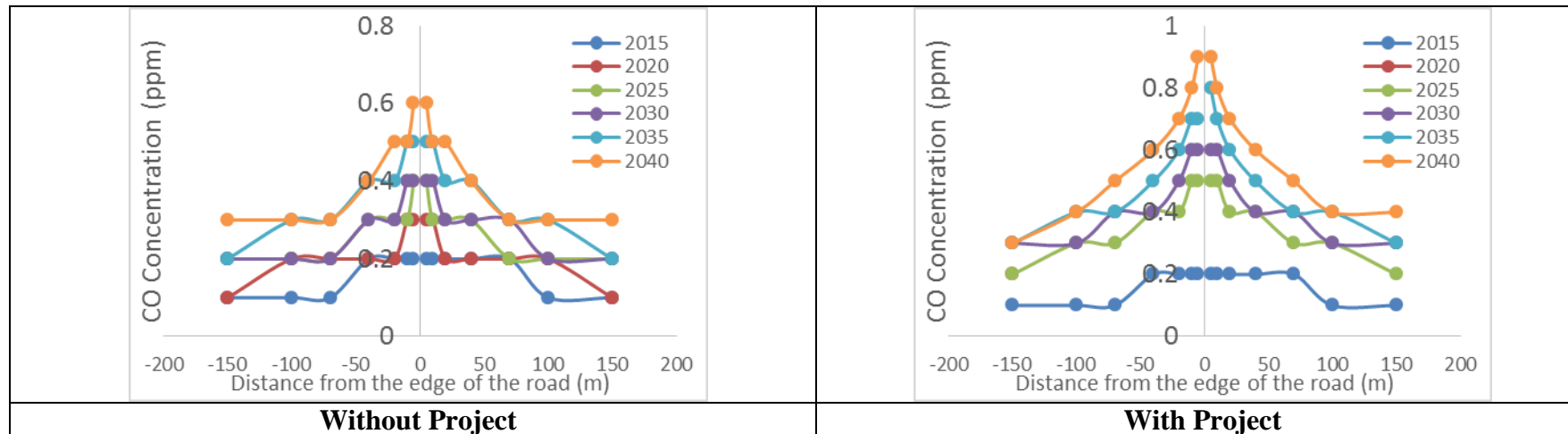


Figure 7.2: CO predicted concentrations (ppm) along the highway corridor receptor location Taiz

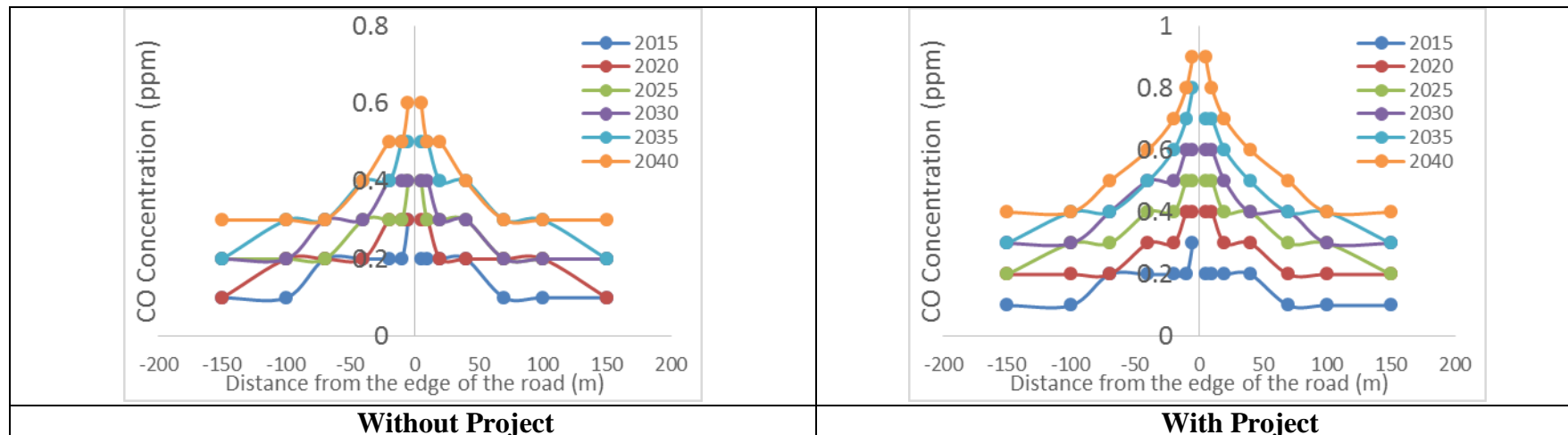


Figure 7.3: CO predicted concentrations (ppm) along the highway corridor receptor location Noubat Dokaim

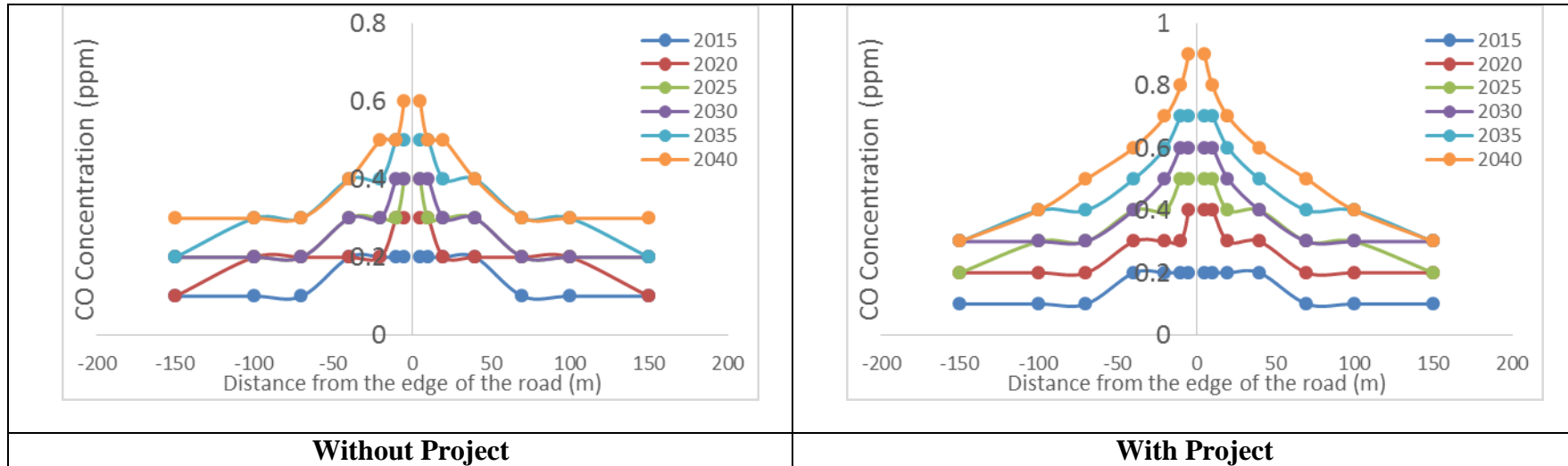


Figure 7.4: CO predicted concentrations (ppm) along the highway corridor receptor location Aden

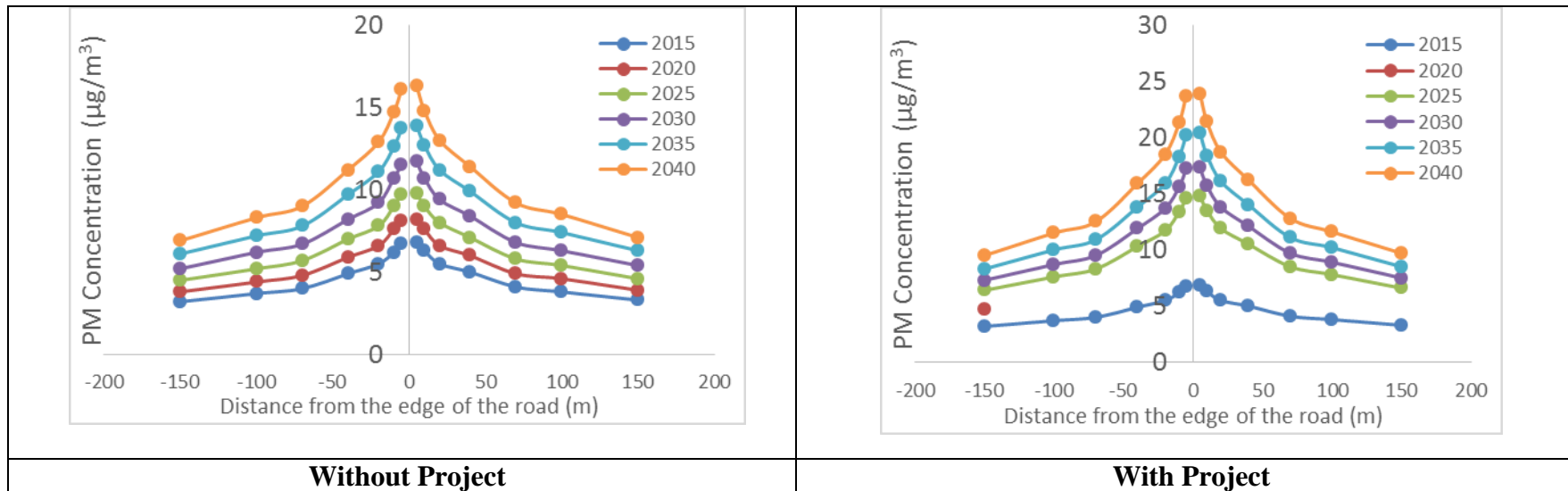


Figure 7.5: PM predicted concentrations (µg/m³) along the highway corridor receptor location Taiz

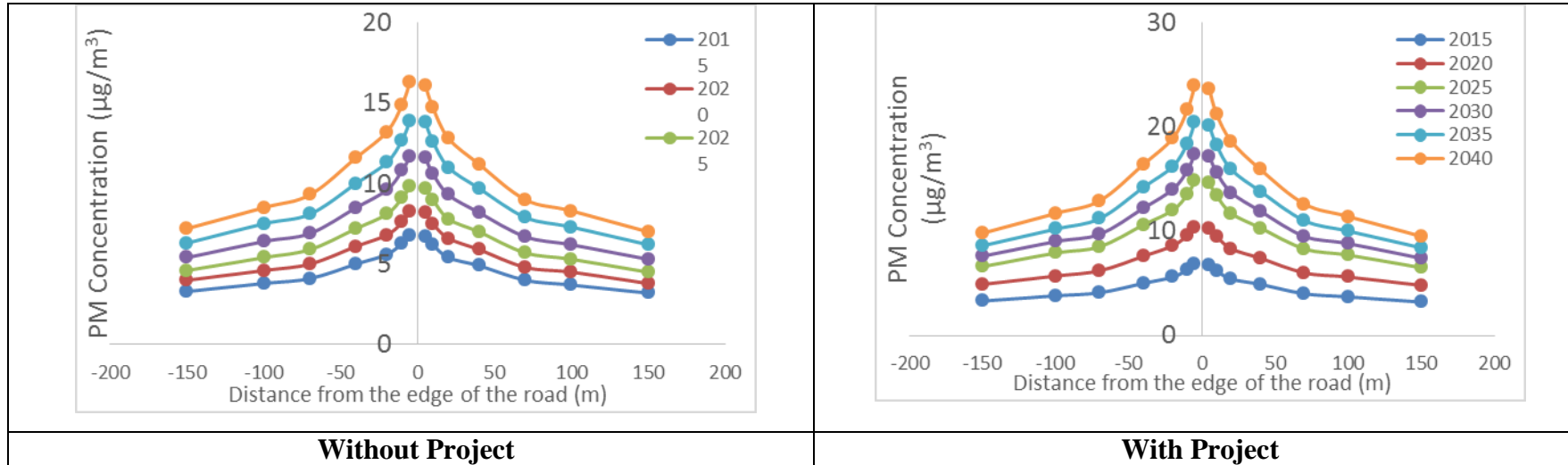


Figure 7.6: PM predicted concentrations ($\mu\text{g}/\text{m}^3$) along the highway corridor receptor location Noubat Dokaim

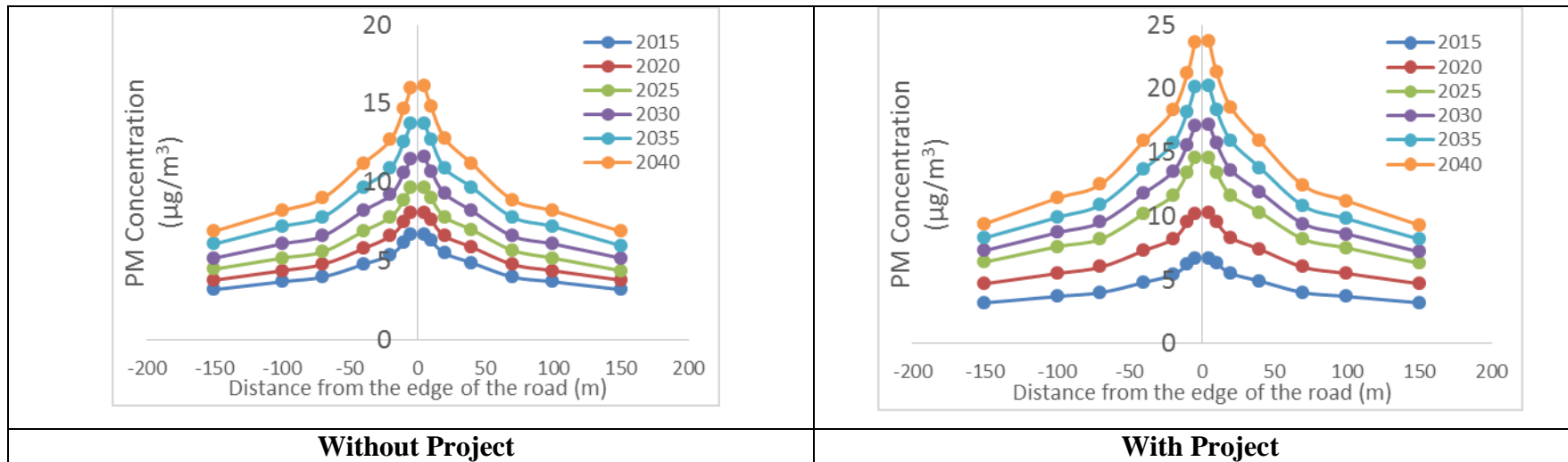


Figure 7.7: PM predicted concentrations ($\mu\text{g}/\text{m}^3$) along the highway corridor receptor location Aden

7.3.5 Air pollution mitigation measures

While the total predicted emission levels under the project are not considered critical, the air pollution mitigation measures shown below are nevertheless to be implemented.

During construction stage:

- Equipment and machinery used for construction will be regularly maintained to minimize the pollution emission levels.
- Regular monitoring of Particulate Matter at crusher sites, during the construction, will be conducted. If established limits are exceeded, water spraying will be used if water is available. Alternatively, screens will be installed in the downwind direction to reduce the spreading of particulate matter beyond the crusher sites.
- Avoiding queuing of the construction traffic vehicle fleet on the roads adjacent to the sites to minimize the exhaust emissions generated during construction work.

During operation stage:

- Roadside plants that will be planted in some areas along the highway with sufficient water will act as pollution sink.
- The reduction of emissions that can be effected by improved engines and quality of fuel are beyond the scope of this project.

7.3.6 Noise and Vibration

Construction stage: During the construction phase there will be the normal, typical and unavoidable noise and vibration generation due to the operation of various types of equipment, and due to rock blasting at certain locations. The typical noise levels (noise level in dB at 50 feet distance) associated with the various types of construction activities and the corresponding construction equipment are presented in **Table 7.14**.

Table 7.14: Noise Levels of Construction Equipment

Clearing		Structure Construction	
Bulldozer	80	Crane	75-77
Front end loader	72-84	Welding generator	71-82
Jack hammer	81-98	Concrete mixer	74-88
Crane with ball	75-87	Concrete pump	81-84
		Concrete vibrator	76
Excavation & Earth Moving		Air compressor	74-87
Bulldozer	80	Pneumatic tools	81-98
Backhoe	72-93	Bulldozer	80
Front end loader	72-84	Cement and dump trucks	83-94
Dump truck	83-94	Front end loader	72-84
Jack hammer	81-98	Dump truck	83-94
Scraper	80-93	Paver	86-88
Grading and Compacting		Landscaping and Clean-Up	

Clearing		Structure Construction	
Grader	80-93	Bulldozer	80
Roller	73-75	Backhoe	72-93
		Truck	83-94
Paving		Front end loader	72-84
Paver	86-88	Dump truck	83-94
Truck	83-94	Paver	86-88
Tamper	74-77	Dump truck	83-94

**Source: U.S. Environmental Protection Agency.*

Operation Stage: - During the operation phase of the project, the typical noise will be generated by the normal traffic on the new highway.

Mitigation measures: Noise impacts can be mitigated by confining the construction and blasting activities to normal working hours in the areas near settlements / villages and by employing modern construction equipment with noise insulation. Specific measures to mitigate noise impacts during the construction phase may include the following provisions:

- **Source Controls** i.e., requirements that all exhaust system will be maintained in good working order; properly designed engine enclosures, and intake silencers will be employed; and regular equipment maintenance will be undertaken.
- **Site Controls** i.e., requirements that stationary equipment will be placed as far away from sensitive receptors as possible (i.e., aggregate crushers, operators, etc.); disposal sites and haul road will be selected to minimize objectionable noise impacts; and shielding mechanisms will be employed where possible.
- **Time and activity constraints** i.e., operations will be scheduled to coincide with periods when people would least likely be affected; work hours and work days will be limited to less noise sensitive times. Particularly there will be no construction activities during Friday noon prayers. Also there will be restricted construction activities during festival seasons.
- **Community Awareness** i.e., public notification of construction operations will incorporate noise considerations; methods to handle complaints will be specified.
 - Workers camp, Construction plant and machinery to be located at least 1000m away from the settlements.
 - To schedule noisy construction operations and their duration in such a way to avoid night-time (11 PM to 7 AM) particularly near the habitations.
 - “No horn” sign boards will be put near all sensitive receptors like schools, hospitals, Mosques madrasa etc.
 - Provision of appropriate signage’s and signals for slowing down near sensitive receptors will help reduce noise.
 - Proper maintenance of vehicles plants and equipment’s will also help in reduction of noise levels.

- Provision of personal protective equipment's like ear plugs to the work force working in noisy environment to protect them from high noise levels for a prolonged period.
- The local people will be informed about blasting (if any) well in advance to avoid any accident.
- The blasting would be done during daytime to minimise disturbance to local people and animals.

Mitigation during operation stage: The design of the highway includes noise barriers at locations where the highway passes within a short distance of settlements/villages or sensible receptors (schools/hospitals/mosques/madrasa).

7.3.7 *Water Environment*

Since water is a scarce resource in Yemen, the protection of these sources will be an important requirement during the execution of the Civil works. Local alteration of water flow and drainage is likely to occur due to the construction of embankments and also due to the disposal of cut/debris material in rolling terrain.

Construction Stage: (i) It is expected that during road construction there will be direct and indirect impacts on water resources. There are small water channels (water crossings) that feed individual agricultural fields, particularly the Qat plantations, or supply of water to mosques or houses etc. Highway construction may obstruct the movement of water through these channels, causing difficulty to the farmers to irrigate their land or have water near their houses. The location of such places is not known with any degree of reliability at the present time. (ii) Degradation of water quality can occur due to an increase in sediment load into watercourses near the construction sites. This may be aggravated by removal of trees/vegetation and consequent increase in soil erosion. (iii) Degradation of water quality is also possible due to accidental discharges into watercourses from drainage of workers' camps and from spillage in vehicle parking and/or fuel and lubricant storage areas.

7.3.8 *Mitigation measures during construction stage:*

- As discussed with local people during public consultation the wells which will be directly affected due to construction will be relocated to suitable places by the contractor after consultation with local people. Until the establishment of replacement wells, water will be made available to the affected people by contractor.
- Restriction of work on construction of bridges and culverts during the rainy season.
- Use of silt fencing, sediment traps etc. for minimization of soil movement.
- Construction of cofferdam with materials that cannot be brought into suspension by flowing waters.
- Provision of cover of tarpaulins or other material under the bridge deck to prevent debris, wastes and toxic compounds from entering the stream.
- Avoidance of lead-based paints in painting bridge components

- Use of oil/water separators at drainage of construction camps to extract floating oils.
- Proper storage of contaminated liquids and disposal after treatment to bring such liquids within prescribed permissible limits.
- Fuelling area for vehicles and equipment's will be selected away from water bodies.
- Adoption of a well-conceived construction material handling protocol e.g. storage away from water sources and provision of retention areas to contain accidental spills of such toxic, hazardous materials.
- Obstruction of any private water channels should be avoided as far as possible by providing small culverts.

Operation stage: (i) The creation of the paved surface of the road will block the natural seepage of rain water into the ground and also create more concentrated runoff water from pavement. There will be a locally confined loss of ground water recharge capacity in the project area. (ii) In case of road accidents there is the possibility spills of fuel on the road may get into water bodies and cause contamination. (iii) There will be the need to supply additional water for the planned service areas which will include toilets, petrol stations, restaurants, mosques etc. The service areas will also generate waste water. Generation of runoff from the petrol pumps at the service areas would also have a harmful effect. (iv) There may be an issue of water source accessibility, as some water wells and other source of water may be on the other side of the highway which could make access by local people difficult or impossible.

7.3.9 Mitigation measures for operation stage:

- Modification of embankment slopes to prevent entry of contaminated water into watercourses.
- Drilling of alternative wells, to replace those wells to which access by local populatins is effectively blocked by the new highway, after consultation with affected local communities.
- Water harvesting will be used as much as possible. Since water harvesting requires detailed knowledge of local micro-conditions, the feasibility of water harvesting at potential locations will be evaluated jointly between MPWH, the supervision engineer and local communities. If feasible, the necessary physical works will be incorporated in the contractor's program of works through change orders.

7.3.10 Landscape and soil

The construction of the new highway will have important impacts on the landscape environment, especially in the hilly areas in Taiz Governorate and to a lesser degree also in Lahj Governorate, where large volumes of cutting will occur to establish the highway platform. According to the Bill of Quantities for the road works, the volume of material to be excavated is 29,126,878 m³. The details of excavation quantities are provided in **Table 7.15**. Most of the materials to be excavated from hills and mountain sides will be re-used for creating the highway embankments, but a relatively

small percentage (estimated at less than 6 %) of unsuitable or unnecessary materials will need to be deposited at sites which are yet to be determined jointly by the contractor, the supervision engineer, MPWH and in consultation with local communities. The deposit of such materials can cause local drainage alterations – with erosion on one side and deposits of the eroded material on the other, if the dumping areas are not properly selected and designed.

Table 7.15: Excavation Quantities

Sr. No	Description	Quantity in m ³
1	Excavate common material except rock in cuttings and side drains	14,629,804
2	Excavate rock material in cuttings and side drains	10,624,196
3	Excavate from approved borrow pits	3,872,878
Total		29,126,878

**Source: Final design Report, Section III, Taiz-Aden, DORSCH Consult, 2005*

According to the engineering design of the highway, the project will require a volume of 27,000,000 m³ of sand and stone from nine borrow locations along or near the planned highway, mostly for the creation of embankments. These borrow locations will be mostly the same locations of the necessary cuts, so the materials which will be cut from those 9 locations will be used almost entirely as fill material in other locations along the highway right-of-way. Stone aggregates will be produced at four locations; these are to be used for producing cement concrete for structures and asphalt concrete for the pavement. All of these locations of borrow areas and stone quarries have been identified and are shown in **Tables 7.16 and 7.17**. The total quantity of borrow materials is 27,000,000 m³ and of aggregates is 7,100,000 m³. Since most of the borrow materials will come from areas which will be cut anyway to create the highway platform, there will only be a limited impact in terms of borrow areas outside the right-of-way of the highway. Only the quarries for aggregates will be located outside the right-of-way of the highway.

Table 7.16: Locations of Borrow Materials

Borrow No	Location	Coordinates	Material Type	Estimated Quantity (m ³)
B1	Ch. 14.900	E 21209, N 1504700,	Alluvium	7,000,000
B2	Ch. 33.000	E 435450, N 1495590,	Alluvium	900,000
B3	Ch. 39.000	E 436500, N 1492210,	Alluvium	1,000,000
B4	Ch. 49.000	E 449183, N 1491029,	Alluvium	900,000
B5	Ch. 76.500	E 4468112, N 1472700,	Alluvium	1,210,000
B6	Ch. 89.000	E 476758, N 14464712,	Alluvium	1,000,000
B7	Ch. 116.500	E 476758, N 14464712,	Alluvium	2,000,000
B8	Ch. 116.500	E 493518, N 1443167	Alluvium	1,100,000
B9	Ch. 125.500	E 501800, N 1439940,	Alluvium	1000,000
Total				27,000,000

**Source: Final design Report, Section III, Taiz-Aden, DORSCH Consult, 2005*

Table 7.17: Locations of Aggregates Materials

Quarry No	Location	Coordinates	Material Type	Estimated Quantity (m3)
Q1	Ch. 71.500	E 464700, N 1476300,	Greenish gray olivine basalt	2,100,000
Q2	Ch. 76.500	E 468900, N 1472930	Greenish gray olivine basalt	3,000,000
Q3	Ch. 83.500	E 473500, N 1468760,	Black basalt	1,000,000
Q4	Ch. 90.000	E 477500, N 1464300	Black basalt	1,000,000
Total				7,100,000

**Source: Final design Report, Section III, Taiz-Aden, DORSCH Consult, 2005*

Soil contamination could occur due to following reasons which may happen during construction and operation phase:

- Maintenance (especially oil change) of machinery and operation of the diesel generator sets on the construction.
- Oil Spills from operation of the mechanical workshops, diesel pumps and diesel storage, during transportation and transfer, parking places, and diesel generator sets.
- Operation of the emulsion sprayer.
- Operation of the residential facilities for the labour and staff.
- Accidental spill of emulsion, oil and other materials.
- Residue of blasting chemicals.

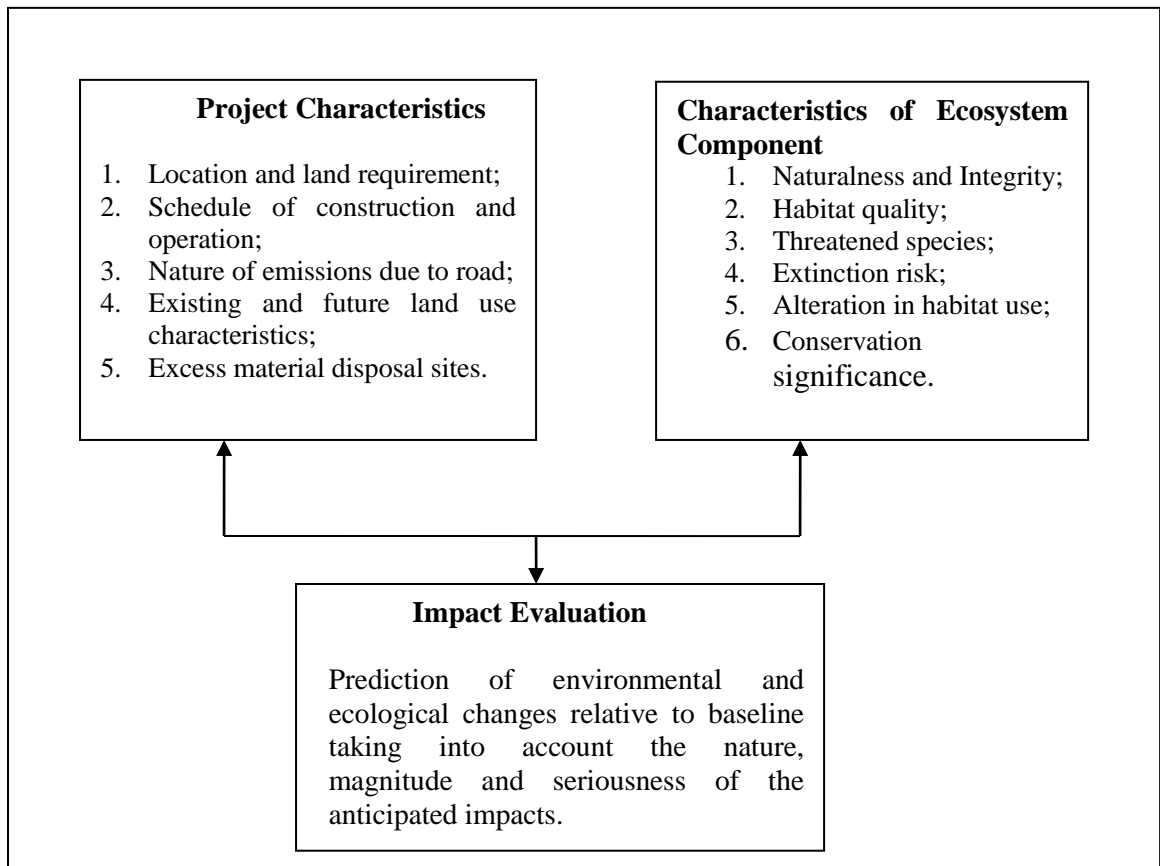
7.3.11 Mitigation measures

- If land at borrow pits and quarries needs to be acquired permanently, it will be compensated as per the entitlement framework given in the RAP.
- The Contractor will identify the disposal locations for surplus materials in consultation with Supervision Consultant, MPWH and local communities in order to minimize the impact on trees and other vegetation and on natural hydrology/drainage systems of the project area.
- After their use, local quarries and borrow areas will be closed, rehabilitated and made safe.
- The land used for temporary construction camps, workshops, labour camps and parking areas will be restored to its original condition as much as possible so that it can be used for the same purpose it had been used earlier.
- Any land used temporarily, such as for construction camps, offices, plants, storage yards, traffic detours, etc. will not be located on fertile land unless unavoidable. If these are to be located on fertile land, the topsoil will be stripped; stored properly and such areas will be restored after completion of work.
- Soil erosion (especially during the rainy season) will be avoided through the available methods, such as retaining structures, erosion fences, etc.

- Wherever the availability of water makes this possible, vegetation will be planted on embankments slopes.
- The road drainage systems will be built to ensure that water runoff from the highway will flow into the road drainage system to prevent any possibility of soil erosion.
- The vegetation that will grow gradually over time on the embankment slopes will help to hold soil in place through their root system. Vegetation will also reduce the share of precipitation reaching the ground through canopy interceptions and evaporation through canopy foliage.
- Movement of construction machinery will be restricted to designated paths which will not pass through agricultural fields in order to avoid compaction and physical disruption of agricultural soil.
- The solid waste generated from the worker camps would be dumped in locally identified areas and these areas will be covered after the camps are dissolved. Alternatively, waste can be deposited in formally established existing waste dumps.
- Burning of solid waste will not be allowed.
- The liquid discharge from the workers camp will be treated in small simple treatment stations at site and the treated discharge shall be discharged so that it favours vegetation growth.
- Maintenance work of the construction machinery will be carried out on pre-designed cemented platforms which will be equipped with oil drains / oil segregators.
- In case of finding of mineralized zones along the road alignment during excavation, it will be brought to the notice of the competent authority of Governorate.
- Appropriate blasting technique will be used which will consider safety, blast geometry, free faces, burden, spacing, initiation pattern and angled holes.

7.4 Ecological Impacts

The process of prediction of ecological impacts was based on the approach of relating sources of stress to ecological receptors identified in the project area. The key project parameters and the ecosystem components considered in the ecological impact assessment are presented in the following box.



7.4.1 Impacts on Flora

- The construction of the highway will have a direct impact on approximately 21,025 trees which will have to be cut in the Right-of-Way of the new highway. Of that total number, about 2,146 trees are fruit bearing trees like mango, pomegranate, orange and guava etc. and 18,879 trees are non-fruit bearing like Athl, Alab, and Amrud and Adelbert etc.
- There will be loss of approximately 412,050 Qat plants. Although, Qat is small plant; still it is a major source of income for the local inhabitants.
- There will be loss of bushes and vegetation which will be cleared during the road construction.
- There will be indirect impact on trees due to deposition of dust on leaves of trees. The dust deposition on leaves will reduce the photosynthesis activity of the trees. However this impact will be short term during the construction phase of the project.
- Some trees and vegetation will be removed to clear the land for construction camps, workers camps and other associated activities.

- The excavation of material may lead to changes in the soil profile, hydrology, and topography and nutrients status of the substrate. These induced impacts could be irreversible in nature.

7.4.2 Impacts on Fauna

- The loss of trees in the project area will affect the natural habitat of some wild animals in the project area.
- There are wild animals like wild cat, jackal, hyena, common mongoose and fox in the project area. During the construction phase of the project these animals will migrate to some other places due to direct impact on their habitation.
- There will be loss of food and water resources for these animals due to land acquisition and tree cutting in the project area.
- The construction activities and operation of the highway will create noise and disturbance in the natural habitats of animals and affect their living conditions.
- There are nests of birds on the trees in the project area. The cutting of trees will directly affect the habitation of these birds (like common sparrow).
- Even if there will not be any direct impact on the habitat of birds, they could still be affected indirectly due to air and noise pollution during construction and operation phase of the project.

7.4.3 Mitigation Measures

- As much as possible and depending on the local conditions (availability of water and soil), plantation of roadside vegetation will be carried out along the highway embankment and in the highway median.
- The location of construction camps, stone crushing unit, asphalt mixing plant and waste disposal sites will be chosen so that they are at a distance of at least 2000 m away from areas with known concentrations of plants or wildlife.
- While there is no vulnerable or endangered flora in the project area, the Greater Spotted Eagle and Asian Imperial Eagle which are seen in the mountainous parts of the project area are under the “vulnerable” category. If any of these eagle species will be observed in the project area the same will be informed to the concerned department.

7.4.4 Aden Bird Wetland

The Highway construction will not have any significant impact on the Aden Bird Wetland because the closest point of the planned highway is more than eight (8) km away from the wetland. There are many land reclamation activities going on in the wetland (not related to the corridor highway project) which are affecting the

natural integrity of the wetland. Nevertheless, it will be ensured that any construction or labor camp for the highway construction is located at least 1 km away from the boundary of the Aden Bird Wetland. Also the contractor will ensure that there is no dumping of any material or waste material in the wetland.

7.5 Social impacts during construction and pre-construction phase

7.5.1 Introduction

Since the proposed highway corridor is a greenfield project, it is certain that a large volume of irreversible conversion of land use will occur within the right-of-way (ROW) of the new highway. This will occur prior to construction, when the Government will need to acquire the land needed to establish the ROW and to hand it over to the contractors. Most of the important land use changes are expected to occur on agricultural land (including Qat plantations) and pasture/grazing land. Smaller in volume, but very important for the population is the acquisition of land used for residential, commercial and cultural purposes, as well as water wells and water pools. Large in volume, but less important in terms of negative impact is the change from barren land (desert) or other unused land to highway corridor Right-of-Way.

The main negative impacts expected due to land acquisition during the pre-construction phase are:

- loss of agricultural land and the resulting loss of agricultural production and in turn of livelihood for farmers;
- loss of land used for residential purposes, which is often combined with the demolition of residential structures and the resulting loss of living space for people;
- loss of land used for commercial purposes, which is often combined with the demolition of commercial structures such as shops, etc. and the resulting loss of income from commercial activities;
- loss of water wells, leading to a loss of access to water resources;
- loss of mosques and graves which are cultural resources.

7.6 Social impacts

This section reviews and analyzes primarily the land acquisition and other resettlement impacts that are likely to be caused by the YCHP. Other potential impacts are described at the end of this chapter. Since the exact alignment of the Corridor Highway is well known and defined, the likelihood of design changes during project execution is very low. The only exception is the planned redesign of one interchange near Noubat Dokaim with the objective to reduce the scope of needed demolitions. The well-defined highway alignment means that the surveys carried out were able to reliably estimate the scale of land acquisition and of other impacts. In the unlikely case of changes in the amounts of land and other assets to be affected, the compensation and other assistance included in this ESIA are to be provided even if the scale of impacts exceeds these estimates.

This section also identifies critical areas, types of settlements and the magnitude of impacts on various categories of land (e.g., agricultural, pasture, residential, commercial, communal or public), community resources and public infrastructure, and religious properties (e.g., graves and mosques) that fall within the proposed highway corridor. Through careful project design and application of engineering design techniques, efforts have been taken to minimize land acquisition, household relocation, and other resettlement impacts. The data provided in this chapter is derived from a census survey and complete asset inventory for the proposed highway corridor that was conducted in late 2013 within a right-of-way (ROW) of 50-70 meters width, as established by MPWH.

The scope of land acquisition and resettlement impacts for the Corridor Highway is shown below and in more detail also in the RAP.

7.6.1 *Estimate of overall permanent land acquisition and resettlement impacts*

A detailed survey and assessment of overall permanent land acquisition and resettlement impacts has been carried out for the project. Three survey teams comprised of surveyors with appropriate social survey skills and local language capability were deployed in the field during December 2013. The teams consisted of 5-6 persons and each team was headed by a senior sociologist to provide guidance and resolve process questions that might arise during the survey. The census of project affected persons (PAPs) within the proposed RoW was carried out through use of a structured questionnaire, supplemented with open-ended discussion. The census survey covered 100% of the households affected and took records of 100% of the inventory of assets affected by the road RoW in the project area. The results of the inventory have been confirmed by each affected household. The key purposes of the census survey was to identify and enumerate affected people, create an inventory of affected land and other assets, and to establish key data for many other aspects of resettlement planning (e.g., budgeting, establishing modes of assistance, monitoring, and others).

In addition, a socio-economic baseline survey of the PAPs, based on a 25 percent random sample of affected households, was also carried out. The objectives for conducting the socio-economic survey were to assess household livelihood sources and income levels, to obtain information from households regarding their relocation preferences, to identify households that may face particular vulnerabilities because of the project, and to provide information useful to preparing mitigation and support measures. The results of the household socio-economic survey are considered in greater detail in Chapter 4.

According to census survey results, a total of 2,685 households are likely to be affected by land acquisition. Among them, 308 households are tenants. In total 31,695 persons will be affected. These households earn their livelihood primarily through agriculture, Qat cultivation, wage labour and through small businesses. A total of 1,223.8 hectares of land is to be acquired permanently for the project. Of the three governorates involved in the project, land acquisition will be disproportionately heavy in Lahj Governorate (909.6 ha.), significant in Taiz Governorate (277.9 ha.), and relatively minor in Aden Governorate (37.3 ha). The impact of land acquisition on

livelihoods is likely to be significant in many cases. Of the 2,159 individual plots involved in land acquisition, 1,318 are to be acquired in their entirety (100%) while the remaining 841 plots are to be acquired in part.

In addition to land acquisition, YCHP will require substantial demolition of structures and relocation of residents. In all, 169 households (or 2,789 people) will be required to relocate. Among the governorates, Taiz will require the greatest relocation (2,546 people), compared to 233 in Lahj and 10 people in Aden. A summary of permanent land acquisition and resettlement impacts is presented in **Table 7.18**.

Table 7.18: Summary of land acquisition and resettlement impacts

Magnitude of Social Impacts	Area (hectare)	
Permanent affected agricultural land	161.0	
Permanent affected residential land	11.03	
Permanent affected commercial land	21.04	
Permanent affected Utility land	223.83	
Permanent affected pasture land	696.18	
Permanent affected arid land	107.95	
Permanent affected religious land	3.77	
No. of affected residential owners	169 (nos.)	
No. of affected commercial (shops) owners	61 (nos.)	
No. of affected well owners	22 (nos.)	
No. of affected agriculture land owners	1,630 (nos.)	
Project affected households (PAHs), among	2,685 (nos.)	
	Land owners	2,377
	Tenants	308
Project affected persons (PAPs)	31,695 (nos.)	
Income sources	Agriculture, Qat plantation, small shops and agriculture labour	

**Source: Census survey, December 2013.*

The permanent land to be acquired includes all land needed for the right of way, servicing areas, rest stops, access roads, overpasses (bridges), underpasses and culverts.

The project will involve temporary land use for construction camps and temporary storage of construction materials and equipment. The land survey did not cover the impacts of temporary land use because the location of construction camps etc. will be selected by the civil works contractors in consultation with local councils at the beginning of project implementation. In most cases, public land will be selected for the construction camps and storage of temporary construction materials. In case private land is needed, it will be obtained through mutual agreement between contractors and landowners.

7.6.2 *Estimated land acquisition by category*

From the census survey carried out in December 2013, it is observed that as many as 1,224.80 hectares of land will be required for the project, belonging to private owners

(485.91 ha), communities (299.58 ha) and the State (439.31 ha. of public land). The land acquisition needs by Governorate are summarized in **Table 7.19**.

Table 7.19: Estimated Land Acquisition by Category and Governorate/District

Governorate	District	Total expropriated land (ha)	Public land (ha)	Communal land (ha)	Private land (ha)
Aden	Daar Sad	37.37	37.37	0.00	0.00
Lahj	Almosaimer	291.69	55.45	137.22	99.02
	Tuban	617.88	346.50	158.28	113.10
Sub-Total Lahj		909.57	401.95	295.50	212.12
Taiz	Al Taiziah	50.04	0.00	0.86	49.18
	Mawiya	227.83	0.00	3.22	224.60
Sub-Total Taiz		277.87	0.00	4.08	273.78
Total		1224.80	439.31	299.58	485.91

**Source: Census survey, December 2013.*

The census survey also determined that a total of 2,159 land plots will need to be acquired. A majority of them are likely to be wholly affected (100% to be acquired) by permanent land acquisition for YCHP. The details of land to be taken and a breakdown by category of affected land plots, by type of land, ownership and governorate, is provided in **Table 7.20**. Concerning commercial land, about 80 percent of such land to be acquired of commercial structures to be demolished are located at one single location, namely near Noubat Dokaim where the original engineering design of 2004 foresees a very large multi-road interchange. At that time, land use at that location was different and most of the now existing commercial structures were built after 2004. MPWH plans to move the location of the planned interchange by about 300 meters so that it will mostly be located on public land. This will avoid about 70% of the high cost of acquiring commercial land and demolishing commercial structures at that location (Noubat Dokaim). The total quantities in those lines are therefore estimated to be 44% of the original quantities.

Table 7.20: Breakdown of Affected Land Plots by Category

Governorate	Land Acquisition						
	Land Acquired (ha)	Private Land	No. of Plots	Communal Land	No. of Plots	Public Land	No. of Plots
Taiz	277.87	Residential	84	Residential	0	Residential	0
		Agricultural	1005	Agricultural	0	Agricultural	0
		Commercial	7	Commercial	0	Commercial	0
		Pasture land	0	Pasture land	0	Pasture land	0
		Arid land	12	Arid land	0	Arid land	0
		Religious	3	Religious	10	Religious	0
		Utility land	158	Utility land	8	Utility land	0
		Total	1269	Total	18	Total	0
Lahj	909.57	Residential	64	Residential	0	Residential	3
		Agricultural	324	Agricultural	0	Agricultural	0
		Commercial	55	Commercial	2	Commercial	6

Governorate	Land Acquisition						
	Land Acquired (ha)	Private Land	No. of Plots	Communal Land	No. of Plots	Public Land	No. of Plots
		Pasture land	81	Pasture land	71	Pasture land	33
		Arid land	104	Arid land	8	Arid land	2
		Religious	1	Religious	3	Religious	1
		Utility land	13	Utility land	21	Utility land	38
		Total	642	Total	105	Total	83
Aden	37.37	Residential	0	Residential	0	Residential	6
		Agricultural	0	Agricultural	0	Agricultural	13
		Commercial	0	Commercial	0	Commercial	1
		Pasture land	0	Pasture land	0	Pasture land	0
		Arid land	0	Arid land	0	Arid land	17
		Religious	0	Religious	0	Religious	0
		Utility land	0	Utility land	0	Utility land	5
		Total	0	Total	0	Total	42
Grand Total	1224.81	-	1911	-	123	-	125

The current use of the land to be acquired, by Governorate, is shown in **Table 7.21**.

Table 7.21: Current use of land to be acquired

Governorate	District	Total expropriated land	Agricultural land	Pasture	Residential	Commercial	Arid Land	Religious	Utility
Aden	Daar Sad	37.37	2.47	0.00	4.45	0.00	12.41	0.00	18.04
Lahj	Almosaimer	291.63	24.75	240.17	0.19	15.43	2.07	0.00	9.02
	Tuban	617.94	15.33	456.01	4.22	5.39	78.35	0.38	58.27
Sub-Total Lahj		909.57	40.07	696.18	4.41	20.81	80.42	0.38	67.29
Taiz	Al Taiziah	50.04	23.98	0.00	1.19	0.06	13.98	0.32	10.52
	Mawiyah	227.83	94.48	0.00	0.98	0.17	1.14	3.07	127.98
Sub-Total Taiz		277.87	118.46	0.00	2.17	0.23	15.12	3.39	138.50
Total		1224.81	161.00	696.18	11.03	21.04	107.95	3.77	223.83

*Source: Census survey, December 2013.

7.6.3 Number of plots expropriated and people affected

It has emerged from the census survey close to about 31,700 people are likely to be affected by the acquisition of the 2,159 land plots which are needed for the new highway. Detailed data, by Governorate, is presented in **Table 7.22**.

Table 7.22: Number of plots to be expropriated and No. of people affected

Governorate	District	No. of plot	Number of plots totally expropriated	Number of plots partially expropriated	Expropriated areas (ha)	Number of landowner households affected	Number of people affected	Number of tenant Households
Aden	Daar Sad	42	8	34	37.40	0	44	5
Lahj	Almosaimer	395	236	159	291.70	534	2699	51
	Tuban	435	213	222	617.94	202	959	7
Sub-Total Lahj		830	449	381	909.64	736	3658	58
Taiz	Al Taiziah	214	132	82	50.04	351	6272	0
	Mawiya	1073	729	344	226.80	1290	21721	245
Sub-Total Taiz		1287	861	426	276.83	1641	27993	245
Total		2159	1318	841	1223.88	2377	31695	308

*Source: Census survey, December 2013.

7.6.4 Estimated overall residential structures to be demolished

According to the results of the December 2013 census survey, a total of 170 residential structures are to be demolished, of which 127 residential structures are located in Taiz Governorate and 42 in Lahj Governorate. Only very minor residential demolition is to occur in Aden Governorate. **Table 7.23** provides details regarding demolition of residential structures under the YCHP.

Table 7.23: Estimated demolition of residential structures by Governorate

Governorate	District	Residential area (Sq.m)				Number of households
		concrete	Brick	Mud	Stone	
Aden	Daar Sad	142.00	367.20	0.00	0.00	1
Sub-Total Aden		142.00	367.20	0.00	0.00	1
Lahj	Almosaimer	0.00	377.67	0.00	64.20	22
	Tuban	651.00	2378.02	19.00	101.00	20
Sub-Total Lahj		651.00	2755.69	19.00	165.20	42
Taiz	Al Taiziah	0.00	1107.51	0.00	1359.53	61
	Mawiya	0.00	1561.00	0.00	2517.00	66
Sub-Total Taiz		0.00	2668.51	0.00	3876.53	127
Total		793.00	5791.40	19.00	4041.73	170

*Source: Census survey, December 2013.

7.6.5 Estimate of commercial structures to be demolished

There are 61 shops or other commercial structures that will be demolished due to the project. The great majority of impacts on such businesses will occur in Lahj Governorate, where 43 commercial structures will be demolished. However, as indicated earlier, most of these are at one single location near Noubat Dokaim where a large interchange is to be constructed. MPWH plans to redesign the interchange so that most of the demolitions of commercial structures may be avoided. 17 commercial structures will be demolished in Taiz Governorate, and one will be demolished in Aden. **Table 7.24** provides details regarding demolition of commercial structures in YCHP.

Table 7.24: Estimated commercial structures demolition

Governorate	District	Commercial area (Sq.m)				Number of owner
		concrete	Brick	mud	Stone	
Aden	Daar Sad	0.00	50.00	0.00	0.00	1
Sub-Total Aden		0.00	50.00	0.00	0.00	1
Lahj	Almosaimer	0.00	0.00	0.00	258.44	11
	Tuban	7884.33	5055.07		956.00	32
Sub-Total Lahj		7884.33	5055.07	0.00	1214.44	43
Taiz	Al Taiziah	0.00	0.00	0.00	61.00	1
	Mawiyah	0.00	176.50	0.00	132.30	16
Sub-Total Taiz		0.00	176.50	0.00	193.30	17
Total		7884.33	5281.57	0.00	1407.74	60

**Source: Census survey, December 2013.*

7.6.6 Impact on Agricultural Land and Livelihoods

Much of the area along the 140 km YCHP highway alignment is presently used for agricultural purposes. In all, YCHP will acquire 161 hectares of agriculture land, plus 696.18 hectares of pasture area. The majority of agriculture land acquisition will take place in Taiz Governorate (118.46 ha) followed by Lahj (40.07 ha). Only 2.47 ha of agricultural land will be acquired in Aden Governorate. All of the pasture land to be acquired is located in Lahj Governorate, according to census survey results.

In particular, among 2,159 plots of land, there are 1,329 plots of private agricultural land, of which 721 plots (54%) will be wholly acquired (by 100%). As local people mainly rely on agriculture as their source of income and livelihoods, the impacts are significant. The distribution of private land acquisition by plot in different governorates is presented in **Table 7.25**.

Table 7.25: Private Agricultural Land Plots to be acquired

	Total private agricultural plots affected	Number of plot to be wholly acquired (100%)
Aden	0	0
Lahj	324	124
Taiz	1005	579
Total	1329	721

**Source: Census survey, December 2013.*

The proposed highway corridor passes through the Governorates of Taiz, Lahj and Aden. A majority of agricultural land to be acquired is planted with crops such as corn (82.21 ha) followed by clover 13.36 ha, wheat (6.33 ha), sorghum (4.44 ha) and henna (0.47 ha). A detailed breakdown affected crops by governorate is provided in **Table 7.26**. However, in line with usual practice, MPWH will notify farmers to harvest any planted crops and will give them sufficient time to do so. Therefore, standing crops are therefore not likely to be affected.

Table 7.26: Types of crops to be affected, by governorate

Governorate	District	Total Agricultural land (ha)	Type of crops					
			Corn	Wheat	Clover	Henna	Sorghum	Cotton
Aden	Daar Sad	2.47	-	-	0.42	-	-	-
Sub-Total Aden		2.47	-	-	0.42	-	-	-
Lahj	Almosaimer	24.75	11.30	6.33	0.73	-	-	-
	Tuban	15.33	0.35		11.96	-	-	0.99
Sub-Total Lahj		40.07	11.65	6.33	12.69	0.00	0.00	0.99
Taiz	Al Taiziah	23.98	16.58	-	-		-	-
	Mawiyah	94.48	53.97	-	0.26	0.47	4.44	-
Sub-Total Taiz		118.46	70.56	0.00	0.26	0.47	4.44	0.00
Total		161.00	82.21	6.33	13.36	0.47	4.44	0.99

*Source: Census survey, December 2013.

The field survey has also revealed that as many 433,075 trees/plants are likely to be cut due to the construction of the proposed highway. These include as many as 412,050 Qat plants, 794 bananas, 522 mangos, 187 papayas, 169 guavas, 50 lemon and other 18,879 trees of other types. A breakdown of number and type of affected trees is provided in the following **Table 7.27**. Concerning the Qat plants, which are actually classified as trees, given their small size and other characteristics, they can usually be removed with their roots and replanted elsewhere. Based on experience in Yemen, it can be assumed that the owners of about 70% of the Qat trees will prefer to relocate their trees since they have suitable land available nearby, while in 30% of the cases the trees will be cut and destroyed.

Table 7.27: Number and types of trees to be affected

Governorate	District	Number of trees													
		Orange	Qat	Palm	Other Trees	Mango	Guava	Papaya	Banana	Apple	Apricot	Figs	Lemon	Pomegranate	Pepper
Aden	Daar Sad	0	0	0	0	0									
Sub-Total Aden		0	0	0	0	0									
Lahj	Almosaimer		22013	3	6795	145	87	10	450			28	13	3	
	Tuban				956	17		175	220		2	30	37		

Governorate	District	Number of trees													
		Orange	Qat	Palm	Other Trees	Mango	Guava	Papaya	Banana	Apple	Apricot	Figs	Lemon	Pomegranate	Pepper
Sub-Total Lahj	30984	0	22013	3	7751	162	87	185	670	0	2	58	50	3	0
Taiz	Al Taiziah	0	3453	1	2471	2	16		2	2				21	280
	Mawiyah	8	386584	10	8657	358	66	2	122			5		7	24
Sub-Total Taiz	402091	8	390037	11	11128	360	82	2	124	2	0	5	0	28	304
Total	433075	8	412050	14	18879	522	169	187	794	2	2	63	50	31	304

*Source: Census survey, December 2013.

7.6.7 Estimated impact on other land attachment assets

There are some other types of land attachment assets which are likely to be affected due to the proposed highway corridor project. It involves 22 water wells, 2 water pools, 38 fences, 16 guard rooms, 10 graves, 8 mosques and one barn. The details as are presented in **Table 7.28**

Table 7.28: Impact on infrastructure and services

Governorate	District	Other land attachment assets						
		Graves	Well	Fence	Water Pool	Barn	Guard Room	Mosques
Aden	Daar Sad	0	1	-	-	-	-	
Sub-Total Aden		0	1	-	-	-	-	
Lahj	Almosaimer	1	2	31	-	-	-	
	Tuban	2	3		1	1	-	2
Sub-Total Lahj		3	5	31	1	1	0	2
Taiz	Al Taiziah	2	1	6		-	3	1
	Mawiyah	5	15	1	1	-	13	5
Sub-Total Taiz		7	16	7	1	0	16	6
Total		10	22	38	2	1	16	8

*Source: Census survey, December 2013.

7.6.8 Introduction and definition of project affected persons

This section reviews and analyses available information regarding the people who will be affected by the YCHP. The information is derived largely from the December 2013 census survey undertaken to identify and enumerate Project-Affected Persons (PAPs) and the land and other assets they will lose as a result of YCHP. Information also is derived from a separate socioeconomic survey undertaken on a 25% sample basis among affected households, to obtain supplementary information regarding their

present livelihoods and living conditions. Further information was obtained through other direct consultations with PAPs.

YCHP adopts a definition of Project-Affected Persons consistent with that provided in World Bank OP 4.12, Involuntary Resettlement. Accordingly, *Project-Affected Persons* refers to all the people who, as a direct result of activities of the project, would have their (i) standard of living adversely affected ; or (ii) right, title, interest in any house, land (including premises, agricultural and grazing land) or any other fixed or movable asset acquired or possessed temporarily or permanently; (iii) access to productive assets adversely affected, temporarily or permanently; or (iv) business, occupation, work or place of residence or habitat adversely affected.

For YCHP, *Project-Displaced Persons* are those who will have to change their place of residence or place of business, as a direct result of project activities.

7.6.9 Significance of land acquisition for agriculture livelihoods and commercial enterprises

The Census inventory survey was carried out through door-to-door survey which has revealed that a majority of households (1,630) are likely to be affected due to the acquisition of agricultural land which will affect their livelihoods. This is because the proposed highway corridor alignment traverses in part through open and rich fertile agriculture land. The affected farming land is used for production of Qat, tomatoes, hot pepper, onion, okra, gourd, banana, papaya, mango, guava, palm and fodder etc. at most of the locations. Apart from agriculture, 61 households are engaged in commercial activities for their livelihoods, many in small village shops. A detailed breakdown of land acquisition per Governorate of agricultural and commercial land is provided in **Table 7.29**.

Table 7.29: Households affected through acquisition of agricultural land and shops

Governorate	Number of Agricultural Land Owners	Number of Commercial Land Owners	Total
Taiz	1290	17	1307
Lahj	340	43	383
Aden	0	1	1
Total	1630	61	1691

**Source: Census survey, December 2013.*

The affected shops in the villages are very small, with only 1-2 persons working in each shop. The total number of persons working in affected commercial establishments is 82. However, as indicated earlier, the planned redesign of the large interchange near Noubat Dokaim will very significantly reduce the number of affected persons and commercial land plots.

In addition, the project will affect 308 tenants' households. They are relatively poor. The majority of them are considered as vulnerable, which will be discussed in later sections.

7.6.10 Persons affected by land acquisition

It has emerged from the census survey that as many as 31,695 persons (of which 19,974 are male and 15,721 female) will potentially be impacted or will suffer socio-economic losses as a result of project activities due to land acquisition for the project. A detailed breakdown of male/female PAPs is summarized in the following **Table 7.30**.

Table 7.30: Persons affected by land acquisition, by gender

Governorate	PAPs Affected by Land Acquisition		Total
	Male PAPs	Female PAPs	
Taiz	14108	13885	27993
Lahj	1844	1814	3658
Aden	22	22	44
Total	15974	15721	31695

**Source: Census survey, December 2013.*

7.6.11 Persons affected by demolition of houses

As many as 2,789 persons (of which 1,405 are male and 1,384 female) will be potentially impacted through residential assets losses as a result of the project. A detailed breakdown of male/female PAPs affected by demolition of houses is summarized in **Table 7.31**.

Table 7.31: Persons affected by demolition of housing, by gender

Governorate	PAPs Affected by demolition of housing		Total
	Male	Female	
Taiz	1283	1263	2546
Lahj	117	116	233
Aden	5	5	10
Total	1405	1384	2789

**Source: Census survey, December 2013.*

7.6.12 Persons affected by demolition of commercial structures

As many as 463 persons (of which 231 are male and 232 female) will be potentially impacted/suffer losses due to demolition of commercial assets as a result of project implementation. Among them, 82 persons work in these commercial establishments. A detailed breakdown of male/female PAPs affected by demolition of business structures is summarized in **Table 7.32**. As indicated earlier, the planned redesign of the large interchange near Noubat Dokaim will very significantly reduce the number of affected persons.

Table 7.32: Persons affected by demolition of Businesses Structures, by gender

Governorate	PAPs Businesses affected by demolition of Structures		Total
	Male	Female	
Taiz	130	135	265
Lahj	95	93	188
Aden	6	4	10
Total	231	232	463

**Source: Census survey, December 2013.*

7.6.13 Estimation and analysis of total affected persons

As many as 31,728 persons are likely to be affected due to the construction of the proposed highway in terms of impact on their business, housing, farm land, infrastructure etc. The majority of PAPs is likely to be affected due to loss of land only (89.7%) followed by a combination of loss of land and housing (8.8%) and loss of land and business premises (1.5%). The findings of the census survey are summarized in the following **Table 7.33**.

Table 7.33: Total Affected Persons, by type of loss

Governorate	PAPs			Total
	Land loss only	Land/Housing loss	Land/Business premises loss	
Taiz	25182	2546	265	27993
Lahj	3237	233	188	3658
Aden	24	10	10	44
Total	28443	2789	463	31695
Percentage	89.7	8.8	1.5	100

**Source: Census survey, December 2013.*

7.6.14 Definition and estimate of affected persons from vulnerable groups

MPWH defines “vulnerable households” as those households that may have special needs and are affected by the project in a way that is different from most of the other households. They may belong to such segments of the population such as self-supporting women and elderly people.

As per the World Bank definition, a vulnerable group is a population that has some specific characteristics that put it at higher risk of falling into poverty than others living in the areas affected by a project. Vulnerable groups often include the elderly, the mentally and physically disabled, at-risk children and youth, ex-combatants, internally displaced people and returning refugees, HIV/AIDS affected individuals and households, religious and ethnic minorities and women.

Given the nature of this specific project and in line with the World Bank definition, it was found that landless tenant farmers who lose access to the land they are working on can be considered as a group of vulnerable people. All of the 308 tenant households identified in the survey are landless farmers. Of those, 62 households are engaging in commercial Qat cultivation and other types of business. The other 246 households are engaging in other agricultural activities. These landless tenant farmers are at a higher risk of falling into poverty than other groups living in the area and are therefore considered as vulnerable people who may need special assistance and livelihood restoration. There is also the group of households that lose a large share of their land, so that the remaining land may be insufficient to generate enough income. This group could in principle also be considered as vulnerable, although many households in this group may upon closer review not be especially vulnerable due to other income sources.

7.6.15 Other potential social impacts

Besides the social impacts related to land acquisition and resettlement, the project may have other social impacts. These are described below.

Despite the depressed business activities in Aden during the recent years, the city of Aden is nevertheless relatively prosperous compared to many other areas of Yemen. The highway section between Aden and Taiz which is to be built under the proposed project would expand the relatively prosperous Aden's market into hinterland areas and improve access to supply chains for Lahj and Taiz Governorates which are marked by far deeper poverty. Lahj Governorate is among the five poorest governorates in Yemen, with about half its population classified as poor according to estimates from the Yemen Household Budget Survey (HBS) of 2005-06. Poverty in Taiz, one of the most populous governorates in Yemen, was estimated to be higher than the national average as well; the 2005-06 estimates put poverty in Taiz at 37.8 percent, 3 percentage points higher than the national average). Both Lahj and Taiz have sizable rural populations, facing twice as high poverty as their urban counterparts. Very importantly, about a fifth of all the poor in Yemen are estimated to live in the three Governorates of Aden, Lahj and Taiz. Moreover, an estimated 18.4 percent of Yemen's bottom 40 percent of the population (ranked in terms of per capita consumption) resides in these three governorates.

The new highway section is expected to promote shared prosperity in the following ways.

- In the short term, the construction itself of the road will bring important short-term benefits through job opportunities for thousands of workers, unskilled and skilled, including those who have been repatriated from Saudi Arabia and Gulf states in the recent past. First, during the construction period a large number of skilled and unskilled workers will be employed by private contractors, resulting in important income generation (about 1.28 million person-days of unskilled work alone during the 3 to 4 years of project execution, at a rate of about US\$ 18 per day). Unskilled workers, which in economic terms are part of the bottom 40% of the population, will typically be recruited from the area of the physical works, resulting in direct income generation for this group in the area of the road. Second, the construction would also bring large-scale business opportunities for many Yemeni firms who will be involved in the construction activities, as contractors, sub-contractors and as suppliers of goods and services. It is these direct short-term benefits that are of specific importance in the context of the ongoing political consolidation and unification process.
- In the medium and long term, the new Saada-Aden Yemen International Highway (SAYICH) Program, of which the Aden-Taiz Highway Project is the first part, is expected to bring trade facilitation and general economic revitalization, by lowering transportation costs and travel times, reducing overall trade costs, and by bringing access to international markets through Aden deeper into the country. The highway will also provide better access by rural populations to markets and services located in the larger cities along the

new highway (Aden, Lahj and Taiz). Most social services, such as general healthcare, emergency medical services, education, etc. are located in the cities and the new highway will provide faster and easier access to those.

- The project is expected to have a transformational impact due to the new institutional arrangements for asset management and maintenance that it will introduce, again providing business opportunities for local firms and communities along the highway corridor.

More generally, whether referring to the project highway between Aden and Taiz or the larger future highway from Aden to the Saudi border, the development of roads and highways is a fundamental component of Yemen's economic development because of the overarching importance of mobility. Access to markets and social services such as health and education simply cannot be improved without improving infrastructure, which also enhances mobility. This is especially the case for Yemen, where the fight against rural poverty is hampered by the inaccessibility of certain areas and whole districts. The government recognizes transport connectivity as the key to facilitating the spread of development's drivers, be it new technologies, knowledge or the meeting of basic needs. Its endorsement of the SAYICH thus represents a transformational part of its social inclusion agenda.

Other potential negative social impacts and risks. In addition to the resettlement impacts, the project may also have some other social risks and adverse impacts on different social groups. The construction of the highway will require a large number of construction workers and at least a part of those may come from other areas of Yemen. With the influx of many laborers from outside the local area, conflicts may arise between inhabitants of temporary construction camps and local communities.

7.6.16 Mitigation Measures

- Mitigation for *loss of land* will be done on the basis of compensation either in cash, or land-for-land swaps, or a combination of both. Mitigation for crop loss will be on the basis of cash compensation taking into account the cropping pattern of the fields. Vulnerable groups may be provided with special support for livelihood restoration.
- *Cultural resources* such as graves and mosques shall be relocated in consultation with local people and the cost of relocation will be covered through cash payments. These consultations will be carried out by MPWH staff and the decisions taken during the consultations will be recorded in writing.
- *Water wells* will be also relocated in consultation with local people to be carried out by MPWH staff and the decisions taken during the consultations will be recorded in writing. The relocation will be supported by cash payments to pay for digging or boring new wells.
- The loss of *residential or commercial structures* will also be compensated through cash payments.

Mitigation measures related to road safety: In practical terms, for the new Yemen Corridor Highway project the only viable and realistic measures to improve road safety are those related to an appropriate engineering design. The following particular measures are included in the design:

- The highway has two carriageways (one for each travel direction) which are divided by a wide median. The separation of the vehicle flow travelling in opposing directions by the median and also by steel crash barriers on each side of each carriageway is expected to effectively eliminate head-on collisions which are today the largest cause of traffic fatalities on the existing road.
- The technical design of the highway will be subjected to a road safety design audit by a specialized international road safety specialist. This activity is already under preparation and will be funded through a trust fund without cost to the Government of Yemen. Any suggestions made by the auditor will be reflected in the final site working design and drawings and will be implemented by the contractor.
- The design includes 60 locations along the new highway where it can be crossed, namely (i) 12 road intersections with overpasses, (ii) 3 bridge underpasses, (iii) 2 bridge overpasses, (iv) 20 road culverts and (v) 23 large other culverts suitable for pedestrians and small vehicles (farm tractors, etc.). These structures are located at all those places where local populations need to cross the highway on a regular basis, in order to access farm fields, other villages, shops, etc. The average distance between designed crossings is 2.3 km.
- The design also includes lighting at all intersections and all those crossings where electricity is available. For the underpasses (culverts) without access to the electricity grid, solar-powered lighting is planned.
- The design includes road markings and safety signage in line with international good practice.

Mitigation related to cultural properties: Mitigation measures / procedures have been defined to deal with chance finds of historic or cultural importance.

The contractor will take reasonable precautions to prevent his workmen or any other persons from removing and damaging any chance-found/discovered cultural heritage article(s). Chance find procedures will be used as follows:

- Stop the construction activities in the area of the chance find;
- Delineate the discovered site or area;
- 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;
- Notify the supervisory Engineer who in turn will notify the responsible local authorities and the Ministry of Culture immediately (within 24 hours or less);
- Responsible local authorities and the Ministry of Culture would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the

findings to be performed by the archeologists from the Heritage Authority (within 72 hours). The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historic, scientific or research, social and economic values;

- Decisions on how to handle the finding shall be taken by the responsible authorities from the Heritage Authority. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeologically importance) conservation, preservation, restoration and salvage;
- Implementation for the authority decision concerning the management of the finding shall be communicated in writing by the Ministry of Culture; and
- Construction work could resume only after permission is given from the responsible local authorities and the Ministry of Culture concerning safeguard of the heritage.

Other mitigation measures:

- In order to avoid conflicts between local people and workers from other parts of Yemen, the civil works contractors will be encouraged to hire local people as workers as much as possible. This is normally in the economic interest of the contractors anyway.

Handling environmental impacts not currently identified:

- If the Contractor or Engineer identify adverse environmental impact(s) at any location which have not been identified in the ESIA or for which mitigation measures are not included in the ESMP, information about such impacts shall be brought to the attention of the PIU and suitable site-specific measures will be developed by the PIU to mitigate such impacts. The Engineer will have the primary responsibility of identifying such cost-effective measures and instruct the Contractor to implement the same.

7.7 Summary of Environmental & Social Impacts

Summary of key Environmental and Social Impacts due to the project is below in **Table 7.34**.

Table 7.34: Summary of Impacts Matrix for key impacts

S. No.	Attribute	Description of Impacts	Significance during project phases		
			Pre-Construction	Construction	Operation
1.	Air Quality	Direct adverse impact on air quality, which shall last almost throughout the pre-construction to construction period. Increase in air pollution during operation	Low	Medium	Low

S. No.	Attribute	Description of Impacts	Significance during project phases		
			Pre-Construction	Construction	Operation
2.	Water Resources/ Quality	Increased Sedimentation, degradation of water quality/loss of water resources And effect on ecosystem.	Low	High	Low
3.	Land	Visible and significant impact on physiography of the region/ change in land use, medium and temporary soil erosion, compaction and contamination	Medium	High	Medium
4.	Ecology	Loss of fruit-bearing and non-fruit bearing trees. Loss of vegetation, pasture etc.	High	High	Low
5.	Consumption of Natural Resources	Construction material like soil & aggregates and water shall be used during construction	Low	Medium	Low
6.	Noise	Vehicular movement and construction activity	Low	High	Medium
7.	Safety of Workers and Residents in project area	Increased risk of injury and accidents in the work areas, as well in off-road locations like borrow areas, quarries and crusher	Low	Medium	Low
8.	Socio-Economic	Loss of land, loss of livelihood and loss of properties. Need for relocation physical cultural assets, such as mosques and graves.	High High	High Low	Low Low

8 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

8.1 Introduction

In order to manage the Environmental & Social impacts in line with Yemen law, and policies of funding agencies for the project, an Environmental and Social Management Plan (ESMP) has been prepared. The ESMP contains management measures avoidance, mitigation, as well as enhancements that would be implemented during the construction and operation/maintenance phase of the project. It covers the measures on and near the highway right-of-way and also in the construction-related sites such as camps, asphalt mixing plants, equipment workshops, etc.

In addition to the ESMP, a Resettlement Action Plan (RAP) has also been prepared to ensure appropriate approach for involuntary resettlement of Project Affected People (PAP).

The Environmental and Social Management plan matrix prepared for the proposed project during construction and operation /maintenance phase is given in **Table 8.1 and Table 8.2**. The main element of ESMP is the cost of implementation which shall be integrated into the contractor's cost. The project envisages about **US\$ 8,073,100** required to cover the following aspects :

- ESMP during construction and operation/maintenance phase;
- Training, and
- Environmental enhancements.



Table 8.1: ESMP during Construction Phase

Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (Incl. Enforcement & Coordination)	Cost Estimate	Comments (e.g secondary impacts)
Agricultural Land Acquisition	Economic and Livelihood loss	Proper Compensation for 161.00 ha of agriculture land shall be provided as per the rates decided (Details provided in RAP).	PIU, MPWH, Revenue Department of Taiz, Lahj and Aden Governorates	An average compensation rate of US\$ 4/m ² is decided for agricultural land. The cost estimate is US\$ 6,440,000. Details are given in RAP.	Appreciation of the land cost in the vicinity of Highway. Ribbon development along the highway.
Acquisition of private and Government Properties, Water access units and religious structures.	Economic loss, Temporary loss of shelters, Temporary non-availability of water for domestic use and for irrigation	Proper Compensation for 22 water wells, 2 water pools, 38 fences, 16 guard rooms, 10 graves, 8 mosques and one barn shall be provided as per the rates decided (Details provided in RAP), Relocation of graves and mosques with consultation with local people. Relocation of water wells in consultation with local people.	PIU, MPWH, Revenue Department of Taiz and Lahj and Aden Governorates.	As per the Entitlement matrix given in RAP.	Pressure on water resources in nearby areas.
Cutting of fruit, non-fruit bearing and Qat trees. Relocation of Qat trees.	Livelihood loss, Loss to Ecology, Loss of nests of birds living on these trees.	Total number of 21,025 trees shall be affected due to Highway construction, out of which about 2,146 trees are fruit-bearing and the rest 18,879 trees are non-fruit bearing. In addition, about 412,050 Qat plants shall also be affected. Green belt development and median plantation has been proposed along the alignment where water is available.	PIU, MPWH, Revenue Department of Taiz and Lahj and Aden Governorates	A compensation rate of US\$ 5 to 500 / tree for fruit, non-fruit bearing trees and for Qat trees US\$ 15 / tree is decided. (Relocation of Qat trees: US\$ 3/tree.) The total cost estimate is US\$ 865,305 for destroyed Qat trees and US\$ 1,854,225 for	



Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (Incl. Enforcement & Coordination)	Cost Estimate	Comments (e.g secondary impacts)
				relocation of Qat trees, US\$ 244,245 for fruit-bearing trees and US\$ 943,950 for non-fruit bearing/other trees .	
Siting of Crushers, hot-mix and Batching Plants.	Air and Noise, Loss of agriculture land, Loss of natural landscape.	Hot mix and batching plants to be located sufficiently away from settlements, agricultural operations or any commercial establishments. Such plants shall be located at least 1000 m away from the nearest village/ settlement preferably in the downwind direction. Arrangements to control dust pollution through provision of windscreens, water sprinkling and dust encapsulation shall have to be provided at all such sites.	Contractor/ SC, PIU, MPWH	Included within Contractor's price. The cost of monitoring is given in Table 9.1 .	Temporary land acquisition.
Operation of Construction Vehicles, Equipment and Machinery.	Air pollution, Noise and Oil spill lead to soil and water contamination.	All vehicles, equipment and machinery to be operated shall be of good international standards. All dumpers carrying construction material and debris should be covered to avoid dust pollution. Use Personal Protective Gear by workers, to be made mandatory at these sites. EHS Guidelines of the World Bank Group to be followed for all construction	Contractor/ SC	Included within Contractor's price. The cost of monitoring is given in Table 9.1 .	



Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (Incl. Enforcement & Coordination)	Cost Estimate	Comments (e.g secondary impacts)
		<p>activities.</p> <p>Idling of vehicles shall not be permitted.</p> <p>All vehicles should adhere to pollution norms.</p> <p>Vehicles and other machinery to be maintained to reduce the air borne contaminants and noise pollution.</p> <p>Noise limits for construction equipment to be operated such as compactors, rollers, front loaders concrete mixers, cranes (moveable), vibrators and saws shall not exceed 75 dB (A), measured at one meter from the edge of the equipment in free field.</p>			
Arrangement of Water for Construction purposes.	<p>Shortage of Water for Local people.</p> <p>Dispute over Water use/resources.</p>	<p>Contractor is not allowed to use any community water resources.</p> <p>To avoid disruption/disturbance to other water users, the contractor shall extract water from fixed locations in consultation with the SC before finalizing the locations.</p> <p>Contractor shall provide a list of locations and type of sources from where water for construction shall be used.</p> <p>Contractor shall not be allowed to pump</p>	<p>Contractor, SC and PIU (MPWH)</p>	<p>Included in Construction cost.</p>	



Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (Incl. Enforcement & Coordination)	Cost Estimate	Comments (e.g secondary impacts)
		<p>water from any irrigation canal.</p> <p>The water for construction shall be used mainly from Wadis (Rivers) or water stored in small dams during rainy season. The water from these sources shall not affect the usage of local people as discussed with Governors and local people.</p>			
Sitting of Labour and Construction camps	<p>Social Issues due to cultural differences,</p> <p>Loss of agriculture land,</p> <p>Loss of natural landscape</p>	<p>Arrangement of local Labor.</p> <p>Avoid camp construction on agricultural land.</p>	<p>Contractor, SC and PIU (MPWH)</p>	<p>Included in Construction cost.</p>	<p>Livelihood generation for local people.</p>
Generation and disposal of construction wastes and excess materials.	<p>Agricultural soil</p> <p>Pasture land,</p> <p>Loss of landscape value,</p> <p>Dust and noise pollution</p>	<p>Waste land shall be used for waste disposal as 439.32 ha of wastelands are available along the alignment.</p> <p>Confining vehicle maintenance and refuelling to areas in construction camps designed to contain spilled lubricants and fuels.</p> <p>Use special containers with complete labelling,</p> <p>Use second containment tanks for oil collection and handling,</p>	<p>Contractor, SC and PIU (MPWH)</p>	<p>Included in Construction cost and the cost of monitoring is given in Table 9.1.</p>	



Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (Incl. Enforcement & Coordination)	Cost Estimate	Comments (e.g secondary impacts)
		<p>Collection, storage and disposal to approved disposal sites, according to EPA requirements, and, to the extent possible, reuse, recycle and properly disposing off all construction materials.</p> <p>Collection of rehabilitation material and transferring it to a licensed dumping site. It is recommended managing the rehabilitation materials for further utilization in the road construction.</p>			
<p>Opening of Borrow and Quarry Sites</p>	<p>Agricultural land and pasture land, Change in land use, Loss of productive soil, Dust Generation.</p>	<p>No borrow and quarry site shall be opened without permission of the SC. The location, shape and size of the designated borrow and quarry areas shall be as approved by the SC and as per the agreement between the land owner and the contractor.</p> <p>The unpaved surfaces used for the haulage of borrow soil and aggregates materials, if passing through the settlements or habitation shall be maintained dust free by the contractor. Sprinkling of water shall be carried out at least twice a day to control dust along such roads during their period of usage.</p> <p>During dry and windy seasons (winter and summer) frequency of water sprinkling shall be increased near the settlement areas and SC shall decide the numbers of</p>	<p>Contractor, SC and PIU (MPWH)</p>	<p>Included in Construction cost and the cost of monitoring is given in Table 9.1.</p>	



Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (Incl. Enforcement & Coordination)	Cost Estimate	Comments (e.g secondary impacts)
		<p>sprinkling locations depending on the local requirement.</p> <p>Contractor shall rehabilitate the borrow areas as soon as work is over for a particular borrow area in accordance with the agreement between the land owner and the contractor. A completion certificate indicating that the redevelopment plan has been executed, countersigned by the owner, shall be furnished by the Contractor for record of the PIU, MPWH.</p>			
<p>Construction near Wadis</p>	<p>Obstruction of flow of water, Contamination of surface water, Siltling of water bodies.</p>	<p>The Wadi Tuban and Aakan are perennial which are crossing the alignment, all other water bodies and wadis are seasonal hence, the contractor shall make sure that the flow of wadis/water bodies/water ways shall not be obstructed / prevented during the presence of water in the water bodies.</p> <p>Construction work close to these seasonal Wadis/water bodies/water ways shall be undertaken only during the dry season. If construction work is expected to disrupt users of community water bodies, advance notice shall be served to the affected community.</p> <p>Contractor shall serve advance notice to the downstream users of water wherever excavation/drilling is to take place in the</p>	<p>Contractor, SC and PIU (MPWH)</p>	<p>Included in Construction cost. The cost of monitoring is given in Table 9.1.</p>	<p>Dispute over water usage between local persons and labors.</p>



Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (Incl. Enforcement & Coordination)	Cost Estimate	Comments (e.g secondary impacts)
		<p>water bodies.</p> <p>Contractor shall take prior approval of the competent authority or SC for any such activity. The PIU, MPWH shall ensure that contractor has served the notice to the downstream users of water well in advance.</p>			
Traffic Diversion And Construction Site Access Points	<p>Air Quality And Noise</p> <p>Road and labour safety</p>	<p>Reduce working night shifts as much as possible in populated areas and apply road watering after heavy movements</p> <p>Apply the Yemeni regulation for ambient noise levels during this phase as a major tool in designing the construction activities schedule.</p> <p>Measure concentrations of particulate matter</p> <p>Use personal protective gear by workers, and make first aid available onsite.</p> <p>Provide warning signs at suitable distance around working areas</p>	Contractor, SC and PIU (MPWH)	Included in Construction cost. The cost of monitoring is given in Table 9.1.	
Chance Finds	Physical Cultural Resources may be impacted	<p>(i) Stop the construction activities in the area of the chance find;</p> <p>(j) Delineate the discovered site or area;</p> <p>(k) Secure the site to prevent any damage or loss of removable</p>	Contractor, SC and PIU (MPWH)	Included in Construction cost.	



Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (Incl. Enforcement & Coordination)	Cost Estimate	Comments (e.g secondary impacts)
		<p>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;</p> <p>(l) Notify the supervisory Engineer who in turn will notify the responsible local authorities and the Ministry of Culture immediately (within 24 hours or less);</p> <p>(m) Responsible local authorities and the Ministry of Culture would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed by the archeologists from the Heritage Authority (within 72 hours). The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historic, scientific or research, social and economic values;</p> <p>(n) Decisions on how to handle the finding shall be taken by the responsible authorities from the Heritage Authority. This could include changes in the layout (such</p>			



Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (Incl. Enforcement & Coordination)	Cost Estimate	Comments (e.g secondary impacts)
		<p>as when finding an irremovable remain of cultural or archeologically importance) conservation, preservation, restoration and salvage;</p> <p>(o) Implementation for the authority decision concerning the management of the finding shall be communicated in writing by the Ministry of Culture; and</p> <p>(p) Construction work could resume only after permission is given from the responsible local authorities and the Ministry of Culture concerning safeguard of the heritage.</p>			
Miscellaneous activities like fuelling, painting etc.	Soil and water pollution	<p>Use of sand platforms for fuelling and transferring of fuel.</p> <p>In case of any oil or paint spillage, immediately remove the contaminated material and dispose it at safe place.</p>	Contractor, SC and PIU (MPWH)	Included in Construction cost.	



Table 8.2: ESMP during Operation / Maintenance Phase

Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (incl. enforcement & coordination)	Cost Estimates	Comments (e.g. secondary impacts)
Road Marking and painting on sign boards.	Road Safety, spillage of oil and paint etc. Air and Noise Quality Waste Management	Use proper warning signs at suitable distance; Immediately remove the contaminated soil and dispose the waste in Hazardous waste disposal site.	MPWH/EPA The cost of monitoring is given in Table 9.1.	As required / per unit.	Only in maintenance areas
Maintenance of side and median guardrails.		Avoid working at night.			
Repair of fence.		Proper collection of waste in working areas.			
Maintenance of road surface.		Avoid bitumen melting activities in open spaces.			
Maintenance of bridges, cleaning of underpasses and maintenance of drainage.		Regular Cleaning of underpasses and culverts.			
Maintenance of service areas for relocated small businesses.	Waste Management	Periodic cleaning and maintaining services areas.	MPWH	As needed	Only in rest and service areas.
Monitoring of Restoration of Borrow area.	Landscape and aesthetics	During restoration period of borrow sites until the site is handed over to land owner.	MPWH and Contractor	Cost included in the cost of construction.	



Project Activity	Potential Environmental and Social Impacts	Proposed Mitigation Measures	Institutional Responsibilities (incl. enforcement & coordination)	Cost Estimates	Comments (e.g. secondary impacts)
Dismantling of Labor and construction camps	Landscape and aesthetics	During restoration period of labor and construction camps as per agreement with land owner until the site is handed over to land owner.	MPWH and Contractor	Cost included in the cost of construction.	
Greenbelt and Median plantation monitoring	Landscape and ecological	Plantation of trees to replace dead trees and regular watering of roadside plantation and median plantation.	MPWH/ Forest or Agriculture Department/Contractor	Cost included in the cost of construction.	

8.2 Environmental Enhancement

The proposed highway alignment is mostly traversing through the rural areas where water is among one of the vital issue for the local inhabitants. However there are other issues like health, livelihood, education and transportation in these areas. Consultations at various levels has been carried out in order to identify and select the existing facilities which should either be improved or to provide any new facilities in these areas under environmental enhancement proposal. The locations identified for environmental enhancement are given in **Table 8.3**.

Table 8.3: Environmental Enhancement

Sr. No	Location	Enhancement Provision	Governorate	Cost US\$
1	Al-Ganad Mosque (Near starting point of the Project Road)	Beautification and Landscaping	Taiz	25,000
2	Stadium in Al-Hussain Sub District of Mawiya District	Improvement of stadium (This location was suggested by local leader and villagers in Al- Maitab Village of Mawiya district).	Taiz	25,000
3	Al-Hussain Village of Mawiya District	New water Facility	Taiz	10,000
4	Humerain Sub Village of Mawiya District	Improvement of water facility	Taiz	10,000
5	Al-oman Village of Mawiya District	New water Facility	Taiz	10,000



MINISTRY OF PUBLIC WORKS AND HIGHWAYS (MPWH)

Environmental & Social Impact Assessment (ESIA) / Environment & Social Management Plan (ESMP) report for Yemen International Corridor Highway Project section between Taiz and the city of Aden (140 km)

Sr. No	Location	Enhancement Provision	Governorate	Cost US\$
6	Al- Asrar Village of Mawiya District	New water Facility	Taiz	10,000
7	Al-Ogoh Village of Mawiya District	New Health facility and new Water Facility	Taiz	60,000
8	Al- Dariajah	Recreation facility for children's and Medical Facility for Women Particularly Gynaecology and Children related medical facility	Al- Mosemaier (Lahj)	75,000
9	Al-Anad	Recreation Facility	Al- Mosemaier (Lahj)	25,000
10	Al -Musamir area	Landscape upper Wadi Murib with for recreation. Water facility and Health Facility.	Al- Mosemaier (Lahj)	85,000
11	Aqan village	School	Tuban	25,000
12	Al-Srahinah village	Health Facility and Public Park near Al-Musamir /Taiz Junction	Tuban	75,000
13	Naubat Dokaim	Recreation Facility	Al- Mosemaier (Lahj)	25,000
14	Al-Hutah	Public Park between the new highway and the old road near by Al-Hutah Lahij city	Lahj	25,000
15	Abyan	Public park in Al-Alam area Aden near by Abyan costal at first 5km	Aden	25,000
16	Aden	Improve Al-Haswah protected area	Aden	50,000
17	Al-Mahjatah area	Public park in Al-Mahjatah area	Aden	25,000
TOTAL ENVIRONMENTAL ENHANCEMENT COST				585,000

9 MONITORING & INSTITUTIONAL STRENGTHENING

9.1 Introduction

Regular monitoring of all significant, environmental and social parameters is essential to ascertain compliance to the country's environmental social laws and regulations. Environmental and Social monitoring helps to detect the scale and extent of impacts caused by the project over time and to assess whether mitigation measures have been properly and timely implemented and are working as expected. The objectives of monitoring are as follows:

- To measure the compliance of construction activities with the ESMP mitigation measures.
- To verify the results of the project's environmental and social impacts.
- To ensure that all safety concepts were implemented properly.
- To ensure that construction work is going ahead with all statutory permissions and consents.

The monitoring activities will ensure the proper implementation of the environmental and social mitigation measures. The monitoring activity will mainly comprise of visual observations carried out by the supervision engineers. Site inspections will take place with emphasis on early identification of any environmental problems and the initiation of suitable remedial action. Where remedial actions are required on the part of Contractor, further checks shall be needed to be made to ensure that these are actually being implemented as per the agreed schedule and in the form required. Each part of the site where construction is taking place needs to be formally inspected from an environmental & social viewpoint on a regular basis.

An environmental and social monitoring program is presented for both the construction and operation / maintenance phases. The monitoring program will focus on air quality, water quality, soil quality, tree plantation; borrow area restoration, and socio-economic activities and the condition of rest and service areas within the project area. The Environmental quality monitoring program will consider the parameters for Air, water, soil and noise quality stated in **Table 9.1**

Table 9.1: Environmental Parameter for Monitoring

Environmental Component	Parameters
Air	PM10, PM2.5, SO ₂ , NO _x , CO Ozone and HC
Surface Water	Temperature, pH, Turbidity, Electrical Conductivity (EC), Colour, TSS, Total Dissolved Solids (TDS), Odour, Total Hardness, Potassium, Calcium, Magnesium, Ammonium, Chloride, Sulphate, Nitrate, BOD, COD and DO
Ground Water	Temperature, pH, Turbidity, Electrical Conductivity (EC), Colour, TSS, Total Dissolved Solids (TDS), Odour, Total Hardness, Potassium, Calcium, Magnesium, Ammonium, Chloride, Sulphate, Nitrate, and heavy metals, Faecal coliforms and Total coliforms

Environmental Component	Parameters
Soil	Organic matter , Total nitrogen, Potassium, Phosphorous, Organic carbon, Sulphate, Sodium, Calcium sulphate
Noise	Leq, Leq _{day} and Leq _{night}

Also the other important areas for environmental monitoring are as follows:

- Monitoring type and frequency
- Monitoring locations
- Sampling and analysis methods
- Monitoring time or seasons
- Responsibility of Monitoring

In the present situation there is no monitoring station for Air Quality or Noise Monitoring in Yemen. Also there is no lab or agency which has capability and manpower for ambient air quality monitoring in Yemen. Hence in order to strengthen the capability of MPWH to start the monitoring of Air and Noise quality along the road there shall be at least two Air & Noise monitoring stations along the proposed alignment particularly in Taiz, Lahj and one in Aden.

The regular monitoring activities will rely on the supervising consultant of all environmental and social impacts to determine contractor compliance or otherwise with the ESMP. The consultant will monitor the application of environmental and social mitigation measures and the result of monitoring activities shall be reflected on the monthly report except the air, water, soil and noise quality which will be presented in quarterly reports.

The Environmental and Social (E&S) Specialists within the PIU (MPWH) will be responsible for ad hoc monitoring of the compliance with the ESMP, and will work in close collaboration with the Ministry of Environment & Water (MoEW) and Environmental Protection Authority (EPA). Their responsibility is to follow up and monitor periodically the contractor, the consultant and the sub-project officer and review monthly reports on contractor compliance.

The (E&S) specialists shall conduct site visit to inspect and determine contractor, consultant and sub-project officer compliance or otherwise with the ESMP and other applicable regulations and statutes. Monitoring activities will rely primarily on field observations, feedback from stakeholders and other affected people, complaints in Grievance Redressal Cell (GRC) and documentation of their reactions to the project works and their perception of the adequacy of the mitigation measures. Photographic documentation will be required in the continuous and regular monitoring.

Upon completion of the project (i.e. during the operation / maintenance phase) and thereafter, it is planned that periodic inspections / monitoring along the highway will continue for some time by the dedicated E&S specialists at the PIU (MPWH) in collaboration with Ministry of Environment & Water and Environmental Protection Authority (EPA).



MINISTRY OF PUBLIC WORKS AND HIGHWAYS (MPWH)

Environmental & Social Impact Assessment (ESIA) / Environment & Social Management Plan (ESMP) report for Yemen
International Corridor Highway Project section between Taiz and the city of Aden (140 km)

The World Bank will monitor the implementation of road specific ESIA/ESMPs and other Safeguard related documents (Resettlement Action Plans etc.). In particular the Bank must ensure that proper monitoring takes place and that the reports are filed regularly. Should these reports indicate incomplete monitoring of specifically identified social issues; these will be reported to the responsible staff in the PIU (MPWH).

The monitoring program for construction and operation / maintenance phase of the project is given in **Table 9.2 and Table 9.3.**

Table 9.2: Monitoring during Construction phase

Parameters To Be Monitored	Proposed Mitigation Measure	Location	Measurements (Incl. Methods & Equipment)	Frequency of Measurement	Responsibilities (Incl. Review And Reporting)	Cost
Air Quality Concentrations of PM10, PM2.5, SO ₂ , NO _x , CO Ozone and HC	<ul style="list-style-type: none"> * Apply (spray) water to the construction surface and other piled materials such as sand as much as needed. * Perform periodical check and maintenance for the construction machinery * Monitor/measure concentrations of particulate matter and gaseous pollutants. 	Locations of Air Monitoring are Al-Ganad (Km 0+000); Al-Danaba (Km 30+500); Al-Mosemaier (Km 72.720); Al-Anad (Km 83+300); Taiz Factory (Km 127+000); Al-Alam (140+638) i.e., Six locations where monitoring was done during ESIA stage and four locations as per suggested by Engineer. Hence total ten locations.	<ul style="list-style-type: none"> * Site inspection * Measuring concentrations of air pollutants using monitoring equipment and appropriate monitoring methods. 	Three seasons in a year expect rainy season for three years. Total air samples shall be 90. The rate per sample is US\$ 400.	Contractor, SC and PIU (MPWH)	36,000
Noise Level Leq and and Leq day and Leq night	<ul style="list-style-type: none"> * Reduce working night shifts as much as possible in populated areas. * Apply the Yemeni Regulation for ambient noise levels during this phase as a major tool in designing the construction activities schedule. 	Locations of Noise Monitoring are Al-Ganad (Km 0+000); Al-Danaba (Km 30+500); Al-Mosemaier (Km 72.720); Al-Anad (Km 83+300); Taiz Factory (Km 127+000); Al-Alam (140+638) i.e., Six locations where monitoring was done during ESIA stage and four locations as per suggested by Engineer.	<ul style="list-style-type: none"> * Site inspection * Measuring of noise levels using monitoring equipment and appropriate monitoring methods 	Three seasons in a year excluding rainy season for three years. Total air samples - 90. The noise shall be continuously monitored for 24 hours. The rate per sample is US\$ 200.	Contractor, SC and PIU (MPWH)	18,000
Surface Water Quality (Temperature, pH,	Siting of labor and construction camps 1000 m away from any water	Tuban and Akan river	<ul style="list-style-type: none"> * Site inspection * Measuring 	Two locations (upstream and downstream)	Contractor, SC and PIU (MPWH)	9,000

Parameters To Be Monitored	Proposed Mitigation Measure	Location	Measurements (Incl. Methods & Equipment)	Frequency of Measurement	Responsibilities (Incl. Review And Reporting)	Cost
Turbidity, Electrical Conductivity (EC), Colour, TSS, Total Dissolved Solids (TDS), Odour, Total Hardness, Potassium, Calcium, Magnesium, Ammonium, Chloride, Sulphate, Nitrate, BOD, COD and DO)	body. Use of silt fencing wherever it is required. Minimise soil erosion near water bodies Prevent any waste or material disposal in any water body.		concentrations of water pollutants using monitoring equipment and appropriate monitoring methods	Tuban and Akan Wadi three season in a year excluding rainy season for 3 years (36 Samples). The rate of monitoring is US\$ 250		
Ground Water Quality (Temperature, pH, Turbidity, Electrical Conductivity (EC), Colour, TSS, Total Dissolved Solids (TDS), Odour, Total Hardness, Potassium, Calcium, Magnesium, Ammonium, Chloride, Sulphate, Nitrate, and heavy metals, Faecal coliforms and Total coliforms)	Remove any oil, bitumen or any chemical or hazardous material immediately and dispose the waste at approved Hazardous waste site. No waste shall be dumped in any of the open well. No discharge of any effluents in any water body. The toilets in construction camps and labor camps shall be as per the standard specifications to avoid ground water contamination	Six locations where monitoring was carried out during ESIA stage.	* Site inspection * Measuring concentrations of water pollutants using monitoring equipment and appropriate monitoring methods	Monitoring at Six locations where monitoring was carried out during ESIA stage. Total 54 Samples. The rate of monitoring is US\$ 250	Contractor, SC and PIU (MPWH)	13,500
Soil Quality (Organic matter , Total nitrogen, Potassium,	Remove any oil, bitumen or any chemical or hazardous material	Four locations where monitoring was carried out during ESIA stage	* Site inspection * Measuring	Four locations for three years and three seasons in a	Contractor, SC and PIU (MPWH)	9,000

Parameters To Be Monitored	Proposed Mitigation Measure	Location	Measurements (Incl. Methods & Equipment)	Frequency of Measurement	Responsibilities (Incl. Review And Reporting)	Cost
Phosphorous, Organic carbon, Sulphate, Sodium, Calcium sulphate)	immediately and dispose the waste at approved Hazardous waste site.		concentrations of soil contaminants using monitoring equipment and appropriate monitoring methods	year i.e. 36 Samples. The rate of monitoring is US\$ 250		
Greenbelt and Median plantation	Good site management practices to be observed to ensure minimal loss to plantation.	Along the entire Road, especially near intersections with population centres.	Site inspection	During construction	Contractor, SC and PIU (MPWH) and Local Administration.	Cost is included in Environmental mitigation cost detail is given in Table 8.3.
Waterways Contamination of waterways due to spillages and disposal of liquid wastes	Maintenance of well-kept construction site and no discharge of effluents into waterways	Waterways/water bodies close to work sites and labor & construction camp.	Visual inspection	During construction	Contractor, SC and PIU (MPWH)	Included in Contractors price.
Drainage System * Readiness of ditches and culverts for rainy season	* Periodic cleaning and maintenance of ditches and culverts * Periodic inspection for solid waste disposal in culverts	Culverts across the road	* Site inspection * Enforcing waste disposal regulations	During construction	Contractor, SC and PIU (MPWH)	Included in Contractors price. Equivalent of one full time environmental monitoring engineer / specialist who shall coordinate and report to Supervising Consultant / Included in the rate above.

Table 9.3: Monitoring During Operation / Maintenance Phase

Parameters To Be Monitored	Proposed Mitigation Measure	Location	Measurements (Incl. Methods & Equipment)	Frequency Of Measurement	Responsibilities (Incl. Review And Reporting)	Cost Of (Equipment & Individuals)
Air Quality Concentrations of PM10, PM2.5, SO ₂ , NO _x , CO Ozone and HC	<ul style="list-style-type: none"> * Apply (spray) water to the construction surface as needed. * Perform periodical check and maintenance for the construction machinery * Monitor/measure concentrations of air pollutants. 	Air Monitoring locations shall be Al-Ganad (Km 0+000); Al-Danaba (Km 30+500); Al-Mosemaier (Km 72.720); Al-Anad (Km 83+300); Taiz Factory (Km 127+000); Al-Alam (140+638) i.e Six locations where monitoring was done during ESIA stage.	<ul style="list-style-type: none"> * Visual Site inspection *Periodic check 	Three seasons in a year except rainy season for two years. Total air sample =36. The rate per sample is US\$ 400.	MPWH	14,400
Noise Level Leq and and Leq day and Leq night	* No night shifts as much as possible in populated areas.	Noise Monitoring Locations shall be at Al-Ganad (Km 0+000); Al-Danaba (Km 30+500); Al-Mosemaier (Km 72.720); Al-Anad (Km 83+300); Taiz Factory (Km 127+000); Al-Alam (140+638) i.e Six locations where monitoring was done during ESIA stage.	* Site inspection	Three seasons in a year except rainy season for two years. Total air sample =36. The rate per sample is US\$ 200.	MPWH	7,200
Surface Water Quality (Temperature, pH, Turbidity, Electrical Conductivity (EC), Colour, TSS, Total Dissolved Solids (TDS), Odour, Total Hardness, Potassium, Calcium,	Monitor any spillage in water body Monitor no illegal dumping of waste in any water body	Tuban and Akan river	<ul style="list-style-type: none"> * Site inspection * Measuring concentrations of water pollutants using monitoring equipment and appropriate monitoring methods 	Two locations (upstream and downstream) Tuban and Akan Wadi three season in a year excluding rainy season for 3 years (24 Samples). The rate of	MPWH	6,000



Parameters To Be Monitored	Proposed Mitigation Measure	Location	Measurements (Incl. Methods & Equipment)	Frequency Of Measurement	Responsibilities (Incl. Review And Reporting)	Cost Of (Equipment & Individuals)
Magnesium, Ammonium, Chloride, Sulphate, Nitrate, BOD, COD and DO)				monitoring is US\$ 250		
Ground Water Quality (Temperature, pH, Turbidity, Electrical Conductivity (EC), Colour, TSS, Total Dissolved Solids (TDS), Odour, Total Hardness, Potassium, Calcium, Magnesium, Ammonium, Chloride, Sulphate, Nitrate, and heavy metals, Faecal coliforms and Total coliforms)	Remove immediately any oil, chemical or hazardous material in case accidental spill and dispose the waste at approved Hazardous waste site. No waste shall be dumped in any of the open well. No discharge of any effluents in any water body.	Six locations where monitoring was carried out during ESIA stage.	* Site inspection * Measuring concentrations of water pollutants using monitoring equipment and appropriate monitoring methods	Six locations where monitoring was carried out during ESIA stage for three seasons in a year excluding rainy season for 2 years. Total 36 and rate of monitoring is US\$ 250.	MPWH	9,000
Soil Quality (Organic matter , Total nitrogen, Potassium, Phosphorous, Organic carbon, Sulphate, Sodium, Calcium sulphate)	Remove immediately any oil, chemical or hazardous material due to accidental spill and dispose the waste at approved Hazardous waste site.	At Four locations where monitoring was carried out during ESIA stage	* Site inspection * Measuring concentrations of soil contaminants using monitoring equipment and appropriate monitoring methods	Four locations for three years and three seasons in a year i.e. 24 Samples. The rate of monitoring is US\$ 250.	MPWH	6,000
Greenbelt and Median plantation	Good site management practices to be observed to ensure minimal loss to plantation.	At all locations where sufficient water exists, especially near intersections with population centres.	Site inspection	During Operation	MPWH, Forest or Agriculture department and	Staff of MPWH and Forest/ agriculture department



Parameters To Be Monitored	Proposed Mitigation Measure	Location	Measurements (Incl. Methods & Equipment)	Frequency Of Measurement	Responsibilities (Incl. Review And Reporting)	Cost Of (Equipment & Individuals)
					local Administration.	
Water crossings/bodies	* No discharge of used oils/effluents into waterways	Water crossings /water bodies close to work sites and base camp.	* Site inspection	During Operation	MPWH	Cost included in contractors' price.
Drainage System	* Periodic cleaning and maintenance of ditches and culverts * Periodic inspection for solid waste disposal in culverts	Culverts across the road	* Site inspection * Enforcing waste disposal regulations	During Operation	MPWH	Cost included in contractors' price.
Maintenance of new rest and service areas and associated services	Periodic maintenance and waste management	New rest and service areas	Visual inspection	Regularly During Operation	Local Administration	Staff of local administration

Table 9.4 below outlines the training programme on Environmental and Social issues and budgetary provisions for training, to be organised by the PIU of the MPWH:

Table 9.4: Institutional Strengthening and Training for Implementation

Institutional Strengthening Activity	Participants	Scheduling	Responsibilities	Cost Estimates
Training on ESMP shall consist of brief about ESMP, Legal aspects; contract clause for environmental and safety, Environmental clearances and permit requirement during construction and environment management area of concern, responsibilities, approvals, ESMP implementation; monitoring and reporting and ESMP management case studies.	MPWH, PIU staff of MPWH, Representatives of Governorates, EPA Engineers & Scientists, and technical staff of Contractors. The approximate participants shall be 200.	First in the starting of project implementation and afterwards in every six months. This will be three day workshop.	Supervision Consultant/MPWH	200 USD per participants which includes study material, lunch and team and cost of logistics like venue etc. Total cost = 200X 200=40,000 USD for one workshop. Total for entire duration of implementation considering 36 months. Hence total session in 36 Months is 6. Total cost= 6X40,000=240,000 USD.
ESMP Implementation particularly Monitoring of Environmental and social issues at construction site and construction camp. This will be on the job training.	Engineers of MPWH and Engineers of contractor. Approximate no 200. This will be two days (one day construction site and one day construction camp) on-site training and organised in every three months.	For Three days every Quarter during entire construction period.	Supervision Consultant/MPWH	The cost for each participants =50 USD per training session. Total cost= 200X50X12= 120,000USD
Total Cost for Training				360,000 USD

The estimated total cost of Environmental Monitoring and Training is presented in the **Table 9.5**.

9.2 ESMP Budget

The total ESMP cost which includes the Environmental mitigation, Environmental and Social Monitoring cost, training cost, and environmental enhancement cost is **US\$ 8,073,100**. The detail of the environmental budget is given in **Table 9.5**.

Table 9.5: ESMP Budget

Components	Stage	Item	Unit	Unit Cost (US\$)	Quantity	Total Cost (US\$)
(A) ENVIRONMENTAL MITIGATION COST						
Flora	Construction	Green belt development (two lanes)	Km	40000	140	5,600,000
		Median plantations	Km	10000	140	1,400,000
TOTAL MITIGATION COST (A)						7,000,000
(B) ENVIRONMENTAL & SOCIAL (E&S) MONITORING COST						
TOTAL E&S MONITORING COST (B)						128,100
(C) TRAINING COST						
TOTAL TRAINING COST (C)						360,000
(D) ENVIRONMENTAL ENHANCEMENT COST						
SUB-TOTAL D: ENHANCEMENT						585,000
Sub Total A: Environmental Mitigation Costs						7,000,000
Sub Total B: E& S Monitoring Cost						128,100
Sub Total C: Training Cost						360,000
Sub Total D: Environmental Enhancement Cost						585,000
GRAND TOTAL						8,073,100

The reporting schedule for reporting all the mitigation, environmental monitoring and training activities is given in **Table 9.6**.

Table 9.6: Scheduling and Reporting

Activity	Year 1				Year 2				Subsequent years			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Mitigation Meas												
Environmental Quality												
Environmental Contamination or Pollution												
Greenbelt development and Median Plantation												
Health and Safety												
Waterways												
Socio-economy												
Monitoring												
Environmental Quality												
Environmental Contamination or Pollution												
Greenbelt development and Median Plantation												
Health and Safety												
Waterways												
Institutional Strengthening												
Mitigation												
Monitoring												
Training												

10 INSTITUTIONAL ARRANGEMENTS

10.1 Introduction

The Ministry of Public Works and Highways (MPWH) of Yemen has a very long experience in building and maintaining roads over the past decades. However, MPWH's focus and emphasis has traditionally been on the most 'efficient' (essentially meaning least-cost) construction, upgrading and maintenance of roads. Only more recently have other concerns, such as the dealing with environmental and social impacts of road projects become important for successful implementation. The institutional arrangements for ensuring adequate management of the environmental and social aspects of the Corridor Highway Project are described in this chapter.

10.2 General Institutional Arrangements

Figure 10.1 provides an overview of the institutional setup related to the implementation of the ESMP and RAP. Details of the roles of the various institutions involved and their interaction are described further below.

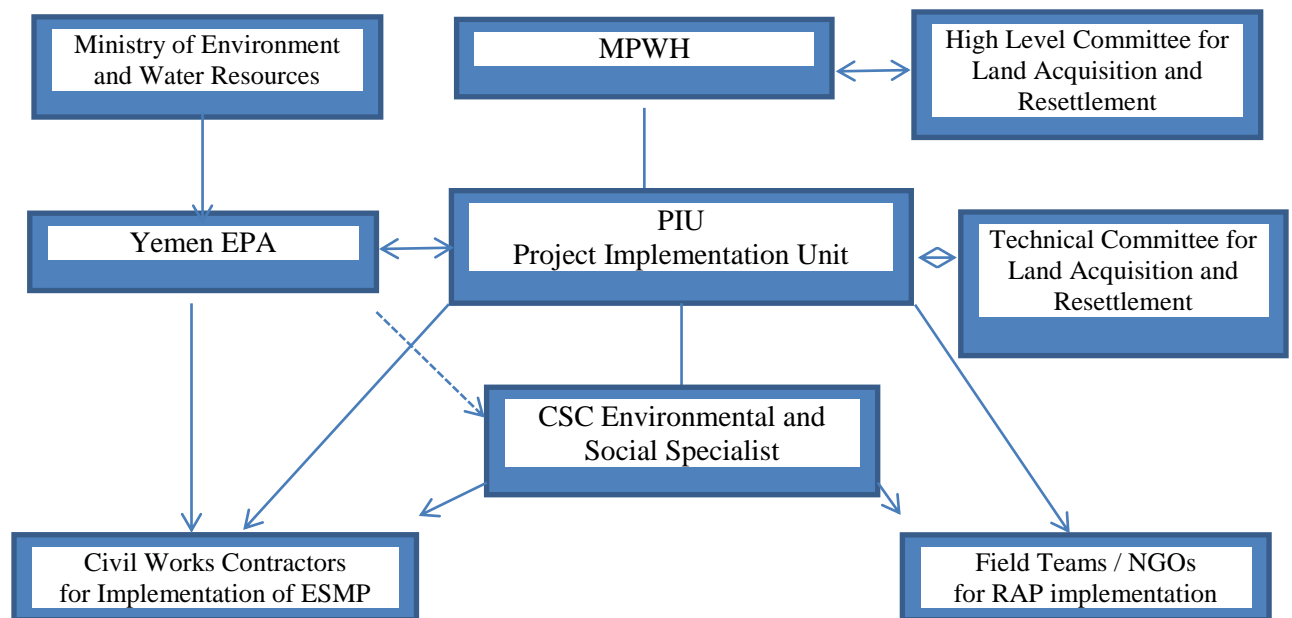


Figure 10.1: Implementation Arrangements for ESMP and RAP

10.2.1 Ministry of Public Works and Highways

The *Ministry of Public Works and Highway (MPWH)* has the overall responsibility for the implementation of the Corridor Highway project. The MPWH has carried out the road corridor selection and the engineering design of the highway section between Aden and Taiz through an international engineering consulting firm (Dorsch Consult, Germany). The MPWH has also engaged another international consulting firm (Voyants, India) for conducting the Environmental and Social Assessment (ESIA), the Environmental and Social Management Plan (ESMP) and the Resettlement Action Plan (RAP) for the project.

10.2.2 Project Implementation Unit within MPWH

To effectively oversee project preparation and to ensure the timely implementation of the project, a Project Implementation Unit (PIU) has been established within MPWH. The implementation of the project's environmental and social mitigation measures will be the responsibility of the PIU. The PIU is headed by a Project Director and presently also includes one Procurement officer, one senior Design Engineer, one IT expert and one Financial Management Specialist. The PIU is also in the process of identifying and hiring an Environmental and Social Specialist to ensure that implementation of the RAP and ESMP is done adequately. It is also envisaged that the Environmental and Social Specialist will later oversee the preparation by external consultants of ESIA's, ESMP's and RAP's for the subsequent stages of the overall SAYICH program. The PIU staffing may be further strengthened if needed during project implementation.

With some appropriate training and the actual exposure of the PIU staff to the environmental and social issues, the PIU staff will become competent to oversee the implementation of the ESMP and RAP.

The PIU will be assigned with specific responsibilities with regard to:

- Monitoring progress in the implementation of the environmental and social provisions, as per planned schedule of activities.
- Supervising implementation of mitigation measures by the civil works contractors along the project highway.
- Assisting the Supervision Engineer at the works sites by providing appropriate environmental advice, and if necessary, developing additional mitigation measures.
- Documenting the actual implementation of the environmental mitigation measures.
- In collaboration with the Environmental Specialist of the Supervision Consultant, preparing and conducting training materials for the MPWH field staff involved in the project, by incorporating the experience of implementation processes and other issues concerning protection of the social and environment safeguards.
- Maintaining working contacts and exchanging information with the other relevant institutions involved in the project.

Among the responsibilities of the Environmental and Social Specialist within the PIU shall be to guide and assist the MPWH in the process of developing, implementing and strengthening the environmental and social management practices applied in this specific highway project and also for in highway development projects in general, drawing on the experience gained in the implementation of this project. The duties entrusted to the Environmental and Social Specialist includes:

- Participate in the preparation and completion of the Environmental and Social Impact Assessment for the project, in close coordination with World Bank staff.
- Ensure that project execution is done in line with the Environmental and Social Management Plan (ESMP) and Resettlement Action Plan (RAP).
- Coordinate with the EPA to obtain the necessary Environmental clearances for the project.
- Develop training program / materials for MPWH staff, contractors and others involved in the project implementation, in collaboration with the Environmental and Social Specialists of the Supervision Consultant.
- Review and approve the Contractor's Implementation Plan for the Environmental and Social measures, as per the ESMP.
- Liaise with the Contractors and the Supervision Consultant to guide and facilitate the implementation of the ESMP.
- Liaise with Government agencies on environmental, social and other regulatory matters.
- Continuously interact with the Beneficiary Committees/NGOs / EPA and Community groups involved in the project.
- Establish a continuous dialogue with the affected communities and ensure that their environmental and social concerns and suggestions are incorporated and implemented in the project.
- Carry out site regular inspections and review the environmental and social performance of the project through an assessment of the periodic environmental and social monitoring reports submitted by the Supervision Consultants, and to provide a summary of those reports to the Project Director at MPWH, and initiate necessary follow-up actions.
- Provide support and assistance to the Government Agencies and the World Bank to facilitate their activities related to the supervision of the implementation of the ESMP during the construction as well as the operational stage of the project.
- Document good practices and lessons learnt in the project relating to the incorporation and integration of environmental and social issues into engineering design, and on implementing measures in the road construction and maintenance programs, and dissemination of the same. This shall form a useful tool to other similar agencies in other parts of the country.
- Report to the Project Director on the environmental and social aspects pertaining to the project.

- Prepare periodic (monthly, quarterly and annual) reports for dissemination within the MPWH and for the World Bank, etc.

10.2.3 Capacity Building Plan for Environmental/Social Specialist at PIU

The PIU is in the process of recruiting an Environmental/Social Specialist whose main task will be to ensure that ESMP will be fully implemented. He/she needs to be well-versed with the requirements of the Yemeni environmental legislation and the policies of the donors that contribute funding to the project. The capacity of the PIU staff in general and the Specialist in particular will need to be enhanced during the course of the project. This will include training on the job through close collaboration with Bank staff and also through suitable class-room based training courses. A study tour may be another option if the necessary resources are made available. To carry out monitoring activities and for obtaining and analyzing pollution related data, the PIU and Environmental/Social Specialist will get suitable transportation to site for inspecting the road works. Since pollution monitoring equipment is currently not available in-house, the PIU will either use external laboratories or procure the needed equipment for collecting pollution data.

10.2.4 Environmental Protection Agency

The Yemen Environmental Protection Agency (EPA) and MPWH are establishing a memorandum of understanding which defines the roles and responsibilities of each organization with regard to the implementation, monitoring and supervision of the agreed ESMP for the project. A draft of this agreement is presented in Annex 10.1. The agreement between MPWH and the EPA will provide for a robust 3rd party insight by the EPA into the extent to which the ESMP is being effective in managing adverse impacts on the environment.

10.2.5 Supervision Consultants (ESMP Implementation)

MPWH will employ two international supervision consulting firms to carry out the supervision of works. One firm has already been selected (for the SFD-funded highway section between Taiz and Noubat Dokaim). The recruitment of the consultant to supervise the IDA-funded section between Noubat Dokaim and Aden is presently underway through an international competitive selection process. The supervision consultants will be the representatives of MPWH on the construction site and thus assist the MPWH with the supervision of the civil works and also of the implementation of the Environmental and Social Management Plan (ESMP). The Supervision Consultants will assume the role of the Engineer according to FIDIC rules. Their TOR indicate that they are to have in-house capability to supervise and advise on the implementation of the ESMP, including on making decisions regarding the applicability of potential design enhancement options. The supervision consultants' team will therefore employ full time environmental and social specialists whose prime duty will be to ensure that the construction of the highway is carried out in a socially and environmentally friendly manner, in line with the ESMP. Their tasks also include the development of environmental and social procedures and good

construction practices, development and delivery of training programmes and workshops etc.

The Supervision consultant's environmental and social specialists should preferably be civil engineers with postgraduate specialization in environmental engineering / environmental sciences. They should have several years of working experience related to the integration of environmental and social issues in the design, construction and operation of infrastructure projects. Experience in construction management and operational maintenance of highways would be very helpful. Their specific roles and responsibilities shall be:

- Supervise the implementation of the ESMP by the Contractors.
- Develop, organize and deliver environmental training programmes and workshops for the staff of the MPWH, Contractors, Field Supervision Staff, MPWH officials and the Quality Auditors.
- Review and approve site-specific environmental and social enhancement/mitigation designs worked out by the Contractor.
- Hold regular consultation meetings with the PIU of the MPWH.
- Review the contractors work program and procedures to ensure compliance with the Environmental & Social Management Plan (ESMP).
- Develop good practice construction guidelines to assist the contractors in implementing the ESMP.
- Carry out periodic environmental monitoring programmes (air, noise, water, etc.) to ensure compliance with the Government requirements and the ESMP.
- Prepare and submit regular environmental & social monitoring and implementation progress reports.
- Assist MPWH PIU to prepare good practice dissemination notes based on the experience gained from site supervision.

10.3 Specific arrangements for RAP Implementation

As authorized by GoY, MPWH bears primary official responsibility for ensuring that land acquisition and resettlement associated with YCHP is planned and implemented in a manner consistent with the laws and regulations of Yemen, and in a manner consistent with the principles and procedures of World Bank OP 4.12. The YCHP Project Implementation Unit (PIU) has been established within MPWH. One of the key responsibilities of the PIU is routine management of land acquisition and RAP implementation under the supervision the Minister of MPWH. Accordingly, the PIU is both the primary author and primary implementing agent for this RAP.

The organizational arrangements for the RAP implementation are the following:

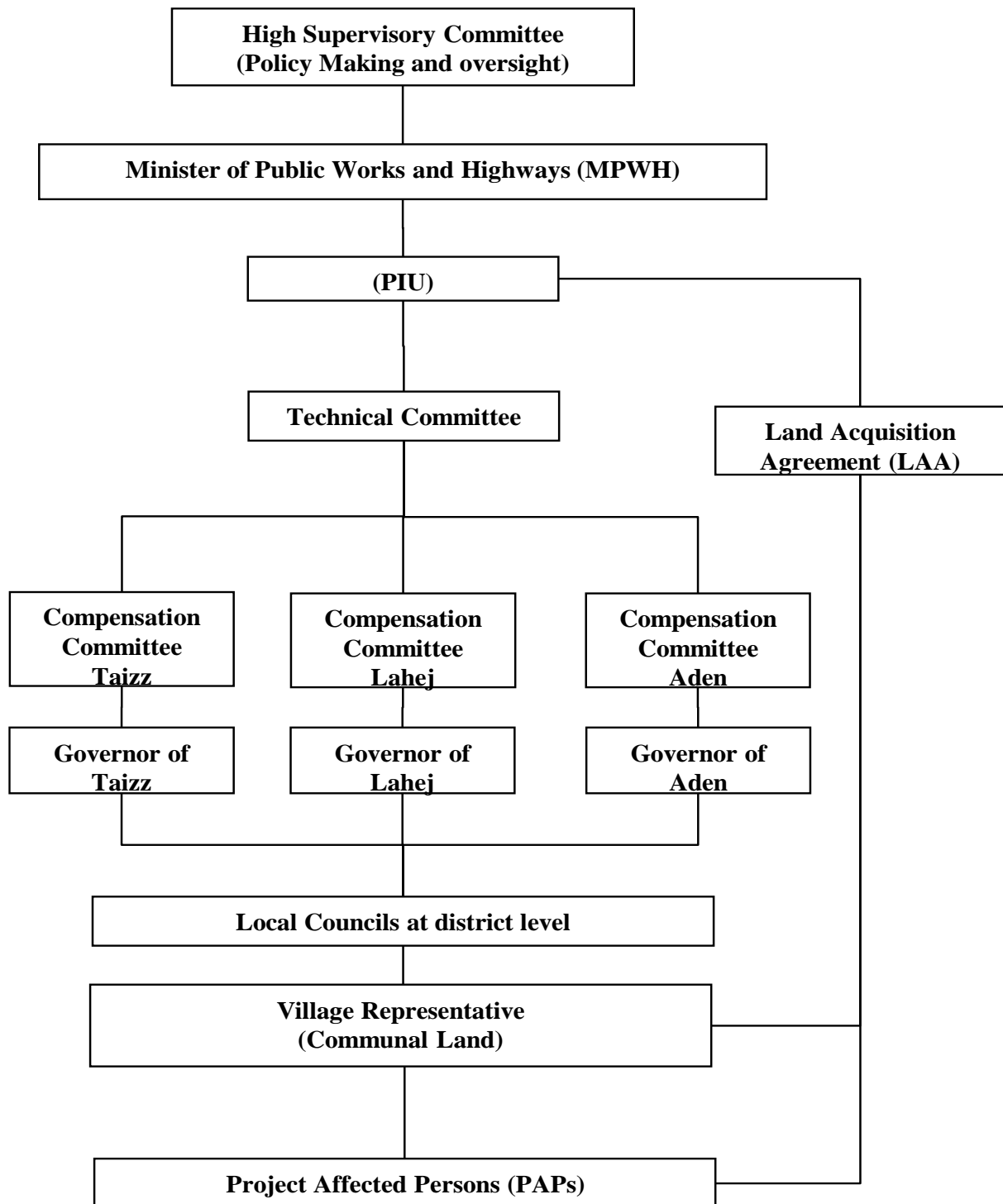


Figure 10.2: Organizational Structure for Land Acquisition and Resettlement

To ensure adequate management attention to RAP implementation, three functional entities have been created to manage various aspects and to ensure effective coordination among agencies and jurisdictions that will be involved. A High Supervisory Committee for Land Acquisition and Resettlement (HSC) in an inter-ministerial entity at the apex of the hierarchy. The YCHP Project Implementation Unit (PIU) will manage day-to-day aspects of RAP implementation. And a Technical Committee for Land Acquisition and Resettlement (TC) will support and assist the PIU in valuation of assets, determination of compensation rates, and other technical aspects associated with RAP implementation. RAP implementation also will be supported by relevant officials at the governorate and district levels. The roles and responsibilities of each of these entities are described in the following section.

10.3.1 High Supervisory Committee (HSC) for Land Acquisition and Resettlement

The primary function of the HSC is to provide overall policy guidance, oversight and coordination for all aspects of land acquisition and resettlement. The HSC is responsible for establishing effective means of multijurisdictional communication and coordination among the three governorates involved in YCHP. The HSC also will establish effective means for inter-ministerial communication and coordination to the extent necessary to ensure timely delivery of any services necessary for full implementation of all RAP assistance measures. Also, the HSC issues final approval for payment of compensation, based on the results of assessments conducted by governorate-level compensation committees.

The HSC will meet on an ad-hoc basis to address issues brought to its attention by the PIU or through the project monitoring process, and to consider any grievances raised by affected persons that have not been resolved at lower levels of engagement. The HSC will be chaired by the Minister of MPWH, and also consists of the following members:

- a) Minister of Finance
- b) Minister of Planning
- c) Chairman of Authority of Land Survey and Urban Planning
- d) Minister of Interior Affairs
- e) Minister of Awqaf
- f) Governor of Taiz
- g) Governor of Lahj
- h) Governor of Aden

The HSC will mainly have the following responsibilities:

- a) Overall policy guidance and oversight for all aspects of land acquisition and resettlement
- b) Approve budgets and final compensation lists prior to payment
- c) Resolve issues that may arise, including grievances raised by affected persons that have not been resolved through lower-level grievance redress committees
- d) Ensure coordination among agencies and jurisdictions as necessary to facilitate RAP implementation

10.3.2 Ministry of Public Works and Highways

Overall project implementation will be executed under the supervision of MPWH. The minister of MPWH will play an important and direct role in RAP implementation. Specifically, the roles and responsibilities assigned to the minister include:

- a) Chairing the HSC, as described above
- b) Managing the relationship between the HSC and PIU
- c) Issuing decrees and approving PIU plans related to compensation
- d) Promoting effective coordination among agencies and jurisdictions involved in implementation
- e) Managing relations with donors and other external stakeholders

10.3.3 Project Implementation Unit

Working under the supervision of MPWH and the HSC, the PIU is responsible for all day-to-day aspects of RAP implementation. The tasks relating to land acquisition and RAP implementation to be performed by the PIU include:

- a) Ensuring that adequate information is provided to affected communities regarding the project and RAP provisions, and ensuring that affected persons are consulted regarding project activities and RAP measures pertaining to them.
- b) With the support of the TC, determining the unit compensation rate for each category of lost land, structures and other fixed assets.
- c) Providing compensation at replacement cost for land, structures and other assets directly to affected persons.
- d) Maintaining effective means of coordination with governorates, districts and local councils as necessary for RAP implementation, and ensuring that resettlement-related actions taken by local jurisdictions are consistent with RAP requirements.
- e) Liaising between the TC and governorate-level compensation committees and provide necessary support to them as needed.
- f) Supervising and providing guidance to consultants and the TC in carrying out land survey and census survey.
- g) Arranging HSC meetings and recording results, and work as the HSC secretariat to implement HSC decrees and decisions.
- h) Participating in the grievance review process, contributing to resolution of complaints where possible and directing unresolved complaints to the HSC as necessary.
- i) Conducting internal project monitoring, preparing internal monitoring reports, and supporting the work of those responsible for external project monitoring.
- j) Keeping full records and documentation relating to expropriation of land and other assets, valuation and confirmation of local compensation amounts, payment of compensation and all other forms of cash assistance, and reviewing appropriateness of any donation of communal land.
- k) Monitoring all RAP-related expenditures against budget provisions, and identifying issues that may require allocation of contingency funding.

- l) Establishing a good financial management system within the PIU to be responsible for paying compensation to PAPs after approved by HSC, keeping records and good documentary system to allow both internal and external monitoring, and also ensuring that compensation is not paid for ineligible expenses.
- m) Preparing the final report regarding the whole land acquisition attached to each PAP file including all the original supporting documents to be delivered to the General Authority of Land Survey and Urban Planning as the final legal records of land ownership, and also keeping these documents for future reference.
- n) Facilitating World Bank supervision relating to RAP implementation.
Within the PIU, a land acquisition and resettlement unit has been established, with adequate personnel assigned, with responsibilities clearly defined, and with adequate resources allocated for full RAP implementation.

10.3.4 Technical Committee for Land Acquisition and Resettlement

The primary function of the TC is to establish and manage effective means for valuation of land and other assets that will be affected by YCHP, to establish and administer RAP eligibility criteria for all categories of affected persons, to assess and certify compensation amounts due affected persons, to recommend HSC approval for timely payment of compensation in full to affected persons, and to assist the PIU as necessary to ensure full and effective delivery of all other forms of assistance to affected persons, as required in this RAP.

The TC establishes valuation criteria and local asset prices and, in a manner consistent with the RAP replacement cost criterion, will establish unit compensation rates for all categories of affected land, structures, crops and trees, or other affected assets.

During project implementation, the TC will assist the PIU for delivery of compensation to ensure effective and timely payment to affected persons. The TC also provides support, as warranted, for project monitoring activities relating to acquisition of assets and payment of compensation. As relevant, the TC also assists the PIU in addressing grievances from affected persons relating to acquisition of assets and payment of compensation.

The TC meets on an ad-hoc basis and is funded and supported as necessary by the PIU. The TC is chaired by the general manager of the PIU. Other members are: the PIU project engineer, the financial manager representing the Ministry of Finance, a representative from the Ministry of Endowment, a representative of the State Lands and Real Estate Authority, and a judge nominated by MPWH.

More specifically, the TC has the following responsibilities:

- a) Carry out land survey works based on Aerial maps prepared previously by GIS Centre showing all properties located within the highway corridor and an additional 5m from each side.
- b) Participate in field visits by technical working teams to identify each property, ownership, type of structures, crops or trees, or other assets
- c) locate on maps any type of properties not shown on maps

- d) Participate in the census survey identifying and enumerating all affected persons
- e) Establish the unit compensation rate, consistent with the replacement cost criterion, for categories of land, structures and all other categories of affected assets. The unit cost shall be determined by taking into account the nature of each property, prevailing local market rates, and any extenuating circumstances that add to the value of particular assets, in consultation with the PAPs or their representatives.
- f) Prepare complete detailed lists of PAPs and their properties indicating size and type of plots (e.g., agricultural land, pasture, unutilized land, communal land, residential land, and commercial land), special features (e.g., access to water), size and type of structures, wells or other fixed assets.
- g) Prepare and record documentation that contains reference number, chainage, location, total area, and percentage of area taken, social information, and other relevant data.
- h) Prepare all technical data like plans, photos, and type of structures, wells, plants, lands of all types, primary building materials, and other aspects as relevant.

10.3.5 Governorate Compensation Committees

A compensation committee will be established in each of the three governorates along the YCHP alignment: Aden, Lahj and Taiz. The primary function of these committees is to ensure the accuracy of land ownership documents, and to assist in the process of establishing unit compensation rates for all categories of affected land, structures and other fixed assets that are consistent with the replacement cost criterion. The Compensation Committee will be chaired by a governorate-level Supreme Court judge, and also consists of the following members:

- a) Representative from Ministry of Public Works and Highways
- b) Representative from Ministry of Awqaf
- c) Representative from Land Survey and Urban Planning Authority
- d) Governorate representative - Local Council
- e) Representative from Ministry of Finance

The compensation committee will mainly play the following roles within its governorate:

- a) Review all ownership documents submitted by owners and verify that these documents are accurate and reflect actual ownership, use or occupancy for each affected site
- b) Verify that compensation amounts for each affected person are based on the unit compensation rates established by the TC and approved by the PIU.
- c) Prepare the final list of affected persons, to be verified and authorized through signed endorsement by the governor. Prepare and maintain a complete file for each affected person.
- d) Support and observe PIU procedures for delivery of compensation to affected persons, to ensure effective and timely payment to affected persons during project implementation
- e) Support efforts to resolve compensation disputes or other grievances raised by affected persons in accordance with project grievance procedures.

10.3.6 Other governorate functions and local authorities

Formally, RAP implementation is a national-level responsibility, resting with MPWH and working through its centralized PIU. However, effective implementation will require coordination with the three governorates (Taiz, Lahj and Aden) along the alignment, along with their subordinate district governments, and with local councils and village committees functioning at the village or settlement level.

Governorate and district-level officials have participated in the census and survey process, facilitating the work of survey teams in the field. The governorates also will have a role to play in determining increases to compensation, above the unit compensation rates, to take account of local extenuating circumstances, variation in production output capacity, or other location-specific factors. The cooperation of governorates and districts also will be solicited on an ad-hoc basis for many other aspects of RAP implementation. This may include facilitation of external project monitoring, addressing grievances from affected persons, working with local councils and beneficiary committees to facilitate assistance to significantly affected persons or vulnerable persons, and facilitating local consultations and information disclosure. More specifically, the governor in three governorates will play the following roles:

- a) Appoint the compensation committee in each governorate
- b) Ratify and approve the final compensation lists of each governorate
- c) Seek to resolve disputes which could not be solved by the CCs
- d) Guidance to redress grievance committees

At district level, the local council will have a more direct role in working with the PIU to ensure that local facilities and services that are damaged or disrupted because of the project are rehabilitated or restored. The local council also will play a leading role in formulating, and facilitating the work of village committees. Similar to governorate level officials, the local council may be involved in facilitation of external project monitoring, addressing grievances from affected persons, and facilitating local consultations and information disclosure.

At the village or settlement level, the village level committees - existing formal, informal or customary organizations in local village or settlement - will play an important ad-hoc role in facilitating RAP implementation. It is likely that PIUs will work with these committees to ensure that any communal land donations are accepted only in a manner consistent with RAP requirements, and in devising strategies or opportunities to assist affected persons whose livelihoods are significantly affected, who may lack formal legal rights, who may be displaced from communal land or structures, or who are otherwise vulnerable to disadvantage because of the project.

Where established, the primary function of the **village representative committee** will be to help the PIU provide other assistance to affected persons, and particular circumstances that exist at the local level. Among other potential aspects, village committees may be asked to assist in:

- a) Facilitating local communal land donation in a manner consistent with cultural practice, ensuring that, in each case, the donation is voluntary and does not result in impoverishment or hardship to any users or occupants of the land.
- b) Facilitating the search for, and project acquisition of, alternative lands for significantly affected persons where in-kind land replacement is possible and preferred.
- c) Facilitating engagement with persons using or occupying communal lands, and facilitating rehabilitation or restoration of communal facilities or services.
- d) Witnessing payment of compensation and cash-based assistance to affected persons, and affected persons' receipt of it.
- e) Monitoring whether contractors repair, rehabilitate or replace any walls, irrigation or drainage channels, or other local infrastructure that may be damaged or destroyed in the construction process.
- f) Assisting affected persons in formulating and pursuing grievances.

10.4 Adaptive management arrangements

Effective implementation of land acquisition and resettlement frequently requires adaptation to changes in project design, or a management response to unanticipated conditions that arise in the project area after the RAP is finalized. As stated above, the PIU will establish effective means for managing and resolving issues associated with land acquisition and resettlement as they arise. While the RAP is the instrument that is intended to guide resettlement implementation, the PIU also may determine that alternative actions or approaches are more appropriate if RAP provisions would be obsolete or ineffective because of changes in the project environment. This includes formulating new modes of assistance if unanticipated categories of impact are identified in implementation, altering the timing or sequencing of actions to adjust to shifts in the project implementation timetable, increasing compensation rates if compensation payment is delayed or where inflation is significant, and other responsive actions.

Adaptive management decisions causing deviation from RAP arrangements are brought to the World Bank's attention during project supervision. However, the scope for such adaptive management is limited. No changes will be made to eligibility criteria for resettlement assistance. Unit compensation rates will not be reduced, compensation amounts will not be less than that to be established through application of the unit compensation rates, and other entitlements or forms of assistance to affected persons will not be reduced in scope without the prior concurrence of the World Bank.

10.5 Grievance management system

The project will include multi-level arrangements for registering and addressing grievances and complaints from project-affected people. The primary purpose of the

project grievance management mechanism is to provide clear and accountable means for affected persons to raise complaints and seek remedies when they believe they have been harmed by the project. An effective and responsive grievance management system also facilitates project progress, by reducing the risks that unaddressed complaints eventually lead to construction delays, lengthy court procedures, or adverse public attention.

10.5.1 Informing project-affected persons about complaint processes

In collaboration with the three governorate administrations involved in the project area, the PIU will take steps to inform project-affected persons about means available to them for lodging complaints. The information will pertain both to informal or customary processes for resolving local property conflicts as well as to the formal mechanism established for PIU purposes. The PIU will also ensure that detailed specific information (including locations and contact information for lodging complaints) is disseminated at the village or hamlet level, through distribution of posters, pamphlets, or other means.

10.5.2 Methods for lodging complaints

The grievance management system relies both on informal or customary means for resolving local property issues as well as a formal mechanism established for project management purposes. Customary arrangements often resolve issues in a timely and effective manner because they are already known within the locality and because local people may be more inclined to accept results as legitimate. Similarly, many complaints relate not to land acquisition or resettlement arrangements, but instead to incidental damage to property caused by contractors. Under such circumstances, it may be more efficient and less costly for the affected person and the contractor to negotiate a solution directly, or for the affected person to seek satisfaction through customary means. Also, complaints relating to use or occupancy of waqf land may best be pursued, at least initially, through discussion with local tribe leaders or Sheikhs.

Any affected person may lodge a complaint through the formal GRM process, regardless of whether informal or customary arrangements for addressing the issue have been pursued. The PIU will designate an official within each governorate as well as district as the contact person for receiving complaints. If the grievance cannot be resolved to the satisfaction of the affected person at the governorate level, the affected person may raise the complaint to the PIU grievance committee at central level. The project grievance management system is available to all affected persons, without charge.

If a grievance remains unresolved following application of the Grievance Redress Mechanism, the affected person can initiate legal proceedings in accordance with governorate and national law (Yemen Constitution, Article 51) and may have recourse to the Appellate Court or Supreme Court, as warranted.

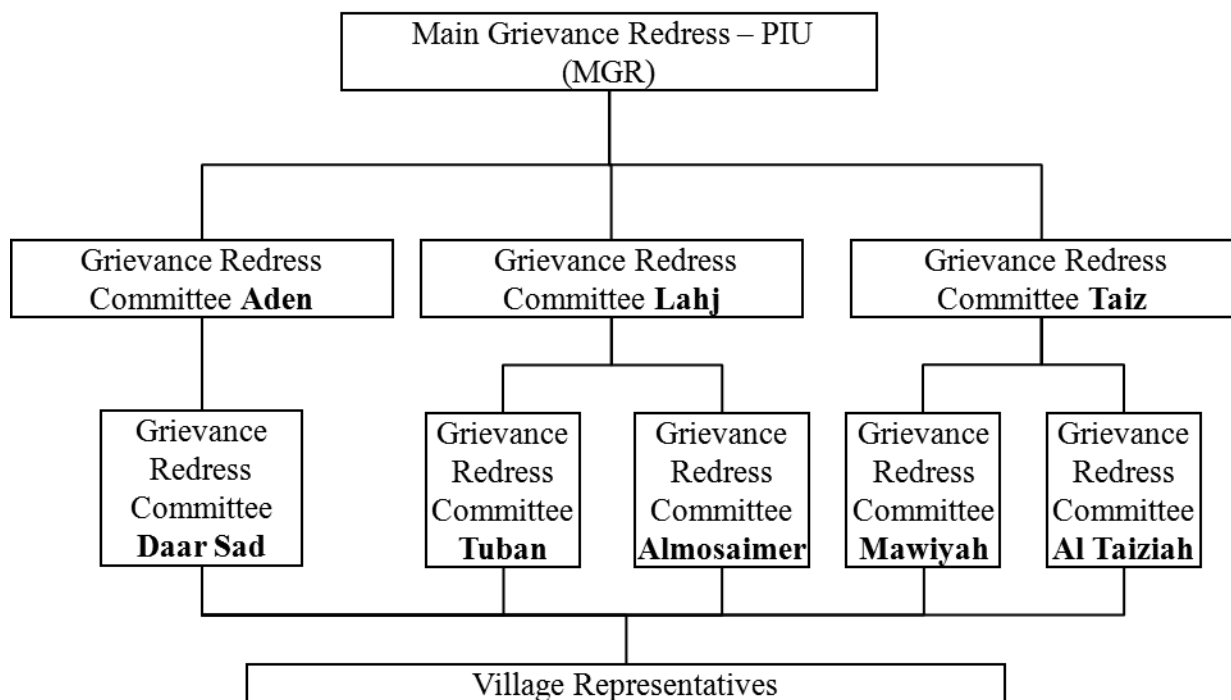
The person or entity undertaking external monitoring will also assist in ensuring that affected persons are aware of means available to them for raising complaints, and will report on the effectiveness of the grievance management system.

10.5.3 Organizational arrangements for grievance review and appeal

Organizational arrangements for grievance redress will be established at four levels as follows:

- Grievances redress committee within PIU: it will consist of PIU director, social specialist and a third person acting as adjudicator.
- Grievances redress committee at governorate level: A GRM committee will be established in each governorate. It will consist of governor, vice governor and a secretary.
- Grievances redress committee at district level: A GRM committee will be established in each district. It will consist of the district head and two elected local council members.
- Villager’s representative committee: The committee will be the lowest level of organization receiving the complaints from the people within the village.

Grievance Redress Management System (GRMS)



10.5.4 Performance standards for responding to grievances

The PAP can send their complaints directly to any of the committees described above. Upon initial receipt of oral or written complaints, the responsible contact person conducts an initial review of relevant circumstances and provides an initial response to the affected person within 15 days. If additional time is needed for discussions or negotiations, the governorate responds to the affected person with a recommendation for resolution within an additional 15 days (or 30 days from the time of complaint receipt). If resolution is not achieved or imminent at the level receiving the complaints within 30 days of receipt, or if the affected person is not satisfied with the recommended action reached, the complaint is elevated to the next higher level grievance committee. The committee should seek any additional information it deems relevant and respond to the affected person within 30 days after receipt of the complaint. Of course, the higher level grievance committee may take additional time to address a complaint in circumstances in which the affected person agrees that additional discussion or negotiation may be warranted.

10.5.5 Recording grievances and status of response

The designated contact person within each of the committee bears primary responsibility for recording receipt of each complaint, whether received orally or in writing. At the end of each month, each committee reports to the PIU grievance committee on the number and subject of new complaints received, and the status of complaints, if any, that remain under resolution. The report also informs the grievance committee of complaints that could not be resolved at the local level and are being elevated to the PIU committee's attention. The PIU grievance committee each month aggregates information received from the lower level committees into a status report, indicating the number and subject of complaints in the system (including active complaints at both the governorate and PIU committee level). The monthly status report also provides up-to-date information on the number and subject of complaints that have been resolved, and the manner in which they have been resolved. The monthly status reports are made available for external monitoring and to the World Bank for project supervision and project evaluation purposes.



MINISTRY OF PUBLIC WORKS AND HIGHWAYS (MPWH)

Environmental & Social Impact Assessment (ESIA) / Environment & Social Management Plan (ESMP) report for Yemen
International Corridor Highway Project section between Taiz and the city of Aden (140 km)

ANNEXURES TO ESIA

Annexure-3.1

World Health Organization Ambient Air Quality Guidelines

Parameters	Averaging Period	Guideline value in mg/m³
Sulfur dioxide (SO ₂)	24-hour 10 minute	125 (Interim target-1) 50 (Interim target-2) 20 (guideline) 500 (guideline)
Nitrogen dioxide (NO _x)	1-year 1-hour	40 (guideline) 200 (guideline)
Particulate Matter PM ₁₀	1-year 24-hour	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline) 150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter PM _{2.5}	1-year 24-hour	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline) 75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

**Source: Air Quality Guidelines Global Update, World Health Organization (WHO), 2005*

Annexure-3.2

Ambient Noise Monitoring Standards

Area/Class	One Hour L_{Aeq} (dB(A))	
	Daytime 07:00 AM- 22:00 PM	Night Time 22:00 PM-07:00 AM
Residential, Institutional and Educational Areas	55	45
Industrial and Commercial Areas	70	70

**Source: Guidelines for Community Noise, World Health Organization (WHO), 1999*

Note:

1. *Guidelines values are for noise levels measured out of doors.*
2. *L_{Aeq} (dB(A)) denotes the time weighted average of the level of decibels on scale A which is related to Human Beings*
3. *A “decibel” is the unit in which noise is measured*
4. *“A” in dB (A) L_{eq} , denotes the frequency weighted in the measurement of the noise corresponds to frequency response characteristics of the human ear.*
5. *L_{eq} : It is an energy means of the noise level over a specified period.*

Yemeni Standards for Drinking Water Quality

S. No.	Parameters	Unit	Maximum Value
Physical Characteristics			
1.	Colour		15
2.	Turbidity,	NTU	05
3.	Temperature	°C	25
4.	pH Value		6.5-9.0
5.	Conductivity	(µmhos/cm)	2500
Chemical Characteristics			
1.	Total Dissolved Solids	mg/l	1500
2.	Total Hardness	mg/l	500
3.	Bicarbonate	mg/l	500
4.	Chloride	mg/l	600
5.	Sulphate	mg/l	400
6.	Calcium	mg/l	200
7.	Magnesium	mg/l	30-150
8.	Sodium	mg/l	400
9.	Potassium	mg/l	12
10.	Iron	mg/l	01
11.	Manganese	mg/l	0.2
12.	Copper	mg/l	01
13.	Zinc	mg/l	15
14.	Aluminium	mg/l	0.2
15.	Nickel	mg/l	0.02
Toxic Organic Pollutants			
1.	Parathion	mg/l	0.0035
2.	Endrin	mg/l	0.0002
3.	Lindane	mg/l	0.004
4.	Methoxychlor	mg/l	0.01
5.	Toxaphene	mg/l	0.0002
6.	Malathion	mg/l	0.19
7.	Dimethoate	mg/l	0.0002
8.	Diazinon	mg/l	0.02
9.	Hexachlor Cylohexan	mg/l	0.04
10.	Acetic Acid	mg/l	0.1
11.	Propionic Acid	mg/l	0.01
Toxicants			
1.	Lead	mg/l	0.05
2.	Selenium	mg/l	0.01
3.	Arsenic	mg/l	0.01
4.	Chromium	mg/l	0.05
5.	Cyanide	mg/l	0.1
6.	Cadmium	mg/l	0.005

S. No.	Parameters	Unit	Maximum Value
7.	Mercury	mg/l	0.001
8.	Barium	mg/l	0.5-1.0
9.	Silver	mg/l	0.01-0.1
10.	Fluorine	mg/l	1.5-0.5
11.	Antimony	mg/l	0.005
12.	Barium	mg/l	0.3-0.1
13.	Total Trihalomethans	µg	150
Chemical Pollutants			
1.	Nitrate	mg/l	10-50
2.	Ammonium	mg/l	0.3-0.5
3.	Nitrite	mg/l	02
4.	Phosphate	mg/l	0.5
Radioactive Materials			
1.	Beta (β) emitters	Becquerel (Bq)	0.1
2.	Alpha (α) emitters	Becquerel (Bq)	01
Microbiological Contaminants			
1.	Faecal Coliforms	Cell/100 ml	10-15

Note:

- ❖ 30 mg/l if Sulphate is 250 mg/l and more and 150 mg/l if Sulphate is less than 250 mg/l.
- ❖ Total pesticides must not exceed than 0.1 mg/l.
- ❖ Includes Chloroform, Bromoform, Bromide, Chloromethane, Dibromochloromethane

a) Small Surface Water Resources

S. No	Land plot no	location	Land use
Taiz			
1	Unused land 97	1.1	Water pass
2	Unused land 85	1.1	Water pass
3	Unused land 76	1.1	Water pass
4	Cash crop 36	1.1	Water pass
5	Cash crop 37	1.1	Water pass
6	Unused land 79	1.1	Water pass
7	Unused land 80	1.1	Water pass
8	Unused land 91	2	Water pass
9	Unused land 92	2	Water pass
10	Unused land 87	2	Water pass
11	Unused land 13	2.35	Water pass
12	Unused land 14	3.63	Water pass
13	Unused land 15	3.65	Water pass
14	Unused land 17	3.85	Water pass
15	Cropland 18	3.88	Water pass
16	Unused land 90	4.05	Water pass
17	Crop cash 26	4.075	Water pass
18	Unused land 136	4.515	Water pass
19	Waters land 6	4.56	Water pass
20	Unused land 37	4.575	Water pass
21	Unused land 38	4.795	Water pass
22	Cash crop 187 a	4.925	Water pass
23	Unused land 120	5.025	Water pass
24	Unused land 39	5.05	Water pass
25	Unused land 74	6.025	Water pass
26	(Unused land) land area 2	6.09	Water pass
27	Unused land 138	6.31	Water pass
28	Cropland 119	6.65	Water pass
29	Cash land 175a	6.775	Water pass
30	Cropland 134	6.87	Water pass
31	Unused land 48	7.475	Water pass
32	Unused land 64,145	7.5	Water pass
33	Unused land 190	8.41	Water pass
34	Unused land 168	8.46	Water pass
35	Unused land 205	8.5	Water pass
36	Unused land 164	8.5	Water pass
37	Unused land 229	8.55	Water pass
38	Unused land 211	8.6	Water pass
39	Unused land 169	8.625	Water pass
40	Unused land 198	8.625	Water pass
41	Cropland 792	9.325	Water pass
42	Unused land 197	9.325	Water pass
43	Unused land 182	9.735	Water pass

S. No	Land plot no	location	Land use
Taiz			
44	Unused land 182	9.885	Water pass
45	Unused land 199	9.975	Water pass
46	Cropland 994	10.3	Water pass
47	Unused land 200	10.3	Water pass
48	Unused land 196	10.39	Water pass
49	Unused land 170	10.425	Water pass
50	Unused land 188	10.575	Water pass
51	Unused land 207	10.625	Water pass
52	Unused land 173	11.575	Water pass
53	Unused land 209	12.425	Water pass
54	Unused land 183	12.5	Water pass
55	Unused land 357	12.634	Water pass
56	Unused land 174	12.9	Water pass
57	Unused land 304	12.9	Water pass
58	Unused land 304	12.9	Water pass
59	Unused land 291	13.4	Water pass
60	Unused land 305	14.275	Water pass
61	Unused land 285	14.75	Water pass
62	Unused land 299	14.925	Water pass
63	Unused land 75 a	15.5	Water pass
64	Unused land 5	15.56	Water pass
65	Unused land 40	16.225	Water pass
66	Waters land 3	16.45	Water pass
67	Unused land 41	16.595	Water pass
68	Unused land 43	16.77	Water pass
69	Unused land 49	16.77	Water pass
70	Unused land 140	16.875	Water pass
71	Unused land 50	16.89	Water pass
72	Unused land 65	17.625	Water pass
73	Unused land 50	17.7	Water pass
74	Cropland 37	17.925	Water pass
75	Cropland 32	18.875	Water pass
76	Unused land 53	19.29	Water pass
77	Unused land 52	19.3	Water pass
78	Unused land 54	19.76	Water pass
79	Unused land 55	20.425	Water pass
80	Unused land 58	20.87	Water pass
81	Unused land 57	22.3	Water pass
82	Unused land 60	22.588	Water pass
83	Unused land 130	22.8	Water pass
84	Cropland 171	22.9	Water pass
85	Unused land 146	22.925	Water pass
86	Cropland 263	22.95	Water pass
87	Cropland 604	23.025	Water pass
88	Cropland 48	23.05	Water pass

S. No	Land plot no	location	Land use
Taiz			
89	Unused land 155	23.35	Water pass
90	Unused land 186	23.45	Water pass
91	Unused land 181	23.6	Water pass
92	Unused land 203	23.825	Water pass
93	Unused land 190	23.825	Water pass
94	9 unused land	23.85	Water pass
95	Unused land 212	23.95	Water pass
96	Unused land 172	24.025	Water pass
97	Unused land 213	24.475	Water pass
98	Unused land 189	24.675	Water pass
99	Unused land 162	24.95	Water pass
100	Cash crop 256	24.95	Water pass
101	Cropland 191	25.25	Water pass
102	Cropland 219	25.325	Water pass
103	Unused land 220	25.325	Water pass
104	Cropland 1106	25.525	Water pass
105	Cropland 653	26	Water pass
106	Unused land 214	26.16	Water pass
107	Unused land 173	26.275	Water pass
108	Unused land 194	26.35	Water pass
109	Unused land 208a	26.525	Water pass
110	Unused land 173	26.925	Water pass
111	Unused land 209	26.96	Water pass
112	Unused land 189	27.05	Water pass
113	Unused land 225	27.05	Water pass
114	Unused land 180	27.1	Water pass
115	Unknown land 35	27.21	Water pass
116	Cash crop 556	27.275	Water pass
117	Cash crop 176	27.55	Water pass
118	Unused land 278	27.575	Water pass
119	Unused land 279	27.625	Water pass
120	Unused land 276	27.8	Water pass
121	Unused land 281	28.625	Water pass
122	Crop 1422	28.675	Water pass
123	Unused land 273	28.96	Water pass
124	Unused land 274	28.98	Water pass
125	Unused land 271	29.18	Water pass
126	Unused land 11	29.55	Water pass
127	Cash cropland 60	30.125	Water pass
128	Cash crop 24	30.225	Water pass
129	Unused land 22	30.225	Water pass
130	Cash crop 463 a تا عورزم دجوتال	30.425	Water pass
131	Cropland 23	31.875	Water pass
132	Unused land 116	31.9	Water pass
133	Unused land 27	32.15	Water pass

S. No	Land plot no	location	Land use
Taiz			
134	Unused land 28	33.08	Water pass
135	Unused land 30	33.275	Water pass
136	Unused land 118	33.7	Water pass
137	Unused land 31	33.775	Water pass
138	Unused land 73	34.61	Water pass
139	A cash crop 169	34.615	Water pass
140	Unused land 32	35.81	Water pass
141	Cash 170a	35.98	Water pass
142	33 unused land	36.26	Water pass
Lahj			
143	Watershed 17	42.625	Waterway
144	Watershed 18	43.225	Waterway
145	Watershed 19	44.125	Waterway
146	Unknown land 74	44.6	Waterway
147	Unknown land 75	45.515	Waterway
148	Unknown land 77	45.55	Waterway
149	Unknown land 79	45.65	Waterway
150	Watershed 20	50.4	Water cross
151	Watershed 16	50.45	Water cross
152	Watershed 15	51.625	Water cross
153	Watershed 14	53.4	Water cross
154	Land area 2	53.925	Water cross
155	Water shade 10	60.55	Water cross
156	Water shad 13	61.35	Water cross
157	Watershed 22	61.375	Water cross
158	Watershed 23	63.125	Water cross
159	Watershed 24	65.075	Water cross
160	Watershed 12	67.25	Water cross
161	Cropland 220	75.375	Water cross
162	Water course	87.225	Water cross
163	Water shade area 4	87.75	Water cross
164	Seasonal water course	89.075	Water cross
165	Seasonal water course	90.55	Water cross
166	Seasonal water course	127.975	Water cross
Aden			
-	-	-	-

b) Access to Ground Water Resources

S.No	Land plot no	location	Land use
TAIZ			
1	Cropland 403A 76A	1.925	Well
2	Cropland 48	4.575	Well
3	Cropland 686	19.28	Well
4	Unused land 212	21.375	Well
5	Cropland 791	23.025	Well
6	Manmade 107	23.125	Residential + well
7	Cropland 779A	23.425	Well
8	Cash crop 431	24	Well
9	cropland 1098	24.575	Well
10	Manmade 89	25.125	Pump room
11	Manmade 77	25.375	Pump room
12	manmade 1	29.2	Well
13	Cropland 874	29.85	Well
14	Manmade 24	31	Well
LAHJ			
15	Building 5	44.2	Pump room
ADEN			
-	-	-	-

c) Species wise Trees to be Affected along the Project Alignment

Governorate	District	Number of Trees														Total
		Orange	Qat	Palm	Other Trees	Mango	Guava	Papaya	Banana	Apple	Apricot	Figs	Lemon	Pomegranate	Pepper	
Aden	Daar Sad	0	0	0	0	0										0
Sub-Total	0.00	0	0	0	0	0										0
Lahj	Almosaimer		22013	3	6795	145	87	10	450			28	13	3		2954700
	Tuban				956	17		175	220		2	30	37			1437
Sub-Total	30984	0	22013	3	7751	162	87	185	670	0	2	58	50	3	0	30984
Taiz	Al Taiziah	0	3453	1	2471	2	16		2	2				21	280	6248
	Mawiyah	8	386584	10	8657	358	66	2	122			5		7	24	395843
Sub-Total	402091	8	390037	11	11128	360	82	2	124	2	0	5	0	28	304	402091
Total	433075	8	412050	14	18879	522	169	187	794	2	2	63	50	31	304	433075

Detailed Land use maps of the project road alignment

②

777732378 / 777732378

دعاج علي صالح البحر / الشيخ المصطفى

رافع محمد علي البحر / طالب / حرم

عبد صالح علي الطراد / موظف / لعصيب

عالمب اذبال غالب / عامل / لعصيب

رشاد يحيى محمد بقران / حراغ / لعصيب

كبير علي محمد بقران / حراغ / لعصيب

محمد علي محمد عبد / عامل / طالب

صالح محمد اليعقوبي / عامل

شكيب نزال غالب راوغ / حراغ

عز الدين علي ناجي سيف / عامل / الرباط

اصيل عبد لطفان / عامل / الحميراء




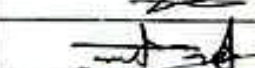








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MINISTRY OF PUBLIC WORKS AND HIGHWAYS
 Consultancy Services for Environmental and Social Safeguards Studies related to the Yemen International Corridor Highway Project section between Taiz and the city of Aden (140 km)
 Questionnaire for Public Consultation

Questionnaire No. _____
 Name of the Village / Township: Al-kharaz Governorate: Taiz
 Chainage / Km: 12+100 Date 24/12/2013 Time: 10:00 AM
 Hours: _____

LIST OF PARTICIPANTS

Name	Occupation / Profession	Age	Sex	Signature
Ahmed Mohammed Aoiad	Farmer	50	male	
Yousif Ali Abdo	Farmer	33	///	
Mohammed M. Aoiad	///	60	///	
Hassan bin Hassan	///	50	///	
Aidel Ahmed Saced	teacher	40	///	
Hassan Abdillah Al-Sabe	///	42	///	
Mabil Mansour Abdillah	///	39	///	
Hajer Abdilh Abdo	///	26	female	
Sare Abdilh Abdo	///	23	///	
Mogbal Yaser Mohamed	///	40	male	
Mohammed Ahmed Salah	///	41	///	
Ali Ahmed Salah	///	36	///	

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MINISTRY OF PUBLIC WORKS AND HIGHWAYS

Consultancy Services for Environmental and Social Safeguards Studies related to the Yemen International Corridor Highway Project section between Taiz and the city of Aden (140 km)
Questionnaire for Public Consultation

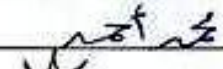





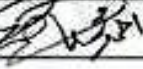
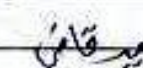



Questionnaire No. _____

Name of the Village / Township: Al-Zunger Governorate: Taiz

Chainage / Km: 24 + 00 Date 19/12/2012 Time: 10:00 AM

Hours: 0.5 hour

LIST OF PARTICIPANTS





Name	Occupation / Profession	Age	Sex	Signature
Mohamed Ahmed Shadad	retired	64	M	
Mohamed Ahmed Alqulbi	Labour	35	M	
Jameal Saif Alshamsi	solidex	27	M	
Haniza Ahmed	businessman	25	M	
Mohamed Ali Alamsi	Student	30	M	
Fawaz Mohamed Jabala	~	16	M	
Salah Hussein	Labour	55	M	
Ahmed Mohamed Mahjub	solidex	32	M	
Muath Saeed Qaed	Labour	18	M	
Alezi Ben Alezi	Student	23	M	
Ghazi Mohamed Hamad	~			

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MINISTRY OF PUBLIC WORKS AND HIGHWAYS
 Consultancy Services for Environmental and Social Safeguards Studies related to the Yemen International Corridor Highway Project section between Taiz and the city of Aden (140 km)
Questionnaire for Public Consultation

Questionnaire No. 002
 Name of the Village / Township: Shu'ayb Mahras Governorate: Taiz
 Chainage / Km: 24 + 900 Date 19/12/2013 Time: 12:00
 Hours: 0.25 hour

LIST OF PARTICIPANTS









Name	Occupation / Profession	Age	Sex	Signature
Sadeq Ahmed	labour	48	male	
Ghaleb Saif	solidure	50	~	
Arif Ahmed Saeed	labour	43	~	
Abdululla Abdo Ahmed	~	45	~	
Ahmed Mossier Naji Alshuaib	~	51	~	

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MINISTRY OF PUBLIC WORKS AND HIGHWAYS
 Consultancy Services for Environmental and Social Safeguards Studies related to the Yemen International Corridor Highway Project section between Taiz and the city of Aden (140 km)
 Questionnaire for Public Consultation

Questionnaire No. _____
 Name of the Village / Township: Al-Adad/Asraf Governorate: Taiz
 Chainage / Km: 27+000 Date 20/12/2013 Time: 11:30 AM
 Hours: _____

LIST OF PARTICIPANTS

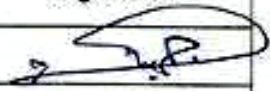








Name	Occupation / Profession	Age	Sex	Signature
Fays Hassan Nasser	farmer	25	male	
Moder khaild Salem	---	16	---	
Hassan Nasser Ali Raisem	---	40	---	
Saeed Mohammed Salah	---	50	---	
Mohammed Ali Al-gradi	---	35	---	
Mohammed Ali Ahmed Labow	---	23	---	
Abdullah Ahmed Mohamed	---	25	---	
khaid Al-jarbani	driver	28	---	

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MINISTRY OF PUBLIC WORKS AND HIGHWAYS
 Consultancy Services for Environmental and Social Safeguards Studies related to the Yemen International Corridor Highway Project section between Taiz and the city of Aden (140 km)
 Questionnaire for Public Consultation

Questionnaire No. _____
 Name of the Village / Township: Al-hajar (Al-Saray) Governorate: Taiz
 Chainage / Km: 28+300 Date 21/12/2013 Time: _____
 Hours: _____

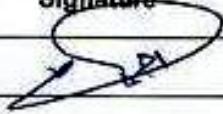



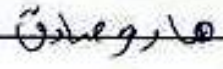

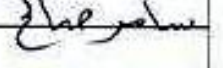

LIST OF PARTICIPANTS

Name	Occupation / Profession	Age	Sex	Signature
Jamel Ahmed Nasser	Farmer	30		
Mohammed Ahmed Qaid	~	22		
Khakel Al-Jarbone	Soilder	24		
Mohammed Qied Al-Saray	farmer	25		
Noman Najay	~	50		
Mohammed Fouad Al-Saray	Student	17		
Waled Ahmed	Soilder	33		
Ahmed Mohammed Nasser	Farmer	60		
Rashad Ahmed Mohamed	Student	20		
Qasem Salah Nasser	~	18		
Nabih Abdullah Al-Saray	Farmer	30		

MINISTRY OF PUBLIC WORKS AND HIGHWAYS
 Consultancy Services for Environmental and Social Safeguards Studies related to the Yemen International Corridor Highway Project section between Taiz and the city of Aden (140 km)
Questionnaire for Public Consultation

Questionnaire No. _____
 Name of the Village / Township: AL-ESAB Governorate: Taiz
 Chainage / Km: 29+700 Date 22/12/2013 Time: _____
 Hours: _____

LIST OF PARTICIPANTS

Name	Occupation / Profession	Age	Sex	Signature
Ahmed Bin Ahmed	labour	20	male	
Majed Mohammed	Driver	28	~	
Abdo Mohammed	labour	32	~	
Mahammed Obeed	~	23	~	
Mahammed Majee	Farmer	25	~	
Abd Al-fatah Madhesh	~	34	~	
Abd Al-Rahem Salah	Student	18	~	
Haron Sateek	Student	12	~	
Farooq Majee	labourer	23	~	
Ahmed Mohammed	farmer	25	~	
Khalid Ali Mansab	labourer	30	~	
Samer Salah	farmer	35	~	
Ali Al-bashry	farmer	35	~	
Ameen Ali	~	38	~	
Maktar Madhesh	~	28	~	












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MINISTRY OF PUBLIC WORKS AND HIGHWAYS

Consultancy Services for Environmental and Social Safeguards Studies related to the Yemen International Corridor Highway Project section between Taiz and the city of Aden (140 km)
Questionnaire for Public Consultation

Questionnaire No. _____
Name of the Village / Township: Thaubeh Governorate: Taiz
Chainage / Km: 31+500 Date 22/12/2013 Time: 11:00
Hours:

LIST OF PARTICIPANTS

Name	Occupation / Profession	Age	Sex	Signature
Ibraheem Ameen Ahmed	farmer	21	male	
Abd Al-Qasem Salah	~	22	~	
Talal Abdo Mohammed	~	19	~	
Masa Bader	~	24		
Abdo Mohammed Harmad	~	18		
Ahmed Madhakh	~	50		
Ibraheem Mohammed	~	19		
Rafeeq Mohammed Salah	~	19		
Mafeed Salah	~	20		
Moadid Abdullah	~	27		
Tameem Mohammed	~	20		
Abdullah Mohammed	~	23		
Mohammed Ali	~	15		
Blegh Abdullah	~	16		
Ali Maheeb	~	24		
Tareq Maheeb	~	30		

13





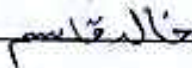

MINISTRY OF PUBLIC WORKS AND HIGHWAYS

Consultancy Services for Environmental and Social Safeguards Studies related to the Yemen International Corridor Highway Project section between Taiz and the city of Aden (140 km)
Questionnaire for Public Consultation

Questionnaire No. _____
Name of the Village / Township: Shah Al-Kabsh Governorate: Taiz
Chainage / Km: 32+600 Date 22/12/2013 Time: _____

Hours: _____

LIST OF PARTICIPANTS


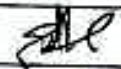




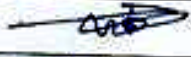

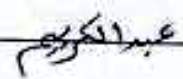
Name	Occupation / Profession	Age	Sex	Signature
Majed Saeed Qasem	Farmer	32	male	
Mahammed Madhash	~	72		
Hamed Abdo Sait Ali	~	22		
Abdullah Madhash Ahmed	~	40		
Ahmed Mohammed Madhash	~	25		
Ahmed Mohammed Kalab	~	40		
Mohammed Ali Ahmed		35		
Khalid Ahmed Ali	~	40		
Khalid Qasem Maghel	~	70		
Mohammed M. Othman	~	16		
Mohammed Abdullah Maser	~	20		
Saeed Mohammed Qasem	~	40		

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MINISTRY OF PUBLIC WORKS AND HIGHWAYS
 Consultancy Services for Environmental and Social Safeguards Studies related to the Yemen International Corridor Highway Project section between Taiz and the city of Aden (140 km)
 Questionnaire for Public Consultation

Questionnaire No. _____
 Name of the Village / Township: Thabk Governorate: Taiz
 Chainage / Km: 33+300 Date 22/12/2013 Time: 11:30
 Hours: _____

LIST OF PARTICIPANTS

Name	Occupation / Profession	Age	Sex	Signature
Sagheer Mogbel	Student	16	M	
Sadam Abdo Ali	~	20	M	
Mohamed Mohsen	Farmer	25	M	
Abdulbasset Anwar	~	23	M	
Waleed Mohsen	Student	18	M	
Mohamed Mogbel	~	18	M	
Mohamed Abdo Saif	~	19	M	
Habab Ahmed	Labourer	23	M	
Sadam Kasem	Student	22	M	
Mohsen Ahmed	Labourer	45	M	
Hussein Abdo Selam	~	21	M	
Aidaros Ali Saeed	Student	20	M	
Kaise Abdulkareem	~	22	M	

(15)






MINISTRY OF PUBLIC WORKS AND HIGHWAYS

Consultancy Services for Environmental and Social Safeguards Studies related to the Yemen International Corridor Highway Project section between Taiz and the city of Aden (140 km)
Questionnaire for Public Consultation

Questionnaire No. _____
Name of the Village / Township: Al-duraja Governorate: Lahj
Chainage / Km: 46 +600 Date 25/12/2013 Time: _____

Hours: _____

LIST OF PARTICIPANTS

Name	Occupation / Profession	Age	Sex	Signature
Mohammed Saday Thalabeh	farmer	29	male	
Ali Salah Nasher	~	40	~	
Basem Saif Ahmed	~	30	~	
Badar Yahia Barawsh	~	37	~	
Ali Salah Ali Sade	Builder	35	~	
Salim Taleb	Solidure	42	~	
Mohssen Salah Ali	~	43	~	
Nasser Taleb	farmer	30	~	
Mohammed Saleh Ali	Solidure	38	~	
Bassem Saday Nasser	farmer	21	~	

Annexure 10.1
Draft Agreement between MPWH and EPA

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Partnership Agreement

between the

Ministry of Public Works and Highways, PIU for the Corridor Highway
and
Yemen Environment Protection Authority, Ministry of Water and Environment

Republic of Yemen

Background and Context

The Government of Yemen started in 2003 to conceptualize and design a completely new dual carriageway highway between Aden and the border with Saudi Arabia (“Saada–Aden Yemen International Corridor Highway” or “SAYICH”). The new highway will provide the country with a 710 km long North-South route that will adequately serve its current and future transport needs. Detailed and in-depth studies to select the best overall highway alignment and the most appropriate technical design solutions were carried out between 2003 and 2005 by the GoY using international consultants.

The first section of the new highway to be built is between Aden and Taiz, with a length of 140 km. (i) The Government of the Kingdom of Saudi Arabia agreed in early 2013 to fund the construction of the first 85 km of this section between the city of Taiz and the locality of Noubat Dokaim. Loan and Grant Agreements totaling US\$ 320 million were signed between the Saudi Fund for Development (SFD) and the GoY in March 2013. The tender for the construction of these 85 km was formally launched on June 30, 2013. It is expected that contracts for the civil works can be awarded before end of 2013 and construction works will start early in 2014. (ii) The World Bank (IDA) is expected to fund the remaining 55 km section between Noubat Dokaim and Aden through a Grant of US\$ 150 million. (iii) The Government of Yemen is in the process of identifying additional sources of financing for the sections of the SAYICH to the North of Taiz.

Environmental Impacts of SAYICH and its management

The construction of the new dual carriageway highway along a new alignment will have significant environmental impacts. These could include increased levels of pollutant emissions, though the reduction in congestion may actually lead to lower emissions, when compared to the situation without the project. Of particular concern could be increased levels of noise close to sensitive receptors like hospitals, mosques, or schools located close to the proposed alignment. Other impacts would depend on the location and terrain – such as erosion on slopes in the hilly/mountainous regions, changes to drainage in valleys, etc. Other impacts on the people and their properties are also envisaged. The MPWH has commissioned

an Environmental and Social Impact Assessment (ESIA) to study these impacts. The ESIA will systematically identify, and appropriately manage these impacts through a hierarchy of avoidance, minimization and compensation/ mitigation in case of adverse impacts and enhancement in case of positive impacts, in line with applicable Yemeni law as well as the World Bank's policies.

In line with the Law no. 26 of 1995 and subsequent bylaw 148 of 2000, the MPWH has been working with the EPA to ensure that the legal requirements for managing these important issues are being met in a timely manner during the course of the preparation of the ESIA for the Aden-Taiz section. Both parties have realized the advantages of early and candid interaction and have come to the following understanding regarding strengthening their partnership:

Purpose of the Agreement

This agreement is being entered into to ensure that the SAYICH program is prepared and implemented fully in line with applicable Yemeni environmental laws and World Bank's environmental policies.

Roles and Responsibilities

MoPWH as the project OWNER:

- a) Shall prepare the Terms of Reference for Environmental and Social Impact Assessment (ESIA) studies for each road section included in the Program;
- b) Shall supervise the consultant hired for such ESIA to ensure that the process and outputs address the Terms of Reference;
- c) Shall share the outputs with EPA in a timely manner to ensure its review and clearance, with any conditions that the review may identify as necessary;
- d) Shall cause the Contractor selected for implementation of each road section in compliance with the Environmental and Social Management Plan (ESMP) for that section;
- e) Shall facilitate the review of implementation of the ESMP provisions by the EPA in line with the timeline agreed for each section, a format for which is placed at Annex 1, in advance, preferably at the time of the approval of the ESIA;
- f) Shall cause the Contractor to undertake reasonable steps to ensure that any shortcomings identified during the review of implementation are dealt with in line with applicable laws/guidelines/policies;
- g) Shall bear the costs of the logistics involved – such as site visits, sample collection and analysis, and also costs of mitigation measures agreed for implementation for environmental protection/enhancement

YEPA as the custodian of Yemen's environmental resources:

- a) Shall ensure that the reviews it is mandated to carry out are completed in a timely manner once it receives the necessary information and documentation;
- b) Shall provide timely advice and/or instructions as necessary to facilitate the ESIA preparation in line with applicable Yemeni laws;

- c) Shall review and, where applicable, clear the ESIA and ESMP for each road section presented to it by the MoPWH;
- d) Shall participate in reviews, including site visits as agreed with MoPWH, during implementation to confirm that the ESMP is being implemented in an acceptable manner;
- e) Shall provide clear and timely advice in cases where it observes deviations from the requirements set out in the applicable laws/policies/guidelines;
- f) Shall confirm that the agreed action plans for any corrections are realistic and implementable as well as, where agreed with MoPWH in advance, that these are being implemented.