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URBAN POLICY & STRATEGIC PLANNING
P & D DEPARTMENT GOVT OF SINDH

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

KARACHI NEIGHBORHOOD IMPROVEMENT PROJECT

"EDUCATIONAL AND CULTURAL ZONE (PRIORITY PHASE – I) SUBPROJECT"

OCTOBER 2017

EMC Pakistan Private Limited

Directorate of Urban Policy & Strategic Planning, Planning & Development Department, Government of Sindh

Educational and Cultural Zone (Priority Phase – I) Subproject

Karachi Neighborhood Improvement Project (P161980)

Environmental and Social Management Plan (ESMP)

October 2017

Executive Summary

Government of Sindh with the support of World Bank is planning to implement "Karachi Neighborhood Improvement Project" (hereinafter referred to as KNIP). This project aims to enhance public spaces in targeted neighborhoods of Karachi, and improve the city's capacity to provide selected administrative services. Under KNIP, the Priority Phase – I subproject is Educational and Cultural Zone (hereinafter referred to as "Subproject"). The objective of this subproject is to improve mobility and quality of life for local residents and provide quality public spaces to meet citizen's needs.

The Educational and Cultural Zone (Priority Phase – I) Subproject ESMP Report is being submitted to Directorate of Urban Policy & Strategic Planning, Planning & Development Department, Government of Sindh in fulfillment of the conditions of deliverables as stated in the TORs.

Overview the Sub-project

Educational and Cultural Zone (Priority Phase – I) Subproject forms a triangle bound by three major roads i.e. Strachan Road, Dr. Ziauddin Ahmed Road and M.R. Kayani Road. Total length of subproject roads is estimated as 2.5 km which also forms subproject boundary.

ES1: Educational and Cultural Zone (Priority Phase – I) Subproject

The following interventions are proposed in the subproject area: three major roads will be rehabilitated and repaved and two of them (Strachan and Dr Ziauddin Road) will be made one way with carriageway width of 36ft. (3 lanes), 6ft. wide cycle strip/lane and 6ft. (Min) side walk on one side of the road and 6-18ft. wide footpath on the other side (depending on the available ROW). Remaining two minor roads will be closed for vehicles and pedestrianized and developed for Student Piazzas and Parking Space. One minor road, Shahrah-e-Kamal Ataturk, will also be equipped with a two-level underground parking space with more than 400 vehicles parking capacity (on both levels) in addition to 400 motorcycle parking. Shahrah-e-Kamal will be closed for vehicular traffic and at ground level a student piazza will be developed using existing ROW of the road over the width of 39m (130ft.). The existing 9ft wide footpath on both sides will

be left for pedestrian movement and access. On Burns Road (Muhammad Bin Qasim Road) behind DJ Science College, a student piazza is proposed and will include the same features as proposed for Shahrah-e-Kamal student piazza. Footpath and lane in front of DJ Science College on Ziauddin Ahmed Road will be developed for Student Piazza. Existing outdoor pavement of Arts Council will be rehabilitated as per design of Piazza. All the existing utilities in subproject area will be rehabilitated. All MV electric cables will be moved underground along with introducing dry type ground mounted transformers. Trenches and road crossings for Cable TV will be provided so that Cable TV agencies may run their cabling underground. Old street lighting system is going to be replaced with a new street lighting system as per EN 13201 standards. Loop circuit water distribution system along with valve chambers is being proposed in consultation with Karachi Water & Sewerage Board (KW&SB). Sewerage flow is normally 80% to 85% of the supplied daily water forming wastewater. It is being designed with complete coordination by the Water Board for future consideration. Small drainage lines will be made along the three major roads and connected to main drainage channel. The subproject area will be equipped with Fire hydrants with underground tanks mainly near the existing buildings/roundabouts.

Regulatory Review

Sindh Environmental Protection Act 2014 envisages protection, improvement, conservation and rehabilitation of environment and provides legal cover for action against polluters and aims for general awareness of communities. The discharge or emission of any effluent, waste, air pollutant or noise in an amount, concentration or level in excess of the Sindh Environmental Quality Standards (SEQS) as specified by the Sindh Environmental Protection Agency (SEPA) has been prohibited under the Act, and penalties have been prescribed for those contravening the provisions of the Act. This sub-project ESMP has fulfilled the requirements of this Act.

The World Bank requires Environmental Assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus improve decision making process. This subproject has triggered the Bank's policy OP 4.01 on Environmental Assessment, OP 4.11 on Physical Cultural Resources and OP 4.12 Involuntary Resettlement.

Operational Policies (OPs) of World Bank and their management under ESMF

OP 4.01 - Environmental Assessment: This Subproject is classified as "Category B" project per the WB Environment Category since the activities and subproject interventions are expected to have environmental and social impacts which can be mitigated.

OP/BP 4.11 - Physical Cultural Resources: Five buildings declared as "Protected Heritage" by the Government of Sindh (Under the Sindh Cultural Heritage (Preservation) Act 1994 on September 7, 1995) are located in Subproject area. The project interventions will not touch the said PCRs. However, the Policy has been triggered because of the close proximity of the PCRs to the working areas. The possible discovery of archeological sites or random findings during the execution of civil works will require measures to manage chance finds. This ESMP includes "Chance Find" procedures for protection of cultural property.

OP/BP 4.12 - Involuntary Resettlement: The components under subproject will be undertaken on government land and existing ROW of subproject roads. The survey for identification of PAPs was done through a transect walk by Consultant Social Specialist and land surveyors as well as overlapping the plans

of subproject interventions and existing imagery of subproject area. According to a detailed survey conducted by ESMP Consultant, there are no PAPs found in subproject area where the subproject interventions are proposed. The parking requirements during construction will be fulfilled while using existing roads in subproject area. Regarding storage of construction material, one lane of the subproject road where construction is ongoing will be used for material storage. For underground parking construction material storage, Muhammad Bin Qasim Road which will be closed for traffic during construction will be used. While OP 4.12 has been triggered in the project ESMF, there will be no involuntary resettlement for the proposed subproject interventions.

Environmental and Social Management

This ESMP report presents the subproject site-specific baseline data collected for air, water, land, biological and socio-economic components of environment, identification, assessment and evaluation of project impacts and preparation of environmental management and monitoring plan for mitigation of adverse impacts that may arise due to the proposed project interventions.

Baseline Data Collection: After a review of the subproject information, detailed environmental and social surveys were conducted by the ESMP Consultant and team to collect primary information for the subproject area. The environmental survey focused on collection of specific baseline information of the subproject area including meteorology, air quality and noise assessment, floral species present in the area including shaded trees, traffic situation and topography of the area. The area lacks biodiversity due to urban setup. The subproject area has 72 mature trees along the footpaths of the roads. The ambient air and noise quality presented in the baseline of this ESMP shows that the air quality and noise levels meet the required Sindh Environmental Quality Standards (SEQS) limits. There is no surface water body present in close vicinity of subproject roads. A heavy storm drainage covered channel is passing in between the Burns Garden (outside the boundary of Burns Garden) and Arts Council which is connected to the Arabian Sea. The concrete storm drainage channel was previously the natural storm water stream and was naturally taking all the rain water in the past. The contours of the nearby regions were predicted to be sloped towards the channel. During monsoon, major water stagnation is not observed on the roads in this zone since the topography of the area favors and supplements the drainage of storm water. Groundwater quality in the vicinity depicts that quality is slightly saline and above the acceptable limits of potable water.

There are 05 buildings declared as “Protected Heritage” by the Government of Sindh (Under the Sindh Cultural Heritage (Preservation) Act 1994 on September 7, 1995) which are located in Subproject area. These include NED City Campus, Victoria Museum (now Supreme Court Building), DJ College, Burns Garden and DJ College Extension. The assessment of impact on PCRs is discussed in section 6.3.3.1.

The social survey focused on specific aspects of the subproject area including health and education, infrastructure and utilities, gender, survey of PCRs as well as overlapping the plans of subproject interventions and existing imagery of PCRs, utilities, sewerage and solid waste management and the survey of land use. Socio-economic profile of 16 randomly selected households (HH) living in apartments of few buildings located along Dr. Ziauddin Ahmed Road and Strachan Road has been developed and presented in section 5.1.1.1. The buildings are not included in subproject area, but HH are using the subproject roads for commuting. According to the HH survey, women constitute 25% of the sample population. The women use the subproject area roads during their commute and many as pedestrians. The socio-economic profile of 14 randomly selected shops doing businesses at the ground floor of apartment buildings located along Dr. Ziauddin Ahmed Road and Strachan Road is given in section 5.1.1.2. While

the shops are not included in the subproject area, the two roads are used by the shop personnel for commuting The largely non-residential subproject area is also used by students, teachers, administrative staff in education and cultural institutions (primarily government employees), and private transporters (bus and rickshaw drivers). The socioeconomic survey indicates that these people belong to different locations across Karachi, some of which are at a fair distance from the subproject area. Most use public transport (mainly public buses) to get to a nearby drop-off point (Pakistan Chowk) and then walk to their respective institutions. There is no requirement of land acquisition for the subproject. For subproject interventions, only Arts Council and subproject roads will be used. NED University, DJ Science College, SM Art College, SM Law College, Burns Garden, National Museum and Supreme Court will not be affected and touched (refer section 5.1.2 & 6.2 of the main report).

Regarding utilities available in the area, the observed haphazard placement of manholes shows that the sewerage system has been modified with the construction of new buildings over a period of time and has not functioning as originally planned. Water supply lines are being properly linked with the existing main lines feeding to this zone. The solid waste management for the whole city is now lodged under Sindh Solid Waste Management Board (SSWMB) who has started placing its dust bins all over the City and doing front end collection from generation points to disposal at landfill sites. There are two dustbins located inside the subproject area which collect the solid waste of the subproject area.

Screening of Impacts: The ESMF presents a rapid assessment checklist for screening of sub-projects which has been used here to screen the impacts of Educational and Cultural Zone (Priority Phase – I) Subproject and filled as per the environmental and social survey conducted for the sub-project area. The screening checklist suggested that environmental and social impacts of subproject are minor and temporary and can be mitigated and managed with indigenous and prevailing civil construction measures.

Impact Assessment: Most of the Project's environmental and social impacts will be beneficial, including for example the ease of mobility, up-gradation of roads with safety features, development of underground parking facilities, places of interaction of people and students, pedestrian-only areas for the convenience of general public, improved and safe utility network and improved access to cultural sites. However, during construction phase, there will be negative environmental and social impacts including, air quality deterioration due to dust and exhaust emissions during construction activities, traffic congestion and management due to road closure. Road rehabilitation works in Educational and Cultural Zone (Priority Phase – I) Subproject will be initiated near 05 protected PCRs however intrusion into PCRs will not take place as project interventions are outside of the PCR boundaries. There are chances of ground water quality deterioration due to spills from construction equipment, fuel, inadequate disposal of waste material, removal of pole mounted oil filled transformers, inadequate disposal of waste material, possible noise emissions from running of construction machinery, public nuisance etc.

Mitigation Measures: These impacts require appropriate mitigation and management measures to contain them. The subproject specific measures suggested are; a) Structural Engineer of PSC will assess regularly the stability of PCRs during construction stage; b) PVC Laminated Polyester Fireproof Mesh Sheet (with small mesh size) should be installed at least 8-10 ft. in height from existing ground level to contain dust inside the construction site; c) road construction operations should be carefully planned and scheduled and when the traffic movement is minimal e.g. early morning; d) water should be sprinkled to suppress emission of dust. Wiping and sweeping should be adopted as a continuous activity to keep the site clean; e) traffic diversion plan must be developed carefully so that no further congestion on the diverted routes takes place; f) Regarding parking for different type of project/construction vehicles, existing subproject roads

within the subproject area will be used which are the property of Government of Sindh, e.g., for development of underground parking at Shahrah-e-Kamal and Student Piazza at DJ Science College, portion of Burns Road (Muhammad Bin Qasim Road) behind SM Arts College will be used. Also one lane of each subproject roads will be rehabilitated and the other lane will be used for parking of construction vehicles; g) It is suggested that the work on connecting roads should not be done simultaneously; h) machinery operation and high noise activities should be carefully planned and scheduled; i) sign postings, warning signs, diversion signs and barriers will be installed to alert public of all potential hazards including limited access to construction sites; j) the existing main storm drainage line will be cleaned before the start of rehabilitation of roads; k) public awareness programs will be initiated to avoid throwing of garbage in the main and proposed storm-water drains; l) sign post will also be applied over the drains to disseminate the information; m) excavation material /civil works related solid waste should be reused or disposed to Landfill site; n) Coordination with KE should be kept during the removal of transformers and an HDPE lining must be put beneath the transformer mounted poles to avoid soil contamination. KE will take all the transformers to its switchgear workshop, so no need to dispose the transformers; o) it will be ensured that the wastes generated from construction activities are stored in a proper interim location onsite which should be adequately barricaded and covered to avoid ingress of storm water. The location of onsite waste storage site will be selected by PSC as per detailed construction plan; p) the existing wearing and base course scrap can be reused in sub-base course of the new roads or disposed at KMC Jam Chakro Landfill site via tarpaulin covered dump trucks; q) empty drums of bituminous material as well as bituminous material itself will be reused as far as possible, recycled back to the asphalt mixer or ultimately disposed at KMC Jam Chakro Landfill site; r) PVC Laminated Polyester Fireproof Mesh Sheet as discussed earlier will be used with hard barricade to reduce the noise levels and check the noise levels outside the barricade periodically for different types of construction activity through a hand held noise meter. If the noise levels exceed the SEQS, polyester sheets will be replaced with noise deflectors / acoustic barriers; s) high noise activities should cease between 22:00 and 06:00 hrs; t) fuel oils and lubricants for construction machinery will be stored in covered diked areas, underlain with HDPE membrane; u) damage to trees will be avoided and trees located along roadside will be protected during construction; v) a survey and inventory shall be made of large trees in the project vicinity – large trees should be marked and cordoned off with fencing and their roots to be protected; w) the tree plantation plan should include the plantation of native trees and *Conocarpus* specie must be avoided; x) adequate crossing facilities will be developed and included in the project for pedestrians and women and children as well as walkways will be improved; y) provision of appropriate personal protective equipment (PPEs) to construction labor to minimize risks, such as but not limited to appropriate outerwear, boots and gloves, safety helmets; z) extensive consultation with stakeholders should be carried out beforehand and their feedback, concerns and input should be taken into account in the project planning and execution; aa) it will be ensured that the construction site is appropriately cordoned off with hard barricade and also it will be ensured that safe and continuous access to all students, college staff, government servants, adjacent shops and residences during construction will be provided; bb) in addition to the control of construction site cordoned off through hard barricade, the excavation pit at Shahrah-e-Kamal should be equipped with guard rails with warning signage to avoid falling of construction crew as well. Approximately 500 m of guardrail will be required to cordon off the excavation pit. The excavation pit will also be protected with shoring protection or if recommended by PSC structural engineer, protected by a retaining wall. The excavated soil will be temporarily stored at Muhammad Bin Qasim Road away from the pit before disposal. Suitable size of dewatering pump will be installed if groundwater found during excavation or rainwater ingression. The water will be discharge into the existing stormwater drains. It is estimated that to cover all the construction sites of Subproject area, 5.6 km long barricade will be required. However, work on all areas of subproject shall not be carried out

simultaneously and will be planned as per detailed construction plan.

The Grievance Redress Mechanism (GRM) proposed for subproject implementation will cater to all subproject beneficiaries. The PIU office will serve as the secretariat for the Grievance Redress Committee (GRC-Project) that will be responsible for providing oversight on the entire GRM process at a strategic level and monitoring of complaints management. The GRM will be consistent with the requirements of the World Bank safeguard policies as well as local laws including the Protection Against Women Harassment at Workplace Act to ensure mitigation of community concerns, risk management, protection against women harassment at workplace and maximization of environmental and social benefits. The overall objective of the GRM is therefore to provide a robust system of procedures and processes that provides for transparent and rapid resolution of concerns and complaints identified at the local level. Information about the GRM (how to use, time frame for resolution of complaints etc.) will be disseminated widely. Regular contact with complainants will be maintained throughout the process and their satisfaction with the system will be assessed in order to ensure that the feedback loop is closed. A record of the grievance redress system will be maintained and analyzed regularly to identify projects weaknesses and bottlenecks (if any) and user satisfaction with the GRM.

Stakeholder Consultations: Stakeholder consultations were carried out during preparation of ESMP. A series of interviews were undertaken with primary stakeholders including students, government servants and teachers, transporters located inside the subproject area who use the subproject roads, as well as businesses and households located outside the boundary of subproject area using the subproject roads for commuting. Meetings were held with institutional stakeholders including KWSB, K-Electric, Department of Antiquities, DMC South and Union Council # 28 and key environmental and social issues were discussed. Consultations revealed that overwhelming majority of the respondents were not satisfied with the current situation of traffic and infrastructure in their areas and it caused major nuisance as well as health issues. Most of the respondents were in favor of two minor roads to be vehicle free and respondents who own vehicles will use the proposed car parking if the fares are reasonable. Some said due to the distance, they will park cars nearby. Most of the respondents were in favor of underground electric wires and utilities. Almost all of them were willing to accept temporary disruption of services and a certain level of inconvenience during the construction phase in view of the longer-term benefit. Most of the utility agencies emphasized that coordination between them and project developers should be established during construction phase. Also, access to pedestrians should be provided.

Disclosure of ESMP: The subproject ESMP hard copies will be sent to all institutional stakeholders and all KMC / DMC offices. A copy of the ESMP will also be available with the contractor on site. Before start of physical works on the subproject, the sub-project ESMP executive summary will be translated in local languages and communicated to all primary stakeholders including students, transporters, government servants, communities/ businesses in the neighborhood and will be uploaded on the PIU website.

ESMP implementation cost: The total cost of the ESMP implementation has been estimated to be about Pak Rupees **15.744 million.**

Contents

Chapter 1 INTRODUCTION....1
1.1. Background....1
1.2. Project Overview....2
1.2.1. Subproject Overview....2
1.3. Environmental and Social Management Plan (ESMP)....3
1.3.1. Need and Purpose of the Study....3
1.3.2. Objectives of the Study....4
1.3.3. Study Methodology....4
1.3.4. Layout of ESMP....5
1.4. Compliance with ESMP....5
Chapter 2 SUB-PROJECT DESCRIPTION....6
2.1. Subproject Vision....6
2.2. Educational and Cultural Zone (Priority Phase – I) Project Boundary....6
2.3. Concept of Development of Subproject Area....7
2.3.1. Road Rehabilitation Plan and Specifications....8
2.3.2. Proposed Traffic Rerouting....16
2.3.3. Rehabilitation of Utilities and Services....17
2.3.4. Subproject Cost....25
Chapter 3 ENVIRONMENTAL AND SOCIAL MANAGEMENT REQUIREMENTS....26
3.1. National Laws and Regulations....26
3.1.1. National Environmental Policy, 2005....26
3.1.2. National Sanitation Policy, 2006....26
3.1.3. Land Acquisition Act, 1894....27
3.1.4. Labor Laws....27
3.2. Provincial Laws and Regulations....30
3.2.1. Sindh Environmental Protection Act, 2014....30
3.2.2. Sindh Solid Waste Management Board Act, 2014....30
3.2.3. Sindh Environmental Quality Standards (SEQS)....30
3.2.4. Sindh Cultural Heritage (Preservation) Act, 1994....30
3.2.5. Sindh Local Government Act, 2013....32
3.3. The World Bank Operational Policies....32
3.3.1. Environmental Assessment (OP 4.01)....34
3.3.2. Natural Habitat (OP 4.04)....34
3.3.3. Pest Management (OP 4.09)....35
3.3.4. Indigenous People (OP 4.10)....35

3.3.5. Physical Cultural Resources (OP 4.11) 35
3.3.6. Involuntary Resettlement (OP 4.12) 35
3.3.7. Forestry (OP 4.36) 36
3.3.8. Safety of Dams (OP 4.37) 36
3.3.9. Projects on International Waterways (OP 7.50) 36
3.3.10. Disclosure of Operational Information (BP 17.50) 36
3.4. Administrative Framework 37
3.4.1. Institutional Setup for Environmental Management 37
3.5. Environmental and Social Guidelines 37
3.5.1. Environmental Protection Agency's Environmental and Social Guidelines 37
3.5.2. World Bank Social Guidelines 38
Chapter 4 ENVIRONMENTAL BASELINE OF SUBPROJECT AREA 39
4.1. Physical Environment 39
4.1.1. Study Area 39
4.1.2. Meteorology & Air Quality 41
4.1.3. Topography 45
4.1.4. Surface Water Resources 46
4.1.5. Hydrogeological Features 46
4.1.6. Geology 47
4.1.7. Physical Cultural Resources (PCRs) 49
4.2. Ecological Baseline 49
4.2.1. Flora of Sub-Project Area 49
4.2.2. Fauna of Sub-Project 52
Chapter 5 SOCIO-ECONOMIC BASELINE OF SUBPROJECT AREA 53
5.1. Socioeconomic Profile of Subproject Area 53
5.1.1. Demographic Profile 54
5.1.2. Existing Land Use 59
5.1.3. Gender 61
5.1.4. Poverty 61
5.1.5. Katchi Abadi/ Slums 61
5.1.6. Security & Law and Order Situation 61
5.2. Infrastructure Profile 62
5.2.1. Healthcare Facilities 62
5.2.2. Educational Facilities 62
5.2.3. Water Supply 62
5.2.4. Sewerage and Sanitation 63
5.2.5. Solid Waste management in subproject area 64
5.2.6. Parking Facilities in Subproject area 65

5.3. Findings of Environmental and Social Surveys of Subproject Area 69
Chapter 6 IMPACTS AND MITIGATION 74
6.1. Environmental Safeguards Processing Steps 74
6.2. Screening of Impacts 74
6.3. Assessment of Potential Impacts and Generic Mitigation 78
6.3.1. Positive Socio-economic and Environmental Impacts of Subproject 78
6.3.2. Impacts and Mitigation Measures 79
6.3.3. Subprojects Siting 79
6.3.4. Labor Issues 97
6.3.5. Pedestrian Crossings 102
6.4. Grievance Redress Mechanism (GRM) 103
6.4.1. Overview and Scope 103
6.4.2. Objectives of Grievance Redress Mechanism 104
6.4.3. Communication & Awareness raising on GRM 104
6.4.4. Proposed Institutional Mechanisms 104
6.4.5. Procedures 105
6.5. Training, Capacity Building and Awareness Raising Requirements 106
Chapter 7 STAKEHOLDER CONSULTATION 115
7.1. Context 115
7.2. Identification of Stakeholders 115
7.3. Consultation with Primary Stakeholders 117
7.4. Consultation with Secondary Stakeholders 130
7.5. Disclosure of subprojects Information 134
7.6. Consultation Plan 134
Chapter 8 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN 134
8.1. Environmental Management and Monitoring Plan 134
8.1.1. Post Monitoring Measures 146
Chapter 9 SOCIAL MANAGEMENT AND MONITORING PLAN 147
9.1. Positive Social Impacts of Sub-Project 147
Chapter 10 ESMP IMPLEMENTATION BUDGET 153

Annexes

Annex A: Sindh Environmental Quality Standards 2016
Annex B: List of Protected Heritage / Cultural Sites located in Subproject area
Annex C: Guidelines for Physical and Cultural Resources
Annex D: A3 Maps of subproject layout plans
Annex E: Population Characteristics of Karachi Districts (2015)
Annex F: World Bank Group's Environment, Health, and Safety Guidelines

List of Tables

Table 2.1: Existing roads specifications included in Subproject Area....8
Table 2.2: Cross Section Elements of Major Roads....11
Table 3.1: World Bank Safeguard Policies Triggered....33
Table 4.1: Mean Monthly Maximum Temperature °C....41
Table 4.2: Mean Monthly Minimum Temperature °C....41
Table 4.3: Monthly Amount of Precipitation (mm) at Karachi Air Port....42
Table 4.4: Mean Monthly Wind Speed (m/s) at 12:00 UTS (Karachi)....42
Table 4.5: Mean Monthly Wind Direction at 12:00UTS (Karachi)....43
Table 4.6: Real-time air quality monitoring conducted in Subproject area....43
Table 4.7: Ambient Noise Quality Results....44
Table 5.1: Administrative Profile of Karachi Division....54
Table 5.2: Profile of Students in Subproject area....54
Table 5.3: Socioeconomic Survey of Households....57
Table 5.4: Socioeconomic Survey of Businesses....59
Table 5.5: Land screening for the subproject interventions....60
Table 5.6: Educational institutes located in Subproject area....62
Table 5.7: Subproject roads infrastructure....67
Table 6.1: Land screening for the subproject interventions....80
Table 6.2: Typical noise levels of construction equipment (noise level in dB (A) at 15 m)....85
Table 6.3: Waste management options (different categories)....93
Table 6.4: Training Plan....108
Table 7.1: Guide for Consultation – Base Matrix....115
Table 7.2: Consultation Plan....135
Table 8.1: Environmental Mitigation and Monitoring Plan during Design Stage....134
Table 8.2: Post Monitoring Measures....146
Table 9.1: Social Mitigation and Monitoring Plan....148
Table 10.1: ESMP Implementation Budget for 1 year Project (Million PKR)....153

List of Figures

Figure 2.1: Satellite Imagery of Educational and Cultural Zone (Priority Phase – I) Subproject 6
Figure 2.2: Schematic Boundary of Priority Intervention (Educational and Cultural Zone (Priority Phase – I) Subproject) 7
Figure 2.3: Overall Plan of Shahrah-e-Kamal Student Piazza 12
Figure 2.4: Typical Floor Plan – Basement Parking for Shahrah-e-Kamal Development (Level 1 and Level 2) 13
Figure 2.5: Vertical view of basement parking (level 1) plan at Shahrah-e-Kamal 13
Figure 2.6: Portion of Muhammad Bin Qasim Road (Burns Road) Surface Parking Plan 14
Figure 4.1: Location map of District South 40
Figure 4.2: Ambient Air Quality monitoring at Sundial Chowk 43
Figure 4.3: Mean Sea Elevation Map of District South, Karachi, Pakistan 46
Figure 4.4: Geological Map of Karachi 48
Figure 5.1: Land use of year 1subproject area in terms of possession of land (Source: Detailed Concept Note of project shared by PIU) 60
Figure 5.2: Haji Shahabuddin Almadni Memorial Dispensary is located along the Strachan Road 62
Figure 5.3: Existing Water Supply System 63
Figure 5.4: Sewerage system of Saddar Town 63
Figure 5.5: Picture of ill maintained newly buried sewerage line at Strachan road with open manhole 64
Figure 5.6: Peak Traffic Volume of Pakistan Chowk Roundabout 65
Figure 5.7: Peak Traffic Volume of Jang Press Roundabout 66
Figure 5.8: A bus stop present at M.R. Kyani Road 68
Figure 5.9: Pedestrian Volume of Subproject Roads 69
Figure 6.1: Nearest PCRs located near the intervention locations 80
Figure 6.2: Hard barricade for construction site along the road with access to pedestrian 82
Figure 6.3: Location of significant construction activity proposed (White arrows show the direction of average wind direction) 83
Figure 6.4: Locations of Residential areas near the Year 1 Subproject area 84
Figure 6.5: PVC Laminated Polyester cover for dust and noise containment 84
Figure 6.6: Locations of Residential areas which are receptors of Construction Noise 86
Figure 6.7: Acoustic barriers 87
Figure 6.8: Main Storm Drainage Line (Outside the boundaries of Burns garden and Supreme Court building) 88
Figure 6.9: Propose road infrastructure including sewerage and stormwater drainage channels 88
Figure 6.10: Several meetings with KE by Design Consultant (Source: Final Design Report) 91
Figure 6.11: Tree plantation arrangements 97
Figure 6.12: Raised pedestrian crossing 102
Figure 6.13: Pelican crossing 103
Figure 6.14: Bus and car drop off 103
Figure 8.1: Proposed Air Quality and Noise Monitoring Locations (Yellow place mark = Noise; Green place mark = air) 145

Acronyms

ADP	Annual Development Program	O&M	Operation & Maintenance
CC	Construction Contractor	P&DD	Planning & Development Department, GOS
DC	Deputy Commissioner	PAPs	Project Affected Persons
DCO	District Coordination Officer	Pak-EPA	Pakistan Environmental Protection Agency
DMS	Detailed Measurement Survey	PBS	Pakistan Bureau of Statistics
DOH	Department of Health, GOS	PCRs	Physical Cultural Resources
EA	Environmental Assessment	PD	Project Director
EIA	Environmental Impact Assessment	PDMA	Provincial Disaster Management Authority
EHS	Environment, Health, and Environment	PKR	Pakistani Rupees
EIA	Environmental Impact Assessment	PIU	Project Implementation Unit
EMMP	Environmental Management and Monitoring Plan	PM	Particulate Matter
EPA	Environmental Protection Agency		
ERU	Environment and Resettlement Unit	PMU	Project Management Unit
ESMF	Environmental and Social Management Framework	PPE	Personal protective equipment
ESMP	Environmental and Social Management Plan	PSC	Project Supervision and Contract Management Consultant
ESS	Environmental and Social Safeguard	RAP	Resettlement Action Plan
FGD	Focus Group Discussion	RFP	Resettlement Policy Framework
GOP	Government of Pakistan	RMUs	Ring Main Units
GOS	Government of Sindh	RS	Reconnaissance Survey
GRC	Grievance Redress Committee	RU	Resettlement Unit
GRM	Grievance redress mechanism	SIA	Social Impact Assessment
GPI	Gender Parity Index	SEPA	Sindh Environmental Protection Agency
IP	Indigenous people	SESA	Strategic environmental and social assessment
IPs	Implementation Partners	SEQS	Sindh Environmental Quality Standards
IUCN	International Union for Conservation of Nature	SMMP	Social Management and Monitoring Plan
LGD	Local Government Department, GOS	SWD	Sindh Wildlife Department
MDGs	Millennium Development Goals	WB	World Bank
MEC	Monitoring and Evaluation Consultant	WHO	World Health Organization
NGO	Non-governmental organization		

Chapter 1 INTRODUCTION

Karachi's lack of development and economic growth in recent decades vis-à-vis its role as the economic and commercial center of the country is gaining increasing visibility due to recent improvements in its security environment as well as new and dynamic leadership in Sindh. Government of Sindh (GoS) has announced strong interest in, and support for, development in Karachi and requested the World Bank to provide support in transforming the city – which led to the Bank's engagement in the city and the production of Karachi City Diagnostic (KCD).

Government of Sindh (GoS) is keen to start with easy to implement interventions that would have visible and high impact results to build confidence between government and citizens, while setting the stage and platform for a longer term and sustained action. Therefore, GoS with the support of World Bank are planning to undertake "**Karachi Neighborhood Improvement Project" (hereinafter referred to as KNIP).** The project would focus on three key areas: (i) to improve livability, safety and inclusion in targeted areas through public space enhancements and improved access to citizen services in selected neighborhoods; (ii) to initiate a mechanism for instituting inclusion between the provincial and local government levels, private sector and civil society; and to better engage citizen participation; and (iii) to support the preparation of follow-on larger investment and policy reforms operations.

The (Priority Phase – I) subproject financed under KNIP is Educational and Cultural Zone worth US$45 million (hereinafter referred to as "Subproject") - The objective of this subproject is to improve mobility and quality of life for local residents and provide quality public spaces to meet citizen's needs.

This ESMP report presents the subproject site-specific baseline data collected for air, water, land, biological and socio-economic components of environment, identification, prediction and evaluation of project impacts and preparation of environmental management and monitoring plan for mitigation of adverse impacts that may arise due to the proposed project interventions. The Educational and Cultural Zone (Priority Phase – I) Subproject ESMP Report is being submitted to Directorate of Urban Policy & Strategic Planning, Planning & Development Department, Government of Sindh in fulfillment of the conditions of deliverables as stated in the TORs.

1.1. Background

Karachi, an ethnically diverse megacity with rapid population growth, is the economic center of Sindh Province. Following Pakistan's independence in 1947, Karachi quickly became the industrial and commercial hub of the new country. Today it is the only megacity in Pakistan. As per recent Census report 2017, total population of Karachi Division is 16.05 million[1], accounting for almost 30% of the entire provincial population, and comprising a high degree of ethnic and linguistic diversity. It is the main seaport and international trade hub of the country. The city also has one of the highest per capita incomes and labor productivity (Gross Value Added per worker) in the country, and contributes between 11 to 20 percent to national GDP (more than twice that of the second largest city).[2] Migration from other parts of the country is the primary driver of this population growth. However, the resulting ethnic diversity did not transform the city into vibrant cosmopolitanism, but instead into pockets of ethnically homogenous zones within a heterogeneous city.

[1] Census Results 2017, Pakistan Bureau of Statistics
[2] World Bank (2016), "Karachi City Diagnostic Report", unpublished draft

During the last few decades, Karachi has suffered infrastructure neglect and there has been a decline in access and quality of these services. Karachi's urban planning, management and service delivery has been unable to keep pace with the needs of a rapidly growing population, quality of living and business environment. As a result, Karachi ranks low on livability and the rapid growth of the city has led to a rapid deterioration in municipal service delivery in many sectors, including urban transport, water supply and sanitation, and solid waste management. Indicators and statistics in these sectors are poor. To respond to these challenges, the Government of Sindh (GoS) seeks the support of the World Bank in developing early harvest interventions in the city of Karachi that will act as a demonstration effect of the potential of economic and urban development interventions in Karachi. These interventions will be included in this proposed project to rapidly improve the lives of the citizens and increase their trust in the state.

1.2. Project Overview

The KNIP project aims to enhance public spaces in targeted neighborhoods of Karachi, and improve the city's capacity to provide selected administrative services.

The project will focus on three key areas: (i) improve livability, mobility, safety and inclusion in targeted areas of Karachi city through public space improvements in selected neighborhoods and improved access to pedestrian facilities; (ii) initiate mechanisms for inclusive decision making and planning for the city with different levels of government (provincial and local), private sector and civil society; and to promote citizen participation in this process; and (iii) strengthen city management and institutional capacity while supporting the preparation of a possible follow-on operation in Karachi focused on larger investments and policy reforms. The project has three components. The infrastructure component aims to improve livability, mobility, safety and inclusion through public urban space improvements in selected Neighborhoods in Karachi (including both commercial and/or residential areas). The sub-component 1.1 includes Saddar Downtown Area Revitalization in Year 1; **Educational and Cultural Zone as Priority Phase – I Subproject** has been selected for the implementation of KNIP.

1.2.1. Subproject Overview

Educational and Cultural Zone (Priority Phase – I) Subproject forms a triangle bounded by three major roads i.e. Starchan Road, Dr. Ziauddin Ahmed Road and M.R. Kayani Road. Total length of subproject roads is estimated as 2.5 km which also forms subproject boundary. Following interventions are proposed in the subproject area:

- There are three (03) major roads and two (02) minor roads with respect to length included in subproject area.
- All 03 abovementioned major roads will be rehabilitated based on the below points:
  - One way Road = 36' wide (3 lanes) – one lane is dedicated for parking vehicles
  - Motorcycle Strip = 6' wide
  - Foot Path = 6-18ft. wide footpath on both sides (depending on the availability RoW)
- The two minor roads will be closed for vehicles, pedestrianized and developed for Student Piazzas. One minor road, Shahrah-e-Kamal, will also be equipped with a 2-level underground parking space with more than 300 vehicles parking capacity.
- Shahrah-e-Kamal will be closed for vehicular traffic and at ground level, student piazza will be developed using existing ROW of the road over the width of 32m (105ft.). The existing 12' wide

footpath on both sides will be left for pedestrian movement and access during construction and after the development as well.

- For portion of Burns Road (Muhammad Bin Qasim Road) behind DJ Science College, student piazza is proposed and will include the same features as proposed for Shahrah-e-Kamal student piazza.
- Part of Dr. Ziauddin Ahmed Road lane and footpath will be developed for the development of Student Piazza in front of DJ Science College premises but outside its boundary.
- Existing outdoor pavement of Arts Council will be rehabilitated based on the design of Piazzas.
- All the existing utilities in subproject area will be rehabilitated. All MV electric cables will be moved underground along with introducing dry type, ground mounted transformers.
- On the roads, there were street lighting poles of about 26 feet height. Single and Double mast poles are also found and many sections of these are not functional. Since the urban plan is being modified and the roads are all going to be one way, therefore, the double mast poles on the medians are being removed. New street lights for the subproject roads are proposed as per the EN-13201 lighting standards at 50' and 25' intervals for vehicles and pedestrians respectively.
- Trenches and road crossings for Cable TV shall be provided so as all the Cable TV agencies may run their cabling underground.
- Related to water and sewerage, some of the main water and sewerage lines running from the zone have been recently rehabilitated by the KW&SB. However, water distribution system is being proposed to be in loop circuit for the same. Valve chambers are being proposed with the consent of KW&SB. Sewerage flow is normally 80%-85% of the supplied daily water forming wastewater. It is being designed with complete coordination by the Water Board for future consideration.
- Small drainage lines will be made along the three major roads (during rehabilitation stage) and the lines will be connected to main drainage channel.
- Currently, there is no firefighting system available in subproject area. The subproject area will be equipped with Fire hydrants mainly near the existing buildings.
- 16 pedestrian crossings are proposed on subproject roads.

1.3. Environmental and Social Management Plan (ESMP)

"Environmental and Social Management Plan (ESMP) is an instrument that details (a) the measures to be taken during the implementation and operation of a project to eliminate or offset adverse environmental impacts, or to reduce them to acceptable levels; and (b) the actions needed to implement these measures." (Source: OP 4.01, Annex A – Definitions).

1.3.1. Need and Purpose of the Study

The Bank requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making.

The Environmental and Social Management Framework (ESMF) of KNIP has been prepared which sets out the principles, rules, guidelines and procedures to assess the environmental and social impacts of all the proposed sub-projects based on World Bank operational policies to satisfy Bank's EA requirements and applicable legal legislations. Based on the principals and guidelines provided in the ESMF, this ESMP of Educational and Cultural Zone (Priority Phase – I) Subproject has been developed.

Sindh Environmental Protection Act 2014 being as principle legislation of environmental protection in Sindh Province envisages protection, improvement, conservation and rehabilitation with the help of legal action against polluters and green awakening of communities. The discharge or emission of any effluent, waste, air pollutant or noise in an amount, concentration or level in excess of the Sindh Environmental Quality Standards (SEQS) specified by the Sindh Environmental Protection Agency (SEPA) has been prohibited under the Act, and penalties have been prescribed for those contravening the provisions of the Act. The sub-project ESMP has been prepared based on the principles of this Act.

ESMP is also compliant with local legislations especially local labor legislations as stated in section 3.1.5, which includes protection against harassment of women in the workplace, child labor, bonded labor, workmen's compensation, and minimum wages.

1.3.2. Objectives of the Study

The objective of development of an Environmental and Social Management Plan (ESMP) for Educational and Cultural Zone (Priority Phase – I) Subproject is to mitigate and monitor adverse environmental and social impacts identified in the Environmental and Social Management Framework (ESMF) developed for this project.

This ESMP complies with the WB safeguards requirements given in all triggered Operational Policies. The ESMP also complies with the national environmental requirements defined through Sindh Environmental Protection Act of 2014, subsequent regulations and guidelines, and also the provincial Acts and Regulations.

1.3.3. Study Methodology

Methodology for the ESMP comprises a series of integrated tasks that were carried out by the Consultant. This was based on a combination of fieldwork (e.g. surveys, consultations etc.) and desk reviews as deemed necessary to meet the needs of the ESMP.

Subproject Description: Subproject documents have been reviewed to reflect the proposed interventions in Educational and Cultural Zone (Priority Phase – I) Subproject. This information is collected and analyzed as part of ESMP process. A detailed review of information is presented in the Project description section.

Legislative Review: A legislative review has been conducted for the project. This included a review of all the related national and provincial legislation, guidelines and WB OPs which are relevant to the subproject and applicable in conducting ESMP study.

Environmental and Social Surveys: After the review of the subproject information, detailed environmental and social surveys were conducted by the ESMP Consultant and team to collect primary information for the subproject area. The environmental survey was focused on collection of specific baseline information of the subproject area including meteorology, air quality and noise assessment, floral species present in the area including shaded trees, traffic situation and topography of the area. The social survey was focused on the specific aspects of subproject area including health and education facilities, infrastructure and utilities, gender, survey of PCRs as well as overlapping the plans of subproject interventions and existing imagery of PCRs, utilities, sewerage and solid waste management and the survey of land use. The socioeconomic data was collected for students, teachers, government servants, bus and rickshaw drivers located in the subproject area as well as business people and households that are located outside the boundary of subproject area but use the subproject roads for commuting. The survey for identification of PAPs was

done through a transect walk by Consultant Social Specialist and land surveyors as well as overlapping the plans of subproject interventions and existing imagery of subproject area.

Stakeholder Consultation and Participation: Stakeholder consultations were carried out during preparation of ESMP. A series of interviews were undertaken with primary stakeholders including students, teachers, government servants, bus and rickshaw drivers, businesses and households located outside the boundary of subproject area using the subproject roads for commuting. Meetings were held with institutional stakeholders and key environmental and social issues were discussed.

Identification and Assessment of Environmental and Social Impacts and Mitigation Measures: Environmental and Social aspects and their associated impacts were considered for proposed interventions under the subproject. Specific mitigation measures were proposed to minimize the significant environmental and social impacts. Environmental Management and Monitoring Plan (EMMP) and Social Management and Monitoring Plan (SMMP) were developed for the implementation of the mitigation measures identified during the study.

ESMP Implementation Budget: Budgetary requirements have been proposed against the monitoring, training and reporting activities proposed for the subproject.

1.3.4. Layout of ESMP

Chapter 1 provides the introduction and background of the project and sub-project. **Chapter 2** provides a detailed description of the sub-project and the implementation requirements to execute the sub-project. The relevant local legislative requirements and WB operational policies applicable for development and implementation of ESMP are described in **Chapter 3.** The environmental baseline conditions of sub-project area are presented in **Chapter 4**. The social-economic profile of sub-project roads is presented in **Chapter 5**. The assessment of environmental as well as socioeconomic impacts, their mitigation measures are presented in **Chapters 6.** The stakeholder consultations and information disclosure have been covered in **Chapter 7**. **Chapter 8** provides the Environmental Management and Monitoring Plan including the parameters to be measured, methods to be used, sampling locations, frequency of measurements, detection limits (where appropriate). **Chapter 9** provides the Social Management and Monitoring Plan including measures to l be taken to reduce and mitigate any adverse impacts on local people and communities. **Chapter 10** covers the ESMP budgetary requirements.

1.4. Compliance with ESMP

This ESMP forms part of the Request for Proposals package/ Bid Documents and its compliance is mandatory. The contractor will be required to prepare site specific ESMP for each subproject based mitigation and monitoring measures in the sub project ESMP. These site specific ESMPs will then be embedded into the civil works contracts and therefore will be legally binding on the contractor. The site specific ESMP must be submitted to the PIU/Supervising Engineer for review and clearance within 30 days of the signing of the contract or before mobilization on site, which ever date is earlier.

Chapter 2 SUB-PROJECT DESCRIPTION

2.1. Subproject Vision

Indicators of livability and public comfort have registered a sharp decline in Subproject area. The interventions in the subproject area seek to upgrade the livability status of the neighborhood – through environmental improvement, infrastructure rehabilitation and by creating spaces for social integration. The vision for a more livable neighborhood also looks into optimizing the still existent social, educational and recreational potential provided by the relevant structures and spaces through utilizing them as catalysts for public space design interventions that are characterized by their inclusive, accessible, safe and comfort based designs - that rely on creating 'places' rather than 'structures'.

This vision aims to knit the destinations of public visitation in a manner that promotes improved public access and through facilitating patterns of circulation that are pedestrian in nature rather than motorized – facilitated both by route identification and associated street furniture that assists walkability. As such, components of design would include street furniture to facilitate pedestrian movement, shaded trees, rerouting of motorized traffic and provision of parking spaces in a way that the neighborhoods environmental sensitivities are not degraded and elements of public conveniences are not obstructed. Space design will be defined not by structural constructs, rather by minimalistic designs that create 'places' for inclusive social integration.

2.2. Educational and Cultural Zone (Priority Phase – I) Project Boundary

Educational and Cultural Zone (Priority Phase – I) Subproject forms a triangle bounded by three major roads i.e. Starchan Road, Dr. Ziauddin Ahmed Road and M.R. Kayani Road. The GPS coordinates of three corners of subproject area are defined hereunder:

1. Corner 1 – Pakistan Chowk - 24°51'15.53"N, 67° 0'41.69"E
2. Corner 2 – Near Shaheen Complex - 24°51'2.90"N, 67° 1'7.55"E
3. Corner 3 – Near Arts Council - 24°51'11.27"N, 67° 1'18.96"E

Total length of subproject roads is estimated as 2.5 km. Subproject Boundary is shown in Figures 2.1 and 2.2.

Figure 2.1: Satellite Imagery of Educational and Cultural Zone (Priority Phase – I) Subproject

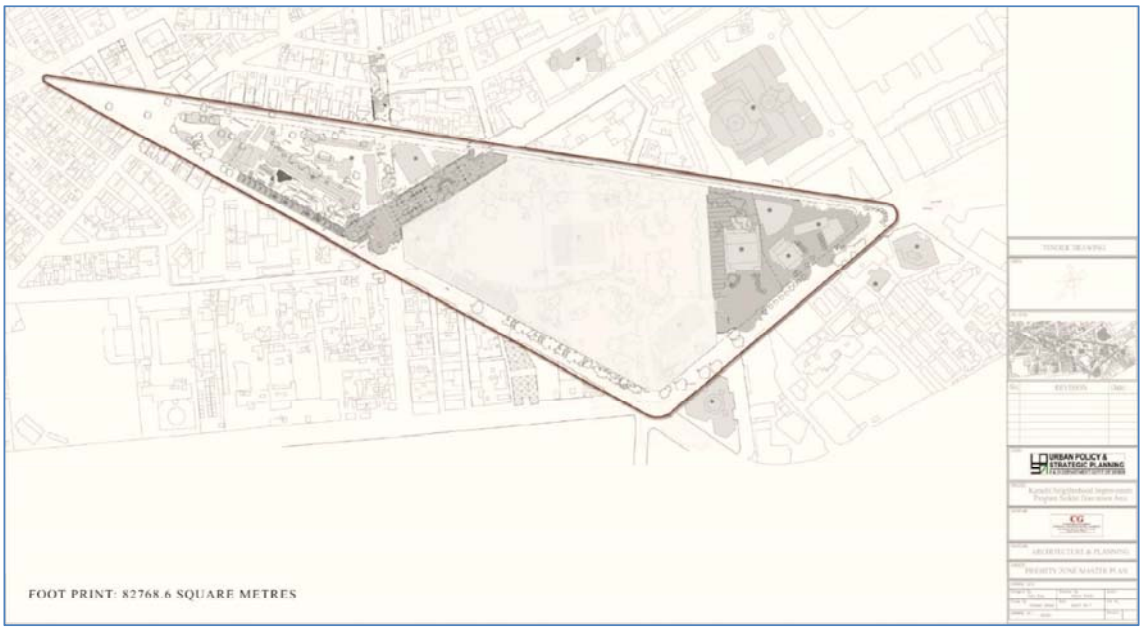


Figure 2.2: Schematic Boundary of Priority Intervention (Educational and Cultural Zone (Priority Phase – I) Subproject)[3]

2.3. Concept of Development of Subproject Area

Educational Spaces Development

One of the most important activities in subproject area is the activity related to youth due to presence of educational institutions including DJ Science College, NED University City Campus, SM Arts College and SM Law College in this Zone. Hundreds of students move around in this area. The Education Zone has therefore been designed keeping in view the requirements of youth, their opportunity of expression and their educational comfort.

All spaces in this Zone are proposed to be totally pedestrianized where students shall freely interact with each other. They will have comfortable spaces for studying and relaxation, with specially designed kiosks for refreshments and snacks. There will be places to hold academic events and these shared pedestrian piazzas shall be the extensions of the educational institutions of the locality. The educational character of these active spaces shall encourage healthy behavior and intellectual development of young people.

Places are designed for holding outdoor events, outdoor art exhibitions, seating spaces shaded pergolas and trellises, etc. These spaces shall be furnished with kiosks of souvenirs, handicrafts, eating spaces, public utilities like toilets, first aid kiosks security assistance etc.

Pedestrian-oriented design over vehicles domination promotes environment-friendly spaces. It reduces air pollution and provides comfortable walking distance that enables people to be able to walk from nearby areas in the cultural zone.

Traditional Development

Provision of the developed spaces and opportunities of expressions of art and tradition can certainly positively contribute into the redevelopment of this fast dying area. In Arts Council, vibrant gatherings like

[3] Drawings provided by Design Consultant

mushairas and intellectual gatherings take place but the institution infrastructure is fast declining. The proposed design shall provide the opportunity of reactivating the declining activities related to art and culture. Places are designed for holding outdoor events, outdoor art exhibitions, seating spaces shaded pergolas and trellises, within the premises of Arts Council.

Infrastructure Rehabilitation

Street lights, Soft lighting on Buildings and widened Footpaths with safety provisions promotes smooth pedestrian walkability for easy pedestrian movement and safety in addition to suitable ramps provision for disabled persons comfort. Multiple, connected circulation paths make all forms of movement easier and more convenient.

Strachan Road, M.R. Kayani Road, and Dr. Ziauddin Road will be comfortable for pedestrians, interesting and attractive to extend the public realm and contribute to a vibrant, urban neighborhood and provide varied experiences in a comfortable setting.

Other proposed infrastructure rehabilitation and urban design interventions include:

- Firefighting system
- CCTV and surveillance devices and control system
- Public facilities and toilets
- Information kiosks at suitable intervals
- First aid assistance at suitable distances
- Safety assistance at suitable distances
- Cart system to provide accessibility to elders and handicapped people
- Properly designed conventional and mechanical public car parking and
- Accessibility through lifts for public convenience etc.
- Manually controllable traffic signaling system for ease of pedestrian movement
- Universal access movement for handicapped such as allowing access wheelchairs and strollers through ramps at level difference pedestrian walkways
- Garbage collection (conveniently located garbage receptors)
- Burying overhead cables with provisions of U/G Conduits, Drainage options
- Storm and Sewage network replacement.

2.3.1. Road Rehabilitation Plan and Specifications

There are three (03) major roads and two (02) minor roads with respect to length included in subproject area having below mentioned specifications:

Table 2.1: Existing roads specifications included in Subproject Area

S#	Road Name	Length (m)	ROW (ft.)	Footpath Width (ft.)
1.	Strachan Road (Din Muhammad Wafai Road)	863	43-65	6 (on one sides), 6-12 (on other sides)
2.	M.R. Kiyani Road	338	89	10 (on both sides) Plus 6'-8' Median/Green Belt in Center
3.	Dr. Ziauddin Ahmed Road	834	65-82	6 (on one side and 6'to12' on the

				other side
4.	Shahrah-e-Kamal	95	141	9 (on both sides)
5.	Portion of Burns Road (Muhammad Bin Qasim Road)	110	65-72	6 (on both sides)

All 03 abovementioned major roads will be rehabilitated based on the below mentioned road design and specification. However, remaining two minor roads, will be closed for vehicle crossing, completely pedestrianized and roof of Parking will be developed for Student Piazzas and among one i.e. Shahrah-e-Kamal will also be equipped with 2-level underground parking space with more than 300 vehicles parking capacity.

2.3.1.1. Major Roads Rehabilitation Plan

All three major roads will be rehabilitated within the existing ROW of the roads. Utilities under and over the roads will also be rehabilitated based on the plan described in the later sections. Following elements will be added in the road design:

Dr. Ziauddin Road

Dr. Ziauddin Ahmed road is proposed to be three-lane road. There is also a provision of bicycle track alongside walks, throughout the project area the bicycle track is segregated from the vehicular traffic with lane markings. The road is proposed as one way. The footpath with dedicated strip accommodating lamp posts, chain bollards, bollards and guardrail, where necessary to separate the pedestrian traffic from vehicular traffic will be developed. There is also the provision of various types of seating, dustbins, planters on the footpath arranged in a manner that prevents obstruction for the pedestrians. Crosswalks are provided near the intersections with pelican crossing for the pedestrian safety.

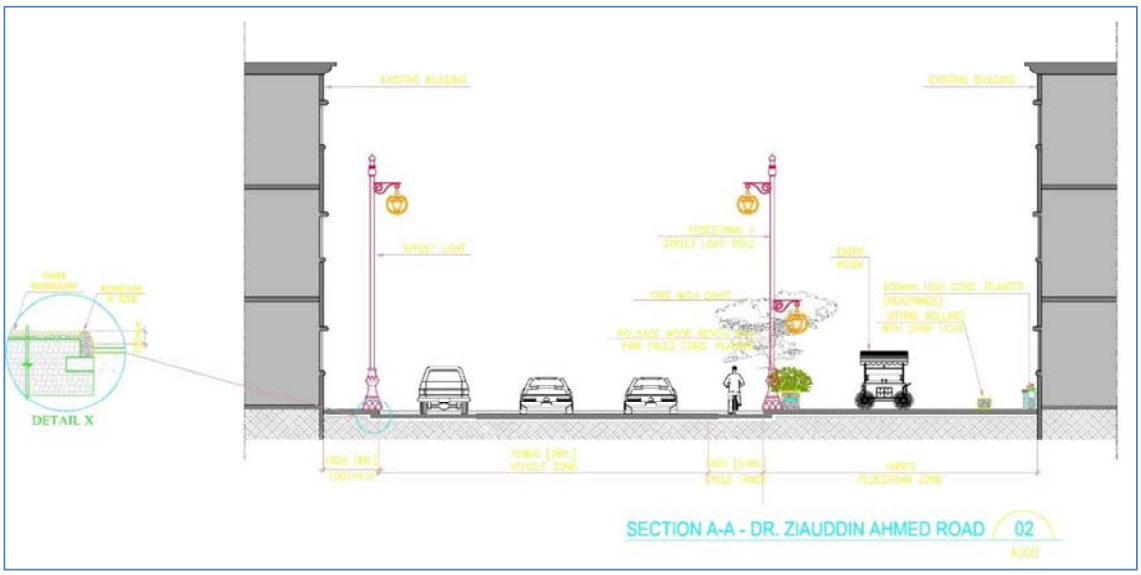


Figure 2.3: X-section of Dr. Ziauddin Ahmed Road

Strachan Road

The road section is proposed to be three lanes of 36 ft then reducing to 24 ft from Secretariat gate to Arts Council Chowk. The Road is proposed as one way. The provision of 6ft. wide bicycle track is designed pedestrian footpath consisting of various types of seating, dustbins, planters on the footpath arranged in a

manner that prevents obstruction for the pedestrians. Crosswalks are provided near the intersections or the property entrances with the facility of a pelican crossing for the pedestrian safety.

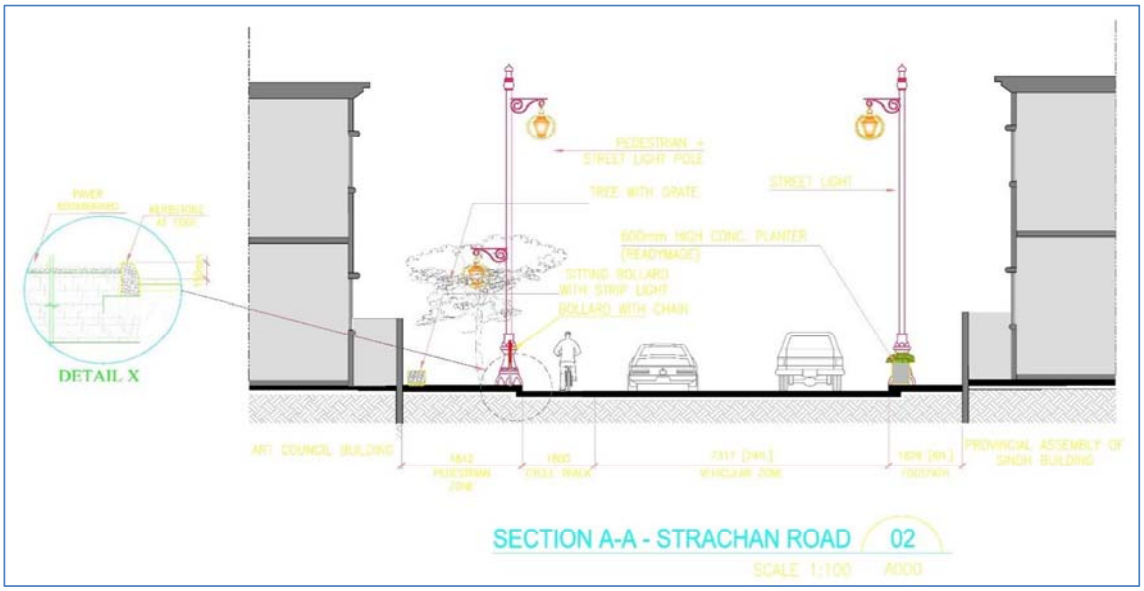


Figure 2.4: X-section of Strachan Road

M.R. Kayani Road

The road is proposed as three-lane road, extending the existing footpath to the existing median retaining the existing large-sized native trees on the median as well as the footpaths. The road is not proposed as one way due to shifting traffic to Aiwan-e-Saddar Road which is used as VIP movement and is blocked during processions near Press Club. The proposal of traffic movement is to organize the traffic on tidal flow basis. A cycle track 6ft wide runs throughout the project area separated from the pedestrian traffic as well as vehicular traffic with the help of bollards or guard rails on intersections. Crosswalks are provided near the intersections or the property entrances with the facility of pelican crossing for the pedestrian safety. The pedestrian walkway is free from any obstruction thereby, facilitating the pedestrians with waste bins, seating, and with illumination.

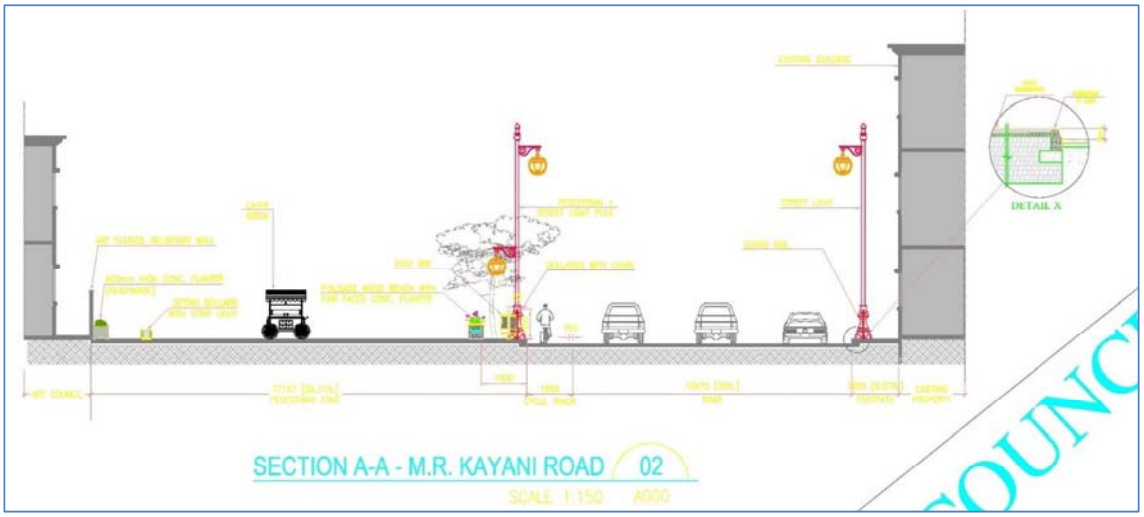


Figure 2.5: X-section of M.R. Kyani Road

For MR Kiyani Road and Dr. Ziauddin Road:

- One way Road = 36’ wide (3 lanes)
- Cycle Lane = 6’ wide
- Footpath = Minimum 6’-0” side walk on one side and 6-18ft. wide footpath on other side (depending on the availability ROW)

For Strachan Road

- One way Road = 24’ wide (2 lanes)
- Cycle Lane = 6’ wide
- Foot Path = Minimum 6’-0” side walk on one side and 6-18ft. wide footpath on other side (depending on the availability ROW)

For all major Road

- Street light for Vehicles = 50’ Interval
- Street light for Pedestrian = 25’ Interval
  - Pedestrian Ramp = 1:12
  - Foot Path = Minimum 6’-0” wide on one side, Min 6’-0” to Varying width (Depending on the available ROW)
  - Road = 36’ 3 lanes and 24’ Wide 2 lane, where applicable
  - Seating/Benches = 14” height from the finished floor level
  - Brackets light = suitable/standard locations
  - Plantation = Suitable/ standard distances/Edges of pavements
  - Cycle track = 6’ wide
- Plantation = 8’ Interval
- Brackets light = Suitable/Standard Locations
- Pedestrian crossing = On the edges/corners of Intersections

Table 2.2: Cross Section Elements of Major Roads

Lane Width			
Thru lanes	3.65 m (min)		
Turning lanes (Single)	5.7 m (up to R = 50)		
	6.3 m (up to R = 25)		
	6.9 m (up to R < 15)		
- Median Width	At all locations, as available		
- Rate of X-Section Transition (Tapered type)	60 KPH	50 KPH	30 KPH
Merging lanes (m/m)	1:25	1:15	1:10
Diverging lanes (m/m)	1:22	1:13	1:10
Minimum taper length	75	50	50
Cross Slopes			
At normal locations	1.5 - 2%		

Median Slopes (min.)	1.5 - 2% (Paved)
Lateral Clearances	
Along Barrier/Fence	0.3 m (min)
Along median curbs	0.3 m (min)
Along foot path	0.5 m (max)
Along channelizing Islands	0.5 m (min)
Miscellaneous	
Buses at bays	Max. two
Emergency bus parking	Not Allowed

2.3.1.2. Development on Minor Roads

Shahrah-e-Kamal will be closed for vehicular traffic and a raised student piazza (0.9 M above the road level) will be developed using existing ROW of the road over the width of 39m (130ft.) mainly to facilitate the students from the neighboring educational institutes. The existing 9' wide footpath on both sides will be left for pedestrian movement and access during construction and after the development as well. It will also acts as a gathering space for art and culture related activities. Also termed as maidan-e-ilm, the piazza comprises various types of seating, hard and soft landscaping, eatery kiosks, public toilets, information kiosks, first aid kiosks, monuments, gazebos, trash bins. The use of staircase and hydraulic lifts is made to connect the piazza with the underground two-level parking. In order to ensure the universal access for disables ease, ramps will be provided at all points where there is a level difference. The piazza will be illuminated with several lighting schemes i.e. lamp posts, recessed lighting. There is a provision for check posts at entry and exit points and CCTV surveillance to help promote the piazza as a safe and a secure public space. The plan is presented in Figure 2.6.

Figure 2.3: Overall Plan of Shahrah-e-Kamal Student Piazza[4]

On the Lower Ground (basement level) at Shahrah-e-Kamal, two-level basements will serve as parking for 400 cars and 400 bikes. The first level of the basement is 1.8 m below the road level and achieves 2.7 m height since the piazza atop raises to 0.9 m. The basement has entry and exit ramps both at Strachan Road as well as Dr. Ziauddin Ahmed Road. There is also another ramp for entry and exit from the second level basement. The parking consists of tracker system and indicator that facilitate the users by illustrating the available parking space on each floor. The staircase and lifts continue till the second basement to facilitate the users and link them up with the public piazza. Each level basement has a provision of 210 number of car parking and same no. of motorbike parking. The second level basement also follows the same height. The Parking floors consist of Staircase and lifts/elevator. A Minimum 3.0 M clear height parking level

[4] Drawings provided by Design Consultant

(each Level) will be RCC framed structure with retaining walls on edges and Columns in intermediate distances. The parking plans are shown in Figures 2.7 and 2.8 respectively.

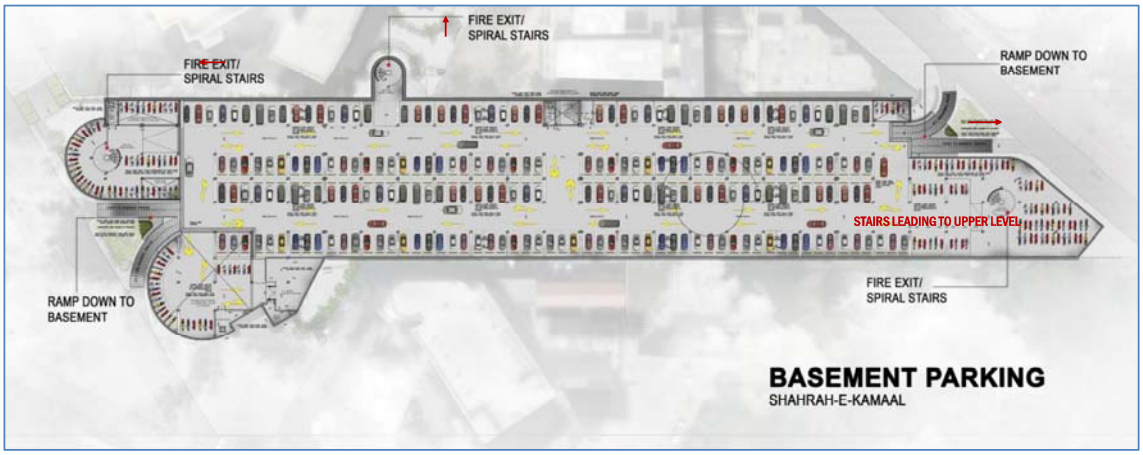


Figure 2.4: Typical Floor Plan – Basement Parking for Shahrah-e-Kamal Development (Level 1 and Level 2)[5]

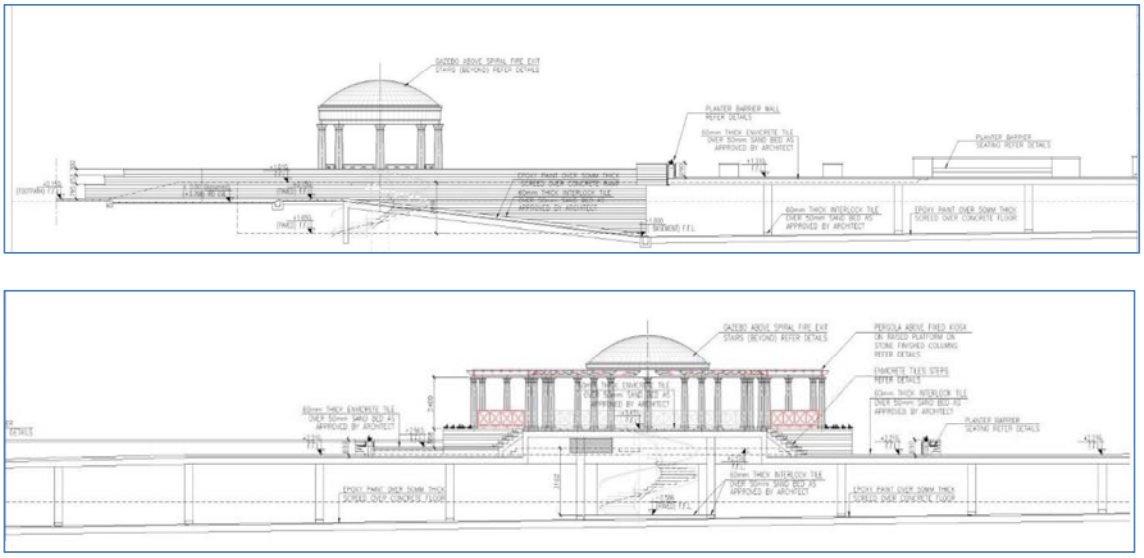


Figure 2.5: Vertical view of basement parking (level 1) plan at Shahrah-e-Kamal

Muhammad Bin Qasim Road

A portion of Muhammad Bin Qasim Road (Burns Road) that intersects with Shahra-e-Kamal is also designed and transformed into a pedestrian link and connects Shahra-e-Kamal with Strachan Road. Since there is an access to educational institutes i.e. S.M Arts and Commerce and NED University from this road, it serves as an active space for the students. It will be partially pedestrianized and the remaining space will serve as car parking. There is also a provision of bicycle and motorbike parking on this road (20-25 vehicles) as presented in Figure 2.9. The Business community will be facilitated by the provision of surface car parking.

[5] Drawings provided by Design Consultant

Figure 2.6: Portion of Muhammad Bin Qasim Road (Burns Road) Surface Parking Plan[6]

2.3.1.3. Intersections/Junctions

Development of Student Piazza at Dr. Ziauddin Ahmed Road – Shara-e-Kamal Attaturk Intersection

The piazza will be connected to Shahrah-e-Kamal Student Piazza at one end and pedestrian trail/footpath of Dr. Ziauddin Ahmed Road at the other. Following features will be included in the development of Piazza:

- Pergola/ Trellis Seating
- Gazebo / Rotunda
- Vintage style Lampposts (for pedestrian movement)
- Bracket Lights
- Placement of Dustbins
- Signage + way Finders

Intersection / Junction between M.R Kayani Road and Dr. Ziauddin Ahmed Road

The junction is designed in a manner that ensures public safety thereby improving the traffic flow. The junctions are provided with guard rails at edges to prevent the pedestrians from intervening into the roads. Openings are provided only at points where there are crosswalks. Each crosswalk is provided with pelican crossing for additional safety for the pedestrians. The use of tactile flooring is made to facilitate the disable guidance.

[6] Drawings provided by Design Consultant

Intersection / Junction between M.R Kayani Road and Strachan Road

Here too, the junction is provided with guard rails at edges which are kept open only at points where there are crosswalks. Various pedestrian safety features are added. Tactile flooring adds to the ease of disables.

Intersection / Junction at Pakistan Chowk

The spaces at Pakistan Chowk are a triangle node which is not touched as it was developed by Culture Department with the help of NGOs. The Central roundabout and triangle are heritage listed open spaces therefore not touched altogether the pavements on the edges are improved. The junction at Pakistan Chowk is also designed in the same manner as the other junctions ensuring pedestrian safety to the maximum extent.

2.3.1.4. Development at Arts Council

Only existing outdoor pavement of Arts Council will be rehabilitated based on the design of Piazzas. The design of pavement in Arts Council is presented in Figure 2.10.

The design of Arts Council is carried out with the intent to promote it as an active space to hold more art and cultural activities thereby attracting the intellects, artists and the public. The design aims at the upgradation of the physical and social environment of this public space. The boundary wall of this space is designed as a combination of solid wall, mural wall and fencing not exceeding the property line. The design makes use of collapsible gates only at the access points. Inside the boundary there is a provision of sculptures, eating spaces for the staff as well as the visitors, shaded sitting spaces, trash bins, sculpture with water bodies only at two locations. The design also aims at the surface improvement of the existing buildings which also includes vertical landscaping which is likely to create a very positive impact on the environment.

Figure 2.10: Architecture and Planning of Arts Council Facility[7]

[7] Drawings provided by Design Consultant

2.3.1.5. Pedestrian Crossings

16 pedestrian crossings are proposed on subproject roads as shown in the below detailed plan.

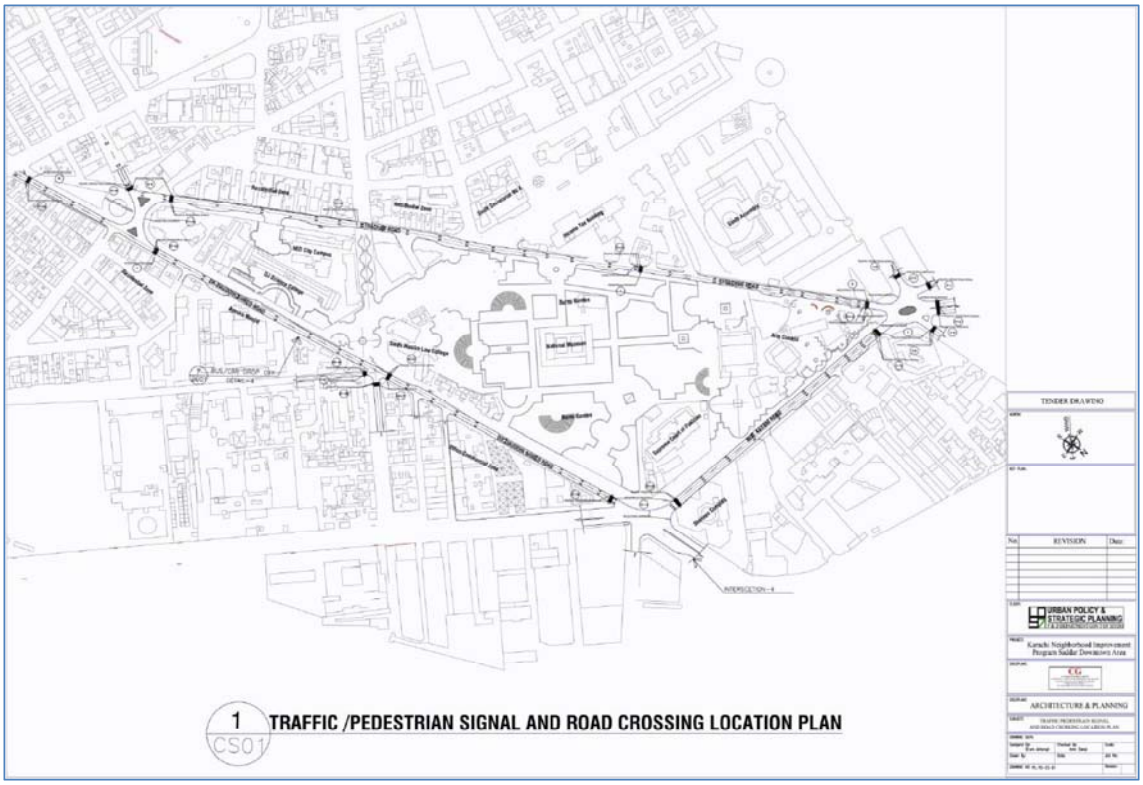


Figure 2.11: Pedestrian Crossings Location Plan

The A3 maps of layout plans shown above are attached as **Annexure – D**.

2.3.2. Proposed Traffic Rerouting

Strachan Road / Din Muhammad Wafai Road

The road is proposed as a one-way movement from the intersection near Arts Council to Pakistan Chowk. This will affect traffic coming from Pakistan Chowk side, for this, the proposed options for private and public transport are to use Dr. Ziauddin Road and then M.R Kayani Road.

Dr. Ziaduddin Ahmed Road

The road is proposed as a one-way movement from Pakistan Chowk area to the intersection at I.I. Chundrigar Road near Shaheen Complex. Thus, the current traffic using the road opposite stretch from Shaheen Complex will be having the option of moving through Strachan Road/ Din Muhammad Wafai Road.

M.R. Kayani Road

The road is proposed as a one-way movement from the intersection near Shaheen complex to next intersection near Arts Council which will connect traffic movement of I.I. Chundrigar Road & Dr. Ziauddin Road.

- Private vehicular traffic towards I.I Chundrigar Road will have to take Aiwan-e-Saddar Road
- Public transport movement of M.R Kayani Road which connects with Sarwar Shaheed Road by using this road will be shifted on Strachan Road/Din Muhammad Wafai Road and then can return towards I.I Chudrigar Road via Ziauddin Road.
- Public transport movement of I.I Chundrigar Road which moves towards Clifton Bridge is not affected.

Traffic Rerouting for construction phase will be prepared by Construction Contractor (CC) in consultation with PSC, PIU, DIG Traffic, Deputy Commissioner Office, KMC, Karachi Transport Ittehad and Mass Transit Cell.

2.3.3. Rehabilitation of Utilities and Services

The scope of rehabilitation work mainly covers the following utility areas:

- Electrical power distribution
- Street lighting
- Communication & Security
- Water & Sewer
- Stormwater Drainage
- Firefighting

2.3.3.1. Electrical power distribution

Existing Situation

The zone selected has all unequal LV cables and over ground MV cables. The proposed challenge, to rearrange these cables by bringing all the MV cables underground with proper handling with the help of trenches and along with that introducing dry type, ground mounted transformers. It has been observed the loads scattered are disordered, therefore, giving a feasible solution substation have to be distributed to equalize the load all over.

Figure 2.12: Existing above ground electric infrastructure including transformers and LV cables

Proposed Interventions - Load Evaluation and Predicting Future Demand

The total existing load been estimated for the entire area is 1,186 KW. The study of the estimated and analyzed load justifies that the average load of the zone is about 1.0-1.3 MW.

Since this is an educational and cultural zone and their load is already established, the electrical load is unlikely to be increased significantly in the future. However, in order to keep the system adaptable of catering changes in future, 15%-20% provisions are being kept in the system design. All overhead networks are proposed to be taken on surface and underground. All Ring Main Units (RMUs) shall be equipped new unless few of them could be reutilized as per the inspection on site.

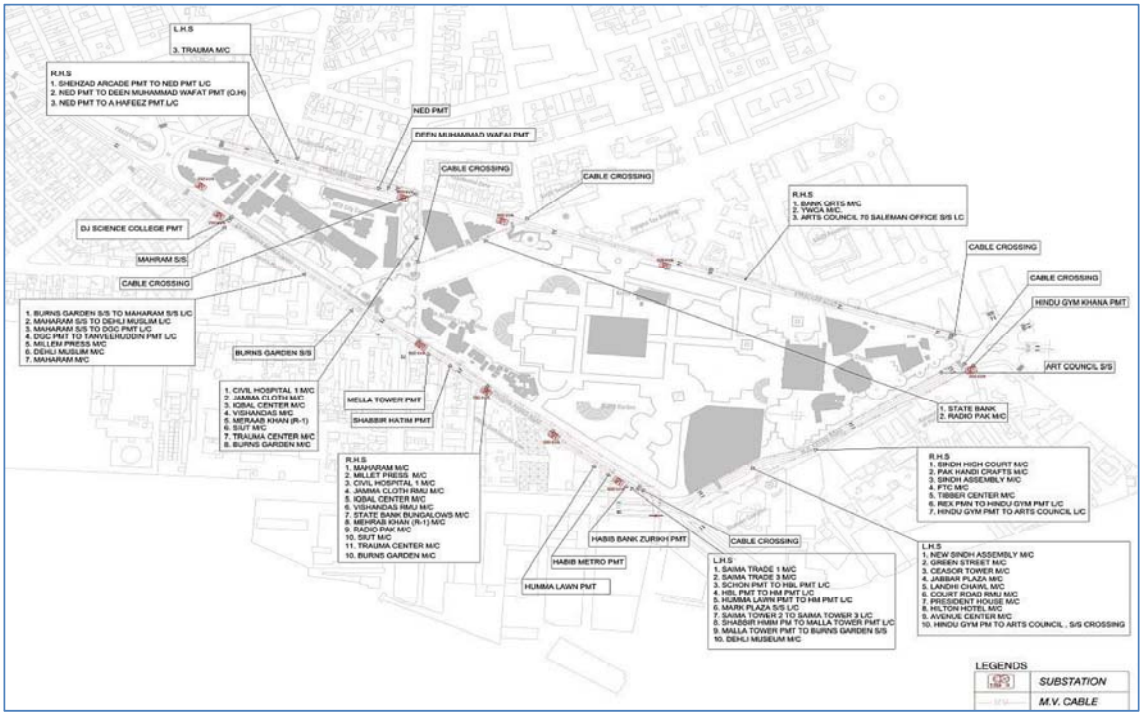


Figure 2.13: Existing M.V Distribution Network including PMTs

Transformer

Pole mounted transformers shall be replaced by Surface mounted Dry Type transformers, Substations shall be placed as per the requirement of K.E. There shall also be few additions of transformers and LV distribution panels are to be located with each transformer and at load densities. All the LV cables and connection to consumers shall also be taken underground. Necessary road crossings and sleeves are being planned accordingly with coordination with K.E.

2.3.3.2. Street lighting

Existing situation

On the roads, there are street lighting poles of about 26 feet height. Single and Double mast poles are also found and many sections of it are not functional. Since the urban plan is being modified and the roads are all going to be one way, therefore, the double mast poles on the medians are being removed.

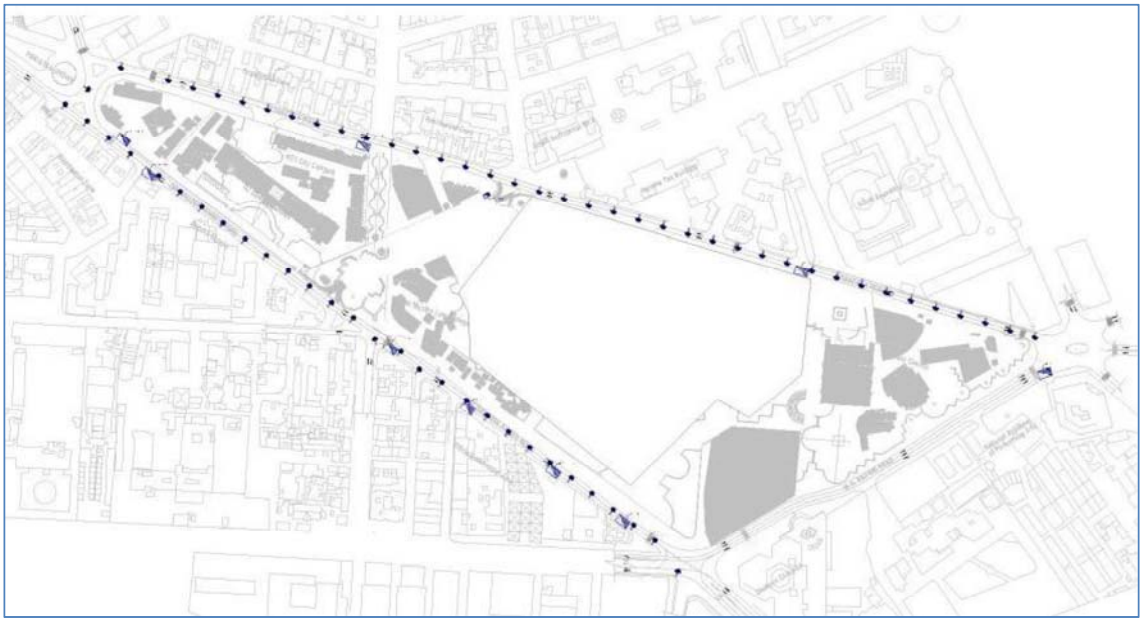


Figure 2.14: Existing positions of Street Lighting

Figure 2.15: Existing Street Lights

Proposed Interventions

The roads are planned to be illuminated as per the EN-13201 lighting standards and their calculations have been carried out to identify the pole spacing, pole heights, fixture wattage etc. to provide the required lux as recommended by lighting standards of that vehicular zone. The environmental safety is also being kept

into consideration, in areas where trees are planted or will be planted; the lighting design is as such to avoid reduction of light caused by the trees. Energy efficient street lights have been proposed on the basis of the required lux. Selected lighting classes for the 60 ft. and 70 ft. wide roads are ME3C and MEW2D respectively.

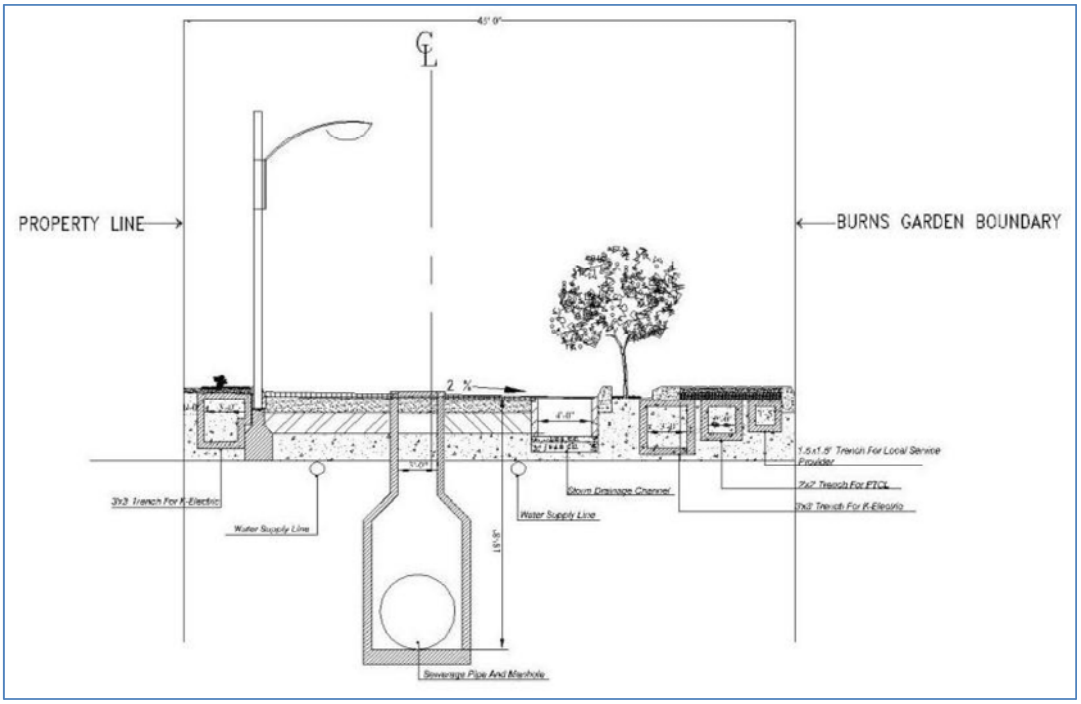


Figure 2.16: Road Section (Street Light)

2.3.3.3. Communication & Security

Existing Situation

During the survey, it is found that PTCL has already laid their copper and fiber infrastructure in this zone. Other than PTCL, there are several other crucial fiber optic cables passing through this zone including Military line, STD line and other service providers such as Mobilink, Wateen, Cyber net etc. Cable TV is mainly running on coaxial cables and it is one of the services which have resulted in creating the overhead disordered cabling.

CCTV system is already installed but needs up gradation. Defunct City District Government Karachi (CDGK) had been running a network of cameras on major road corridors of the city for over years and termed the access of the CPLC to the City Government's Command and Control Centre.

The Copper and Fiber optic infrastructure from all the concerned authorities have been well coordinated, a simple plan has been proposed in which we are simply raising the joint enclosure handholes during revamping the footpaths and roads and to preserve most of the infrastructure as it is.

Proposed Interventions

Back to back CCTV system is being redesigned and Central CCTV Control room is being proposed near the museum and will be uplinked to CPLC.

Trenches and road crossings for Cable TV shall be provided so as all the Cable TV agencies may run their cabling underground. Wi-Fi hotspots are being provided in the public parks, cultural and educational zone.

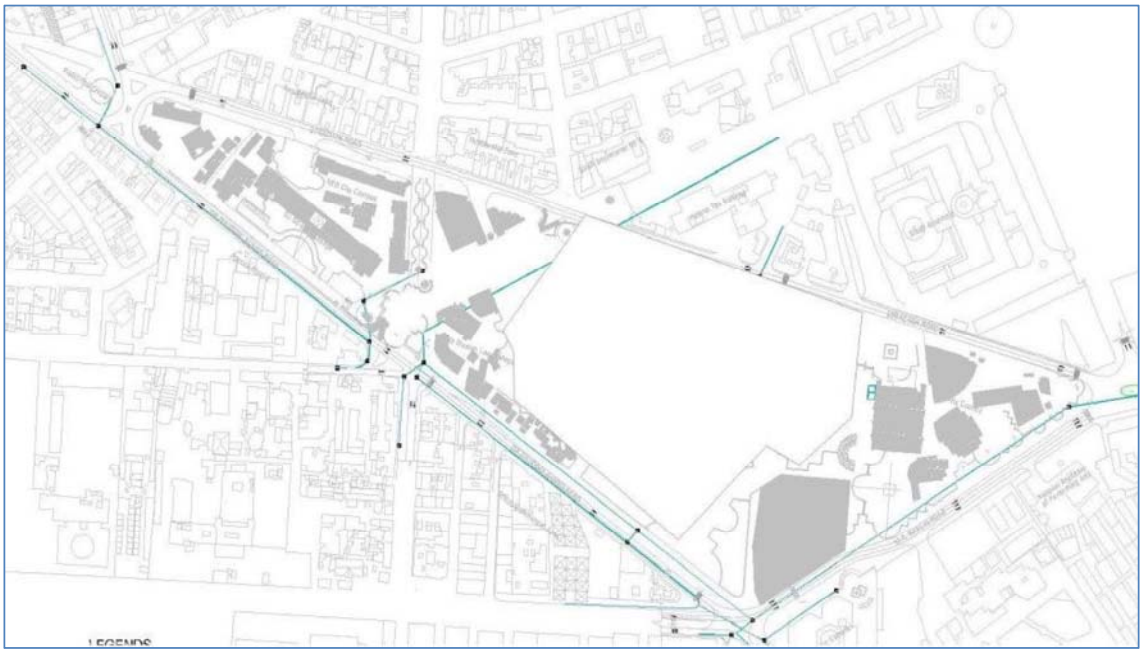


Figure 2.17: Existing Fiber Network by PTCL

2.3.3.4. Water & Sewerage

Existing Situation of Water Supply

Some of the main water and sewerage lines running from the zone have been recently rehabilitated by the KW&SB. The observed haphazard placement of manholes depicts the sewerage system has kept on been modified with the construction of new buildings over a period of time and is not left as originally planned.

Figure 2.18: Picture of ill maintained buried sewerage line at Strachan road with open manhole

Proposed Interventions

Valve chambers are being proposed with the consent of KW&SB so as to make the line easy to maintain in future. Water distribution system is being proposed to be in loop circuit for the same.

The water requirements for kiosks and toilets are 16,050 US Gallons per day and 2,250 US Gallons per day respectively i.e. total water requirement is 18,300 US Gallons per day and will be catered from the existing supply of water for the area. After consultation with KWSB, the main lines have enough capacity to cater the additional water requirements and can be easily met after the introduction of in loop circuit water distribution system.

Sewerage flow is normally 80%-85% of the supplied daily water forming wastewater. It is being designed with complete coordination by the Water Board for future consideration.

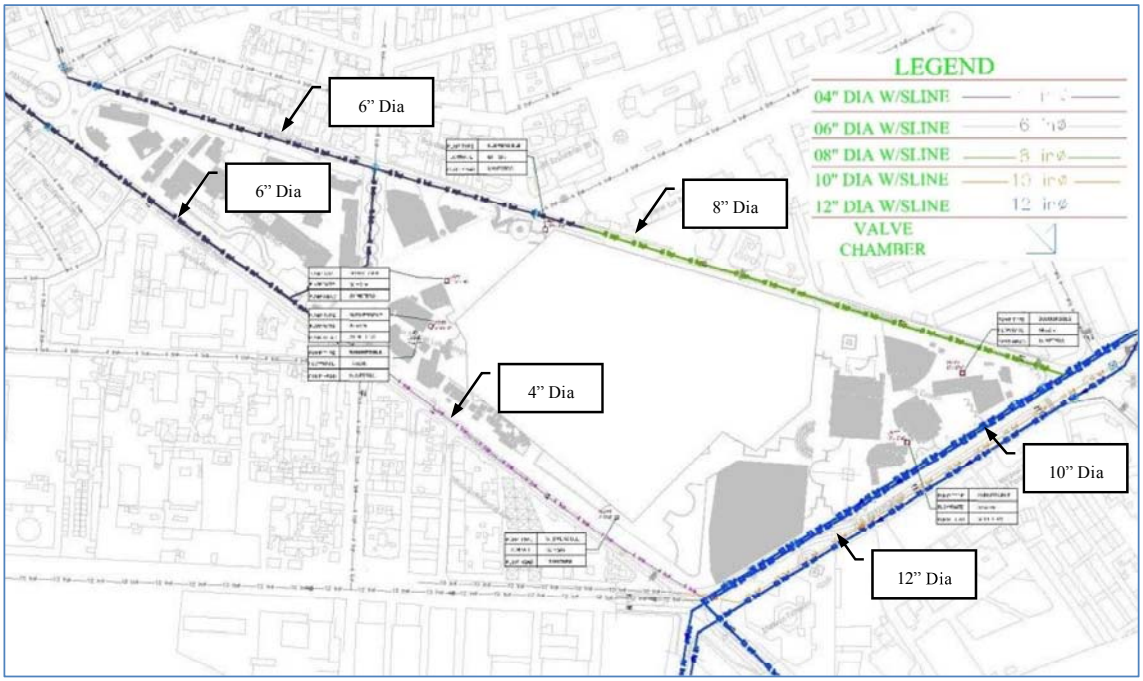


Figure 2.19: Water Supply System

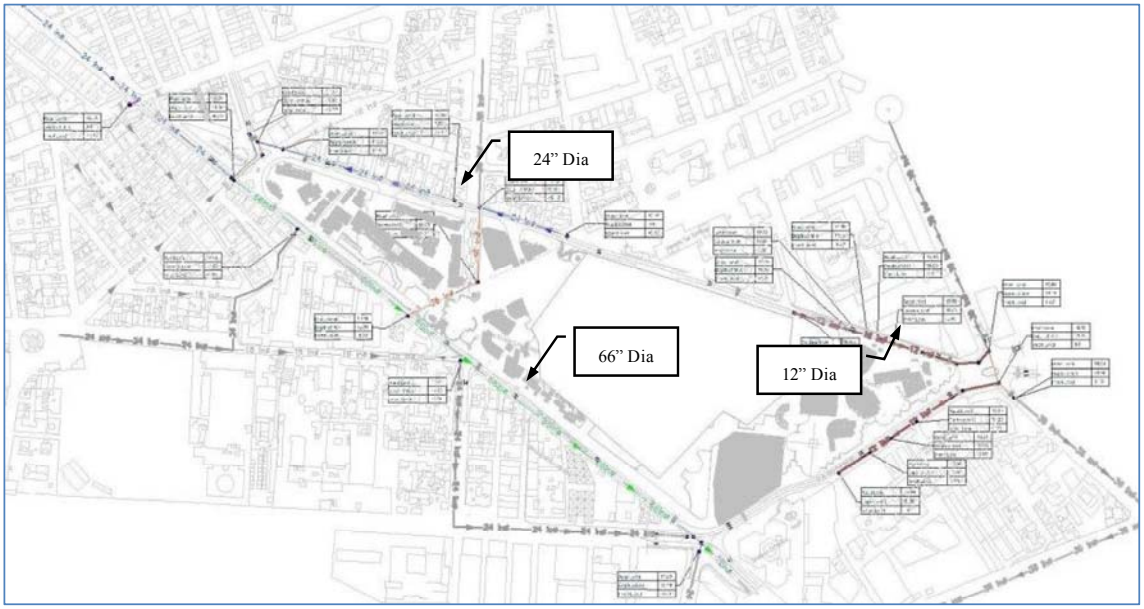


Figure 2.20: Sewerage System

Toilet blocks & kiosk

There will be 8 underground and overhead toilet and kiosk tanks, 3 tanks are for toilet blocks and the rest 5 are for kiosk. The transfer pumps to supply water to the toilet block overhead tanks which then with the help of gravity go to the designed toilet blocks. Similarly, booster pumps supply the water to the underground tanks which then flow to the required carts.

2.3.3.5. Storm water drainage

Existing Situation

According to the observations on the site, it is notified that during monsoon the roads did not show any major water stagnation in this zone since the topography of the area favors and supplements the drainage of storm water. A heavy storm drainage covered channel is passing in between the Burns Garden (outside the boundary of Burns Garden) and Arts Council which is connected to the Arabian Sea. The concrete storm drainage channel was previously the natural storm water stream and was naturally taking all the rain water in the past; the contours of the nearby regions were predicted to be sloped towards the channel.

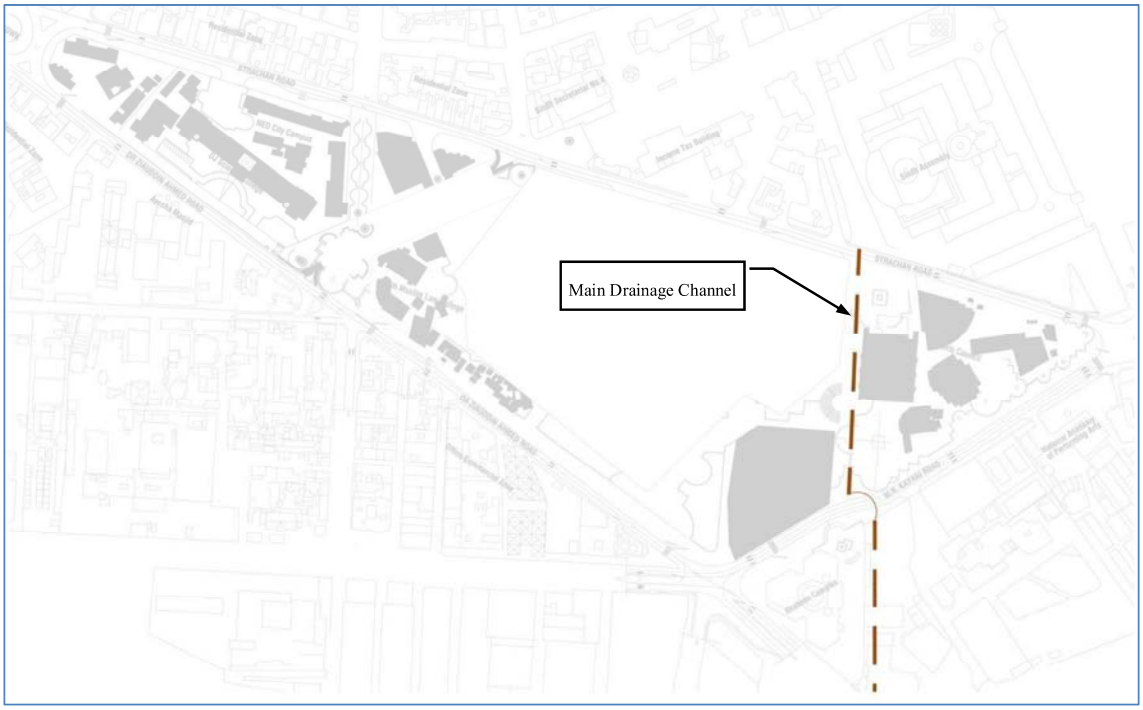


Figure 2.21: Existing Storm Drainage Line

Storm drainage originates from Blue Ribbon Bakery towards I.I. Chundrigar Road through Soldier Bazar. It needs to be cleared for future use to avoid overflow during monsoon.

Proposed Interventions

Small drainage lines will be made along the three major roads (during rehabilitation stage) and these lines will be connected to main drainage channel which is discussed above. Figure 2.22 shows the location of proposed drainage lines and Figure 2.23 shows the flow of storm water with arrows.

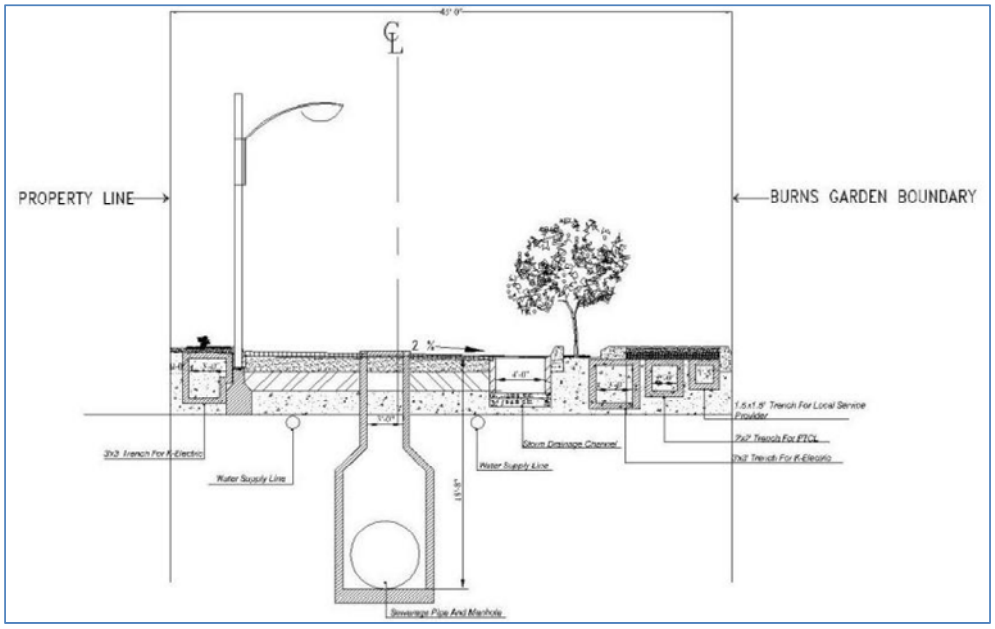


Figure 2.22: Proposed small drainage lines along the major roads (4' wide)

Figure 2.23: Flow of Storm Drainage along the roads (Arrows showing the flow)

2.3.3.6. Firefighting

Existing Situation

Currently, there is no firefighting system available in subproject area. It was also observed that due to the disordered wiring and disorganized metering any sort of hazard could take place.

Proposed Interventions

External Firefighting for such a mixed educational and cultural zone would require a water supply delivery system that can best be achieved by a water system that includes hydrants, a distribution system, storage,

and a source of supply capable of delivering a minimum flow of 250 GPM (950 L/min) at a gauge pressure of 20 psi (140 kPa) residual pressure for a 2 hour duration. However, the distances of Fire Hydrants shall be as per the NFPA standards.

This zone shall be equipped with Fire hydrants mainly near the existing buildings. There shall be underground Fire reservoir and pumps shall be installed. Along with the electric pump, diesel pumps shall also be proposed in case of power failure.

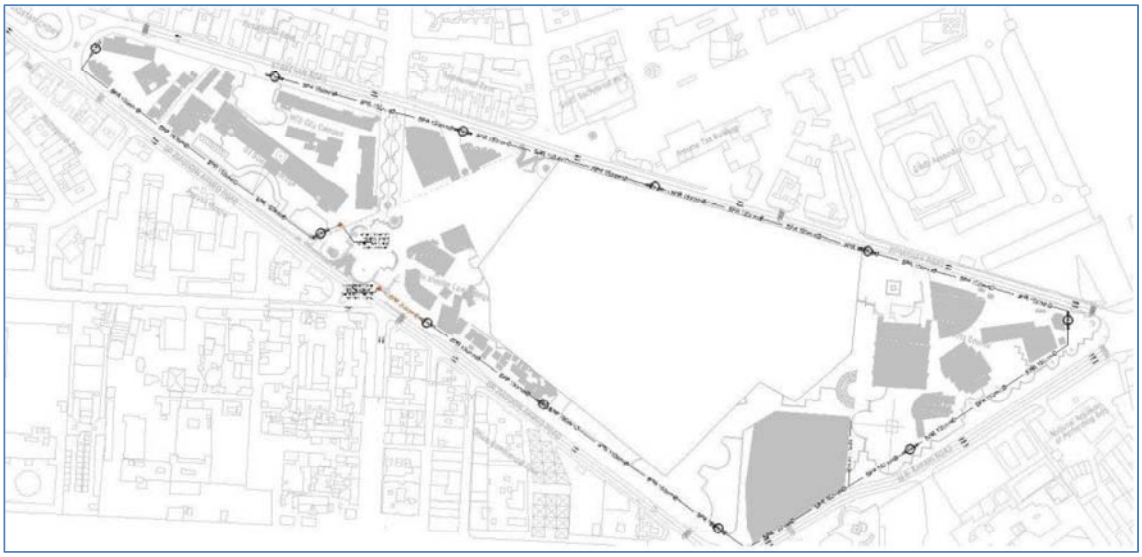


Figure 2.24: Firefighting System

2.3.4. Subproject Cost

Total subproject cost is estimated to be US$ 12.59 Million.

Chapter 3 ENVIRONMENTAL AND SOCIAL MANAGEMENT REQUIREMENTS

This section provides detailed review of policies, legislation, and guidelines that will have relevance to the proposed Educational and Cultural Zone (Priority Phase – I) Subproject and review of administrative framework as well as institutional set-up relevant to the environmental and social management of the proposed subproject.

3.1. National Laws and Regulations

Pakistan's statute books contain a number of laws related to the regulation and control of the environmental and social aspects. However, the enactment of comprehensive legislation on the environment, in the form of an act of parliament, is a relatively new practice. Most of the existing laws on environmental and social issues have been enforced over an extended period of time, and are context-specific. After the Eighteenth amendment in the Constitution of Pakistan, many federal subjects devolved to provincial legislation. The Concurrent List in fourth schedule of the Constitution containing entries of subjects wherein federal and provincial legislation could legislate has been abolished. Since project coverage is in province of Sindh; therefore, only those national laws and regulations are discussed here which have application in the project. There are still several federal laws which have not been repealed by the provinces and applicable in provinces with its original titles. The laws relevant to the proposed subproject are briefly reviewed below.

3.1.1. National Environmental Policy, 2005

The National Environmental Policy, 2005 aims to protect, conserve and restore Pakistan's environment in order to improve the quality of life for the citizens through sustainable development. It provides an overarching framework for addressing the environmental issues facing Pakistan, particularly pollution of fresh water bodies and coastal waters, air pollution, lack of proper waste management, deforestation, loss of biodiversity, desertification, natural disasters and climate change. It also gives direction for addressing the cross sectorial issues as well as the underlying causes of environmental degradation and meeting international obligations.

The National Environmental Policy, 2005 while recognizing the goals and objectives of the National Conservation Strategy, National Environmental Action Plan and other existing environment related national policies, strategies and action plans, provide broad guidelines to the Federal Government, Provincial Governments, Federally Administrated Territories and Local Governments for addressing environmental concerns and ensuring effective management of their environmental resources.

3.1.2. National Sanitation Policy, 2006

The national Sanitation Policy, 2006 devised to provide a broad framework and policy guidelines for all level of governments to enhance and support sanitation coverage in the country.

The primary focus of the policy is on the safe disposal of excreta away from the dwelling units and work places by using a sanitary latrine and includes creation of an Open Defecation Free environment along with the safe disposal of liquid and solid wastes; and the promotion of health and hygiene policy in the country.

3.1.3. Land Acquisition Act, 1894

This Act is a colonial legacy which provides law for the acquisition of land needed for public purposes. The Act provides complete mechanism for determining the amount of compensation for land, trees, horticulture, to be made on account of such acquisitions. The law provides details of various peculiarities involved in acquisition of land such as preliminary investigation, objection to acquisition, declaration of intended acquisition, enquiry into measurements, value & claims, taking possession, reference to court and procedure thereon, apportionment of compensation, payment, temporary occupation of land, acquisition of land for companies, disputes resolutions, penalties and exemptions, etc. This Act has 55 sections addressing different areas. Section 4(2) of the Act mentions that it shall be lawful for any official authorized by the Collector to enter upon and survey, to dig or to do all other acts necessary to ascertain whether the land is suitable for such purpose.

The LAA and its implementation rules require that impacts assessment/valuation effort, land and crops are compensated in cash at market rate to titled land owners and registered land tenants/users, respectively.

Based on the LAA, only legal owners/title holders and tenants registered with Land Revenue Department or possessing formal lease agreements, are eligible for compensation or livelihood support. However, other national projects, have been awarded compensation and assistance, in good faith, to non title holders and other forms of PAPs (squatters /encroachers) based on their own resettlement policies.

The components under subproject will be undertaken on government land and existing ROW of subproject roads (as screened in section 6.2). According to the results of detailed social survey, there are no PAPs found in subproject area where the subproject interventions are proposed. There are no encroachers / squatters living or doing businesses in the subproject area. Also, the parking requirements during construction will be fulfilled while using existing roads in subproject area. There will be no land acquisition required for the proposed interventions.

3.1.4. Labor Laws

3.1.4.1. Employment of Child Act, 1991

Article 11(3) of the Constitution of Pakistan prohibits employment of children below the age of 14 years in any factory, mines or any other hazardous employment. In accordance with this Article, the Employment of Child Act (ECA) 1991 disallows child labor in the country. The ECA defines a child to mean a person who has not completed his/her fourteenth years of age. The ECA states that no child shall be employed or permitted to work in any of the occupation set forth in the ECA (such as transport sector, railways, construction, and ports) or in any workshop wherein any of the processes defined in the Act is carried out.

The PIU and Subproject contractor(s) will be bound by the ECA to not allow any child labor or bonded labor at the Subproject site.

3.1.4.2. The Bonded Labor System (Abolition) Act, 1992

Article 11(2) of the Constitution of the Islamic Republic of Pakistan prohibits all forms of forced labor. In accordance with this Article, The Bonded Labor System (Abolition) Act, 1992 provides for the abolition of bonded labor system in the country. Under section 4(2) of this Act, No person shall make any advance under, or in pursuance of, the bonded labor system or compel any person to render any bonded labor or other form of forced labor. The practice of bonded labor has become a punishable offence after enactment of this act (with imprisonment for a term which shall not be less than two years nor more than five years,

or with fine which shall not be less than fifty thousand rupees, or with both). Vigilance Committees are formed at the district level to keep an eye on the working of law and help in rehabilitation of freed bonded labor.

The PIU and Subproject contractor(s) will be bound by the Act to compel its labor and the provisions of this Act will be ensured.

3.1.4.3. Workmen's Compensation Act, 1923

Workmen's Compensation Act, 1923 provides for the compensation to be paid by employer to workers or their legal heirs in case of death, permanent total disablement, permanent partial disablement and temporary disablement during working.

The Subproject contractor(s) is liable to pay compensation in case of any accidents and PIU will ensure the compensation as per this Act.

3.1.4.4. Minimum Wages Ordinance, 1961

Section 9 (1) of this ordinance states that no employer shall pay any worker wages at a rate lower than the rate declared under this Ordinance to be the minimum rate of wages for such worker. 9 (2) Any employer who contravenes the provisions of this section shall be punishable with imprisonment for a term which may extend to six months or with fine.

The Sindh Finance Minister (Syed Murad Ali Shah) while announcing the Sindh Budget (2016-17) on 11 June 2016 has raised the minimum wage rate for unskilled workers from Rs. 13,000 to Rs. 14,000 per month with effect from July 2016[8].

The Subproject contractor(s) is liable to pay at least minim wages to its unskilled labor and PIU will ensure payment of not less than the minimum wage as specified above.

3.1.4.5. The Industrial and Commercial Employment (Standing Orders) Ordinance, 1968

The ordinance which applies to construction industry and contractor, does not specify the hours of working in one shift however, standing orders under this act state that The periods and hours of work for all classes of workmen in each shift shall be exhibited in Urdu and in the principal language of workmen employed, in the industrial or commercial establishment on notice boards maintained at or near the main entrance of the establishment and at the time-keeper's office, if any.

The Factories Act, 1934 (Section-34), Mines Act, 1923 (Section 22-B, C), Shops and Establishment Ordinance, 1969 (Section 8) and Road Transport Ordinance, 1961 (Section-4) are used to determine working hours and rest time in different industries which are not applicable for construction works conducted by Contractor. Section 34 of the Factories Act provides that "no adult worker shall be allowed or required) to work in a factory for more than 48 hours in a week; if the factory is seasonal, 50 hours a week and if the work is of continuous nature, he may work for 56 hours in a week. As for the daily hours, these may not be more than 9 hours a day (in case of seasonal; 10 hours). Any adult worker is required to work overtime, if asked, and the rate of overtime payment is double the usual pay (Section 47). Overtime is not payable to the contract workers, employed on piece rate basis.

[8] Finance Department, GOS

3.1.4.6. The Protection against Harassment of Women at the Workplace Act 2010

The Act was promulgated on March 11, 2010 to make provisions for the protection against harassment of women at the workplace. It states that each organization shall constitute an Inquiry Committee within thirty days of the enactment of this Act to enquire into complaints under this Act. The Inquiry Committee shall hold an inquiry against the charges and statement of allegations within three days of receipt of a written complaint. The Inquiry Committee if found the accused to be guilty, shall pose the penalties described in the Act.

The Grievance Redressal Mechanism as described in this ESMP is based on this Act and Grievance Redress Committee formed for this Subproject will cater protection against women harassment at workplace based on the provisions of this Act.

A Code of Conduct at the Workplace will be developed by CC to provide protection and safety to women against harassment and will be followed during the whole construction period.

3.1.4.7. ILO Conventions - Ratifications for Pakistan

Pakistan has ratified 08 fundamental and 26 technical ILO conventions in which following are relevant to the project:

- C029 - Forced Labor Convention, 1930 (No. 29)
- C111 - Discrimination (Employment and Occupation) Convention, 1958 (No. 111)
- C138 - Minimum Age Convention, 1973 (No. 138)
- C001 - Hours of Work (Industry) Convention, 1919 (No. 1)

C029 - Forced Labor Convention, 1930 (No. 29)

Article 1 of the convention states each member undertakes to suppress the use of forced or compulsory labor in all its forms within the shortest possible period. Article 2 of the convention states that the term forced or compulsory labor shall mean all work or service which is exacted from any person under the menace of any penalty and for which the said person has not offered himself voluntarily.

C111 - Discrimination (Employment and Occupation) Convention, 1958 (No. 111)

For the purpose of this Convention, discrimination includes any distinction, exclusion or preference made on the basis of race, color, sex, religion, political opinion, national extraction or social origin, which has the effect of nullifying or impairing equality of opportunity or treatment in employment or occupation.

C138 - Minimum Age Convention, 1973 (No. 138)

Article 1 of the convention states that Each Member which ratifies this Convention shall specify, in a declaration appended to its ratification, a minimum age for admission to employment or work within its territory and on means of transport registered in its territory; subject to Articles 4 to 8 of this Convention, no one under that age shall be admitted to employment or work in any occupation.

C001 - Hours of Work (Industry) Convention, 1919 (No. 1)

The term industrial undertaking under this convention includes (c) construction, **reconstruction, maintenance, repair,** alteration, or demolition of any building, railway, tramway, harbor, dock, pier,

canal, inland waterway, road, tunnel, bridge, viaduct, sewer, drain, well, telegraphic or telephonic installation, electrical undertaking, gas work, waterworks or other work of construction, as well as the preparation for or laying the foundations of any such work or structure;

Article 2 of the Convention states that the working hours of persons employed in any public or private industrial undertaking or in any branch thereof, other than an undertaking in which only members of the same family are employed, shall not exceed eight in the day and forty-eight in the week. The limit of hours of work prescribed in Article 2 may be exceeded in case of accident, actual or threatened, or in case of urgent work to be done to machinery or plant, or in case of "force majeure", but only so far as may be necessary to avoid serious interference with the ordinary working of the undertaking.

3.2. Provincial Laws and Regulations

3.2.1. Sindh Environmental Protection Act, 2014

Legislative assembly of Sindh Province of Pakistan passed the bill on 24th February 2014 to enact Sindh Environmental Protection Act 2014. The Act envisages protection, improvement, conservation and rehabilitation of environment of Sindh with the help of legal action against polluters and green awakening of communities. It equally lays emphasis for the preservation of the natural resources of Sindh and to adopt ways and means for restoring the balance in its eco-system by avoiding all types of environmental hazards. This act has also provided for Sindh Sustainable Fund derived from various sources such as voluntary contributions or fees generated etc. This fund is utilized for protection, conservation or improvement of environment.

3.2.2. Sindh Solid Waste Management Board Act, 2014

The SSWMB Act, 2014 enacted to establish a board for collection and disposal of all solid waste, to arrange effective delivery of sanitation services, to provide pollution free environment and to deal with other relevant matters. The Board established under the Act headed by the Chief Minister or his nominee and constitutes of thirteen other ex officio members of other relevant departments. SSWMB is managing the waste in subproject area.

3.2.3. Sindh Environmental Quality Standards (SEQS)

With the SEPA Act, 2014 the Sindh EPA revised the Environmental Quality Standards (EQS) with full consultation of the private sector, industrialist, trade and business associations and NGOs and approval of Sindh Environmental Protection Council has developed Sindh Environmental Industrial Wastewater, Effluent, Domestic Sewerage, Industrial Air Emission, Ambient Air, Noise for vehicles, Air Emissions for Vehicles and Drinking Water Quality Standards 2015 vide Notification No.EPA/TECH/739/2014. Only a few of these standards will be applicable to the noise and liquid effluents discharged to the environment from the activities under the proposed project. The SEQS is presented in **Annex A**.

Subproject Contractor(s) is liable to follow the SEQS in letter and spirit.

3.2.4. Sindh Cultural Heritage (Preservation) Act, 1994[9]

Sindh Cultural Heritage (Preservation) Act of 1994 was passed by the Provincial Assembly in February 1994 and was enacted in April 1994. This act aims to preserve and protect ancient places and objects of

[9] Sindh Cultural Heritage (Preservation) Act, 1994 – Gazette of Sindh (April, 1994)

architectural, historical, archaeological, artistic, ethnological anthropological and national interest in the Province of Sindh.[10]

The act enables the Government to declare any premise or object of architectural, historical, archaeological or national value, after consultation with the Advisory Committee. The act also states that if it is apprehended that any person intends to destroy, remove, alter, deface or imperil the protected heritage or to build on or near the site thereof in contravention of the terms of an agreement for its preservation under section 8 of the act, the Committee may issue an order prohibiting any such contravention.

Under this Act government has constituted an advisory committee constitute of a Chairman and six other members may be appointed by Government.

The act prohibits any person who intends to destroy, remove, alter, deface or imperil the protected heritage or to build on or near the site thereof in contravention of the terms of an agreement for its preservation under section 8, the Committee may an order prohibiting any such contravention.

The act enables the Government if apprehends that a protected heritage is in danger of being destroyed, injured or allowed to fall into decay, Government may Acquire it under the provision of the Land Acquisition Act, 1894, as if the preservation of a protected heritage were a "public purpose" within the meaning of that Act. The Committee is responsible to maintain and preserve every protected heritage in respect of which Government has acquired any of the rights mentioned in section 7 or which the Government has acquired under section 12 of the act.

The act also mentions that if any person including the owner destroys, removes, injures, alters, defaces a protected heritage maintained by Government under this act or in respect of which an agreement has been executed under section 8 of the act, shall be punishable with fine which may extend to one lakh rupees, or with imprisonment which may extend to three years, or with both. There is no restriction of distance from construction activity to a PCR protected under this Act.

[10] Certain PCRs of Sindh are also covered by the Antiquities Act of 1975 which ensures the protection of nominated PCRs across Pakistan. The law prohibits new construction in the proximity (within a distance of 200 feet) of a protected antiquity and empowers the Government of Pakistan to prohibit excavation in any area that may contain such articles of archaeological significance. In Karachi, there are 8 PCRs protected under the Antiquities Act of 1975. (See table below) Distance between the subproject area and these PCRs is also specified. The Antiquities Act of 1975 is not applicable for the subproject interventions as the 8 protected sites are located more than 200 feet from the subproject area.

PCRs protected under Antiquities Act 1975

S#	PCR protected under Antiquities Act	Distance from subproject area (ft.)
1.	Wazir Mansion, birthplace of Quaid-e-Azam Muhammad Ali Jinnah, Bundar quarters, Kharadar, Karachi	4,708
2.	Chaukhandi Tombs, near Landhi on National Highway, Karachi	82,960
3.	Lakho Shaikh (Baluch) Graveyard, Kharkhro, Karachi	91,700
4.	Khaliq Dina Hall and Library, M.A. Jinnah Road, Karachi	1,240
5.	Frere Hall, Karachi	4,168
6.	Flag Staff House (Quaid-e- Azam House Museum), Karachi	3,698
7.	Mausoleum of the Quaid-e-Azam Muhammad Ali Jinnah, Karachi	9,954
8.	Jam Bijar Fort (or Banbhore), Mirpur Sakro, Karachi	169,810

The subproject involves rehabilitation of roads and utility works at the existing roads, development of student piazzas and underground parking space. There are 05 buildings declared as "Protected Heritage" by the Government of Sindh (Under the Sindh Cultural Heritage (Preservation) Act 1994 on September 7, 1995)) which are located in Subproject area. The names and locations are listed in **Annex B**. The project interventions will not touch the said PCRs and as confirmed by ESMP Consultant engineer, there will be no impact on them during construction as they are located at considerable distance from the proposed interventions. However, the possible discovery of archeological sites or random findings during the execution of civil works will require measures to manage chance finds. This ESMP includes "Chance Find" procedures for protection of cultural property and contracts for subcontractors will include "Chance Find" procedures.

3.2.5. Sindh Local Government Act, 2013[11]

Sindh Local Government Act was passed in 2013 and extends to the whole of Sindh Province. It aims to establish an elected local government system to devolve political, administrative and financial responsibility and authority to the elected representatives of the local governments; to promote good governance, effective delivery of services and transparent decision making through institutionalized participation of the people at local level; and, to deal with ancillary matters. It deals with the matters such as Constitution and Composition of Councils, Local Government Elections, Functions of the Councils, Local Taxation, Local Fund and Property, Administration of Service and Transitional Provisions. In the nutshell, the local governments are administered by this act which defines their composition, functions, scope and other related matters.

Metropolitan governance in Karachi is framed by the Sindh Local Government Act 2013 (SLGA 2013), with a metropolitan entity for the entire city area and district-level municipal entities under it. Newly elected local governments (LG) for Karachi came into office in August 2016 after a gap of six years. LGs in Karachi include the Karachi Metropolitan Corporation (KMC – headed by elected Mayor and Deputy Mayor) at the metropolitan level and six District Municipal Corporations (DMCs – headed by elected Chairmen and Vice Chairmen) at the District level. These LGs collectively provide municipal functions in the urban and rural areas of Karachi Division (an administrative unit consisting of six districts[12]) with municipal functions divided between KMC and DMCs. There is no formal coordination or relationship between KMC and DMCs, creating another layer in city governance. Government of Sindh (GoS) retains substantial control which limits the autonomy of these LGs, and a number of powers are available to GoS to oversee and regulate the functioning of LGs. GoS has also in the recent past taken over a number of key municipal/ urban functions and removed them from the mandate of LGs. As the province and the city governments are being run by rival political parties, this asymmetrical balance of power is adversely impacting delivery of services and contributing to a lack of vertical integration between various tiers of city governance.

3.3. The World Bank Operational Policies

The application of World Bank Operational Policies is described below in Table 3.1.

[11] The Sindh Local Government Act, 2013. Sindh Act NO. XLII OF 2013. (Sep, 2013)

[12] Karachi Division is an administrative unit comprising six districts of Karachi, namely: East, West, South, Central, Korangi and Malir There is one DMC for each of these six districts. Rural areas of the Division, which lie in the periphery of the city, fall under a separate LG, the District Council, with its own elected council and chairperson. From 2001 to 2010, under a previous LG law, the entire Karachi Division was consolidated as the City District Government Karachi and was run by a single elected Nazim (mayor). For more details see https://en.wikipedia.org/wiki/Government_of_Karachi

Table 3.1: World Bank Safeguard Policies Triggered

S#	Environmental Assessment	Policy Reference	Applicable	Not Applicable	Remarks
1.	Environmental Assessment	OP/BP 4.01	✓		This Subproject is classified as "Category B" project per the WB Environment Category since the activities under the project would be small-scale interventions in terms of rehabilitation, restoration, maintenance on the existing footprints to improve livability.
2.	Natural Habitat	OP/BP 4.04		✓	This OP is not triggered as the subproject components will not impact natural habitat.
3.	Pest Management	OP 4.09		✓	This policy is not triggered since the project components do not involve the use pesticide / pest management.
4.	Indigenous People	OP/BP 4.10		✓	There are no known indigenous people as defined by OP 4.10 in Karachi District.
5.	Physical Cultural Resources	OP/BP 4.11	✓		There are 05 buildings declared as "Protected Heritage" by the Government of Sindh (Under the Sindh Cultural Heritage (Preservation) Act 1994 on September 7, 1995)) which are located in Subproject area. The names and locations are listed in Annex B. The project interventions will not touch the said PCRs and as confirmed by ESMP Consultant engineer, there will be no impact on them during construction as they are located at considerable and safe distance from the proposed interventions. However, due to close proximity of PCRs, policy has been triggered. The projects impacts on PCRs will be assessed as is discussed in section 6.3.3.1. Furthermore, the possible discovery of archeological sites or random findings during the execution of civil works cannot be ruled out. Therefore, this ESMP includes "Chance Find" procedures for protection of cultural property and contracts for subcontractors will include "Chance Find" procedures.
6.	Involuntary Resettlement	OP/BP 4.12	✓		The components under subproject will be undertaken on government land and existing ROW of subproject roads. According to a detailed social survey conducted by ESMP Consultant, there are no residents or businesses found in the subproject area. The interventions will also not have a temporary impact on livelihoods. Therefore, there are no PAPs as per OP 4.12 were found in subproject area where the subproject interventions are proposed. Also, the parking requirements during construction will be fulfilled while using existing roads in subproject area. While OP 4.12 has been triggered in the project ESMF, no involuntary resettlement will occur for the proposed subproject.
7.	Forestry	OP 4.36		✓	This OP is not triggered since the subproject is not located in the forest areas.
8.	Safety of Dams	OP 4.37		✓	This OP is not relevant since the subproject does not involve construction of dams.

9.	Projects on International Waterways	OP/BP 7.50		✓	This OP is not triggered as the subproject interventions (involving rehabilitation and improvement of sewerage and storm water drainage systems in the subproject area) do not pollute the tributaries of Indus River System which as per Indus Water Treaty is designated as International Waterway between India and Pakistan.

3.3.1. Environmental Assessment (OP 4.01)

The World Bank requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making. The OP defines the EA process and various types of the EA instruments. The proposed project may consist of activities which can potentially have negative environmental and social impacts, hence the Policy is triggered and this ESMF has been developed. Since the activities under the project would consist of rehabilitation, restoration, maintenance of the existing infrastructure and public spaces to improve people's livability, the level of environmental impacts is likely to be low to moderate. This project is classified as "Category B" project per the WB Environment Category since no irreversible, long-term and significant adverse impacts are foreseen to take place as a result of its implementation.

The OP 4.01 also defines ESMF as "An instrument that examines the issues and impacts associated when a project consists of a program and/or series of sub-projects, and the impacts cannot be determined until the program or sub-project details have been identified. The ESMF sets out the principles, rules, guidelines and procedures to assess the environmental and social impacts. It contains measures and plans to reduce, mitigate and/or offset adverse impacts and enhance positive impacts, provisions for estimating and budgeting the costs of such measures, and information on the agency or agencies responsible for addressing project impacts. The term "Environmental Management Framework" or "EMF" may also be used."

The subproject intends to finance a variety of types of interventions (e.g. The subproject involves rehabilitation of existing roads and utility works; development of student piazzas; underground parking space; public toilets, improved paving for sidewalks, pedestrian crossings and roads, street lighting, landscaping, street furniture including MSW containers and bins, or navigation signs, reorganized street parking or improved bus facilities; and better street crossings at appropriate locations) that can have adverse but small nature environmental impacts. This ESMP has been prepared as the subproject interventions have localized but adverse environmental and social impacts (identified and screened through ESMF checklist).

3.3.2. Natural Habitat (OP 4.04)

The conservation of natural habitats, like other measures that protect and enhance the environment, is essential for long-term sustainable development. The Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats and their functions.

This OP is not triggered as the subproject interventions will not have any impact on natural habitats

3.3.3. Pest Management (OP 4.09)

Through this OP, the WB supports a strategy that promotes the use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides. This policy is triggered for A4N component as the component comprising activities engaging with pesticides and pest management.

This policy is not triggered since the subproject components do not involve the use pesticide / pest management.

3.3.4. Indigenous People (OP 4.10)

For purposes of this policy, the term "Indigenous Peoples" is used in a generic sense to refer to a distinct, vulnerable, social and cultural group possessing characteristics in varying degrees.

There are no indigenous people in the subproject area. Hence OP 4.10 is not triggered.

3.3.5. Physical Cultural Resources (OP 4.11)

The World Bank's general policy regarding cultural properties is to assist in their preservation, and to seek to avoid their elimination. The specific aspects of the Policy are given below.

- The Bank will assist in the protection and enhancement of cultural properties encountered in Bank-financed projects, rather than leaving that protection to chance. In some cases, the project is best relocated in order that sites and structures can be preserved, studied, and restored intact in situ. In other cases, structures can be relocated, preserved, studied, and restored on alternate sites. Often, scientific study, selective salvage, and museum preservation before destruction is all that is necessary. Most such projects should include the training and strengthening of institutions entrusted with safeguarding a nation's cultural patrimony. Such activities should be directly included in the scope of the project, rather than being postponed for some possible future action, and the costs are to be internalized in computing overall project costs.
- This policy pertains to any project in which the Bank is involved, irrespective of whether the Bank is itself financing the part of the project that may affect cultural property.

There are 05 buildings declared as "Protected Heritage" by the Government of Sindh (Under the Sindh Cultural Heritage (Preservation) Act 1994 on September 7, 1995)) which are located in Subproject area. The names and locations are listed in Annex B. The project interventions will not touch the said PCRs and as confirmed by ESMP Consultant engineer, there will be no impact on them during construction as they are located at considerable and safe distance from the proposed interventions. However, the possible discovery of archeological sites or random findings during the execution of civil works will require measures to manage chance finds. This ESMP includes "Chance Find" procedures for protection of cultural property and contracts for subcontractors will include "Chance Find" procedures. Therefore this OP is not triggered.

3.3.6. Involuntary Resettlement (OP 4.12)

The WB's experience indicates that involuntary resettlement under development projects, if unmitigated, often gives rise to severe social and economic risks. This policy includes safeguards to address and mitigate these risks. The overall objectives of the 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.

The components under subproject will be undertaken on government land and existing ROW of subproject roads. According to the social survey, there are no PAPs found in subproject area where the subproject interventions are proposed. Also, the parking requirements during construction will be fulfilled while using existing roads in subproject area. While OP 4.12 has been triggered for the Project ESMF, there will be no involuntary resettlement for the proposed subproject interventions.

3.3.7. Forestry (OP 4.36)

The objective of this Policy is to assist the WB's borrowers to harness the potential of forests to reduce poverty in a sustainable manner, integrate forests effectively into sustainable economic development, and protect the vital local and global environmental services and values of forests.

This policy is not triggered because the interventions of the subproject component will be developed in urban areas of Karachi District and will not relevant to any reserved forest protected under Forest Department, Government of Sindh. Therefore, this OP is not triggered.

3.3.8. Safety of Dams (OP 4.37)

The Policy seeks to ensure that appropriate measures are taken and sufficient resources provided for the safety of dams the WB finances.

This OP is not relevant since the proposed project does not involve construction of dams.

3.3.9. Projects on International Waterways (OP 7.50)

This OP defines the procedure to be followed for projects the WB finances that are located on any water body that forms a boundary between, or flows through two or more states.

This OP is not triggered as the subproject interventions (involving rehabilitation and improvement of sewerage and storm water drainage systems in the subproject area) do not pollute the tributaries of Indus River System which as per Indus Water Treaty is designated as International Waterway between India and Pakistan.

3.3.10. Disclosure of Operational Information (BP 17.50)[13]

The World Bank recognizes that transparency and accountability are of fundamental importance to the development process and to achieving its mission to alleviate poverty. Transparency is essential to building and maintaining public dialogue and increasing public awareness about the Bank's development role and mission. It is also critical for enhancing good governance, accountability, and development effectiveness. Openness promotes engagement with stakeholders, which, in turn, improves the design and

[13] Safeguard Policies, A Quick Review – The World Bank, Tiblisi (April, 2008)

implementation of projects and policies, and strengthens development outcomes. It facilitates public oversight of Bank-supported operations during their preparation and implementation, which not only assists in exposing potential transparency issues, but also enhances the possibility that problems will be identified and addressed early on.

In accordance with this Policy, the present ESMP will be disclosed to public and also available on the World Bank's InfoShop. The ESMP's executive summary Urdu translation will be available at the official website of the PIU (http://www.urbandirectorate.gos.pk/). The subproject assessment and mitigation checklist will be maintained on file at the PIU throughout the life of the project.

3.4. Administrative Framework

Environmental issues are governed by Provincial Government. The Government of Sindh (GOS) has designated its Ministry of Environment and Alternative Energy, to administer matters related to the environment in Sindh.

3.4.1. Institutional Setup for Environmental Management

The highest environmental body in the country is the Pakistan Environmental Protection Council (PEPC), which is presided over by the Chief Executive of the country. Other bodies include the Pakistan Environmental Protection Agency (Pak-EPA), provincial EPAs (for four provinces, AJK and Northern Areas), and Environmental Tribunals. The Federal government has also formed the Federal EPA, which is headed by a Director General and has wide-ranging functions given in PEPA 1997. These include the preparation and coordination of national environmental policy for approval by the PEPC, administering and implementing the PEPA 1997 and preparation, revision or establishment of NEQS. The Provincial Environmental Protection Agencies are formed by the respective Provincial Governments. A Director General who exercises powers delegated to him by the Provincial Government heads each Provincial EPA. IEEs and EIAs are submitted to provincial EPAs for approval.

3.5. Environmental and Social Guidelines

Two sets of guidelines, the Pakistan-EPA's guidelines and the World Bank Guidelines are reviewed here. Since Sindh EPA has not formulated separate guidelines therefore, Pakistan EPA's guidelines have been benefited from. These guidelines address the environmental as well as social aspects.

3.5.1. Environmental Protection Agency's Environmental and Social Guidelines

The Federal EPA has prepared a set of guidelines for conducting environmental and social assessments. The guidelines derive from much of the existing work done by international donor agencies and NGOs. The package of regulations, of which the environmental and social guidelines form a part, includes the PEPA 1997 and the NEQS. These guidelines are listed below followed by comments on their relevance to proposed project:

- **Policy and Procedures for Filing, Review and Approval of Environmental Assessments, Pakistan Environmental Protection Agency, September 1997:** These guidelines define the policy context and the administrative procedures that govern the environmental assessment process from the project pre-feasibility stage to the approval of the environmental report. The section on administrative procedures has been superseded by the IEE-EIA Regulations, 2000.

- **Guidelines for the Preparation and Review of Environmental Reports, Pakistan Environmental Protection Agency, 1997:** The guidelines on the preparation and review of environmental reports target project proponents and specify:
  - The nature of the information to be included in environmental reports
  - The minimum qualifications of the EIA conductors appointed
  - The need to incorporate suitable mitigation measures at every stage of project implementation
  - The need to specify monitoring procedures.
- The terms of reference for the reports are to be prepared by the project proponents themselves. The report must contain baseline data on the Study Area, detailed assessment thereof, and mitigation measures.
- **Guidelines for Public Consultation, Pakistan Environmental Protection Agency, May 1997:** These guidelines support the two guidelines mentioned above. They deal with possible approaches to public consultation and techniques for designing an effective program of consultation that reaches out to all major stakeholders and ensures the incorporation of their concerns in any impact assessment study.
- **Guidelines for Sensitive and Critical Areas:** The guidelines identify officially notified protected areas in Pakistan, including critical ecosystems, archaeological sites, etc., and present checklists for environmental assessment procedures to be carried out inside or near such sites. Environmentally sensitive areas include, among others, archaeological sites, biosphere reserves and natural parks, and wildlife sanctuaries and preserves.

3.5.2. World Bank Social Guidelines

The principal World Bank publications that contain environmental and social guidelines are listed below.

- Environment, Health, and Safety (EHS) Guidelines prepared by International Finance Corporation and World Bank in 2007
- Pollution Prevention and Abatement Handbook 1998: Towards Cleaner Production
- Environmental Assessment Sourcebook, Volume I: Policies, Procedures, and Cross-Sectoral Issues.
- Social Analysis Sourcebook

In case of any conflict between the above guidelines and the ones discussed under Section 3.5.1, the WB guidelines will be followed.

Chapter 4 ENVIRONMENTAL BASELINE OF SUBPROJECT AREA

This section of the Report presents specific existing environmental conditions of the sub-project roads i.e. Educational and Cultural Zone (Priority Phase – I). Available secondary data from published literature and previous studies conducted by Consultant in the sub-project area and existing situation of sub-project roads through detailed environmental surveys has been collected to develop the baseline profile.

4.1. Physical Environment

Air shed, watershed, geology, hydrology and seismicity: Baseline data on the air shed describes the climatic conditions and quality of air. Similarly baseline data on watershed describes the hydrology and quality of surface and groundwater as well as water availability. Data on geology, geomorphology, soil characteristics and seismicity are needed to evaluate the terrestrial resources.

4.1.1. Study Area

The subproject area is located in District South which is one of the districts of Karachi Division. District South is a distinct from other districts because it comprises old city of Karachi and important due to its historical, institutional and educational centers which include the official residences of the governor and chief minister, DJ Science College, SM Arts and Law college, NED City Campus, the Sindh Assembly, city sessions and High Court, the Supreme Court's registry and the Quaid's birth place.

Educational and Cultural Zone (Priority Phase – I) Subproject forms a triangle bounded by three major roads i.e. Starchan Road, Dr. Ziauddin Ahmed Road and M.R. Kayani Road. The sub-project roads collectively comprising 2.5 km in length starting from Pakistan Chowk intersection up to Shaheen Complex and Arts Council. The location map of District South is shown in fig 4.1.

4.1.1.1. Major Landmark near subproject roads

DJ Science College, located at Dr. Ziauddin Ahmed Road, inaugurated as Sindh Arts College by Lord Reay, Governor of Bombay, on 17 January 1882.

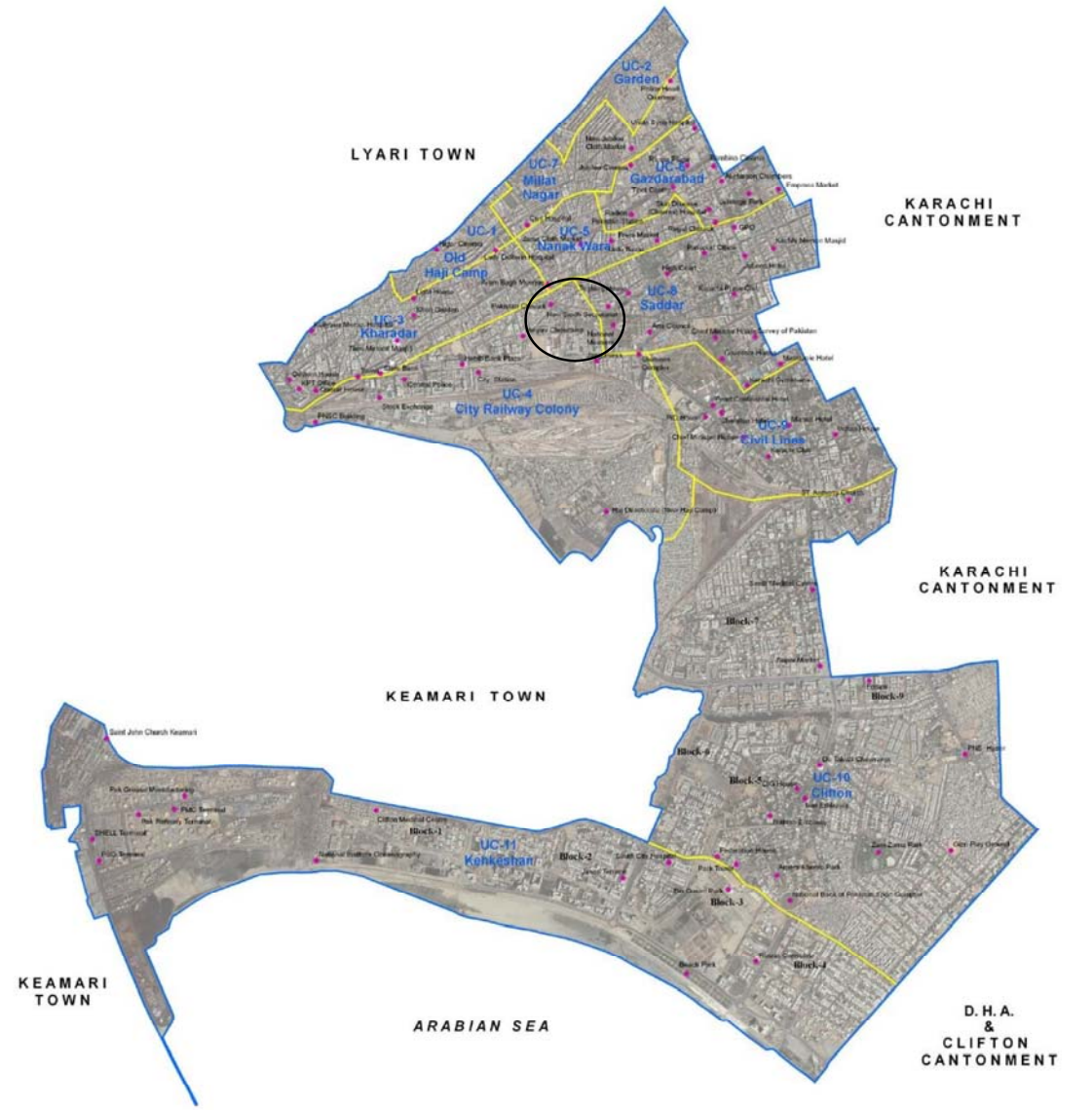
NED University City Campus, Department of Architecture and Planning is located at the Old Campus, situated in the heart of Karachi, consisting of buildings that go back to 1935.

National Museum of Pakistan displays a two million years old axe discovered on the Potohar Plateau. There is a remarkable gallery describing the early civilization of Debal and Mansura.

Supreme Court, formerly the Prince of Wales Museum, located at M. R. Kayani Rd.

Sindh High Court, located at Shahrah-e-Kamaal Ataturk Road, built in 1929 entirely out of pink-hued Jodhpur sandstone and one of the most imposing buildings in the city.

Burns Garden, a famous park located at Shahrah-e-Kamaal Ataturk Road and houses National Museum of Pakistan, includes variety of old trees as well as terrace garden of Sobhraj Chatumal terrace popularly known as Pardah Bagh.



UC NO.	UC NAME	POPULATION 2005	AREA SQ KM	ROAD LENGTH (km)
UC-1	Old Haji Camp	103,279	0.31	10.64
UC-2	Garden	97,389	0.43	15.84
UC-3	Kharadar	97,891	1.16	38.62
UC-4	City Railway Colony	65,294	3.38	30.47
UC-5	Nanak Wara	95,722	0.56	14.59
UC-6	Gazdarabad	99,294	0.73	15.47
UC-7	Millat Nagar	79,106	0.69	20.81
UC-8	Saddar	99,171	1.59	26.73
UC-9	Civil Lines	68,137	1.55	15.35
UC-10	Clifton	57,710	7.28	109.88
UC-11	Kehkeshan	72,572	6.60	51.75
SADDAR TOWN		935,565	24.28	350.15

Figure 4.1: Location map of District South[14]

[14] Sindh Building Control Authority Website (www.sbca.gos.pk)

4.1.2. Meteorology & Air Quality

As the only meteorological station of Pakistan Meteorological Department (PMD) is located at Jinnah International Airport, Karachi which measures the overall Karachi climate data, therefore this station is taken as the secondary source to present the meteorology of subproject area.

Karachi is located just above the tropical zone i.e. 24° North. It is situated along the coast of Arabian Sea. Both these factors influence the climate of Karachi. It can be characterized by dry, hot and humid condition. There is minor seasonal intervention of a mild winter from mid-December to mid-February into a long hot and humid summer extending from April to September, with monsoon rains from July to mid-September.

4.1.2.1. Temperature

The air temperature in Karachi Division and its coastal areas are generally moderate throughout the year due to presence of sea. Climate data generated by the meteorological station at Karachi Air Port represents climatic conditions for the region. Table 3.1 and 3.2 (below) shows that the annual mean maximum temperatures ranged between 32 and 33°C and averaged at 32.6°C, whereas, the annual mean minimum temperatures ranged between 21.0 and 22.5°C and averaged at 21.8°C, at the Karachi Airport Meteorological Station keeping in view the temperature data being recorded for past eleven years (2001 to 2013). During winter the range of variation of temperature is slightly large.

Table 4.1: Mean Monthly Maximum Temperature °C

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	27.2	29.6	33.1	34.6	35.1	34.9	32.2	32.3	33.1	36.0	33.5	30.4	32.7
2002	27.0	28.2	33.3	35.4	35.6	35.1	32.2	31.6	31.4	36.5	32.7	28.1	32.3
2003	27.6	28.5	32.4	36.6	35.7	34.9	34.1	32.6	32.5	37.0	32.2	28.3	32.7
2004	26.6	29.9	36.2	35.4	36.8	35.6	33.8	32.7	32.8	33.7	33.1	29.4	33.0
2005	24.9	26.3	31.5	35.3	35.4	36.0	33.2	32.2	34.2	35.2	33.1	28.4	32.1
2006	26.0	31.3	31.8	34.0	34.6	35.3	33.8	31.0	34.2	35.0	33.4	26.3	32.2
2007	26.9	29.4	31.4	37.7	36.0	36.4	N/A	N/A	N/A	N/A	N/A	N/A	33.0
2008	24.4	26.9	34.3	34.4	33.9	35.1	33.5	31.9	34.7	35.5	32.5	27.2	32.0
2009	26.2	29.8	33.0	36.0	36.8	35.7	34.5	33.0	32.8	35.9	33.0	28.6	32.9
2010	27.5	29.2	34	35.7	36.5	34.7	34.6	33.2	34.5	35.9	32.7	28	33.0
2011	26.9	28.5	33.2	35.8	35.3	35.3	34.2	32.8	32.9	N/A	N/A	N/A	N/A
2012	25.7	26.9	31.7	35.1	35.5	34.6	33.2	32.7	33.2	35.0	32.7	28.2	32.0
2013	26.7	28.0	33.3	34.0	35.1	36.5	33.8	32.1	33.0	35.7	32.3	28.3	32.4

Source: Pakistan Meteorological Department

Table 4.2: Mean Monthly Minimum Temperature °C

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	11.5	14.9	19.6	23.8	28.1	29.0	27.1	26.5	25.9	24.4	18.6	15.8	22.1
2002	12.8	13.8	19.5	23.9	27.0	28.2	29.6	25.6	24.8	22.5	17.7	14.9	21.7
2003	12.7	16.9	19.8	24.2	26.5	28.2	23.6	27.0	25.3	20.9	15.2	12.0	21.0
2004	12.9	14.5	19.1	24.8	27.3	28.8	27.5	26.3	25.3	22.4	18.0	15.4	21.9
2005	12.3	11.3	20.3	23.0	26.4	28.3	27.2	26.6	26.6	22.9	18.9	13.0	21.4
2006	11.7	18.1	19.6	24.5	27.5	28.5	28.3	26.3	26.8	25.7	19.4	14.0	22.5
2007	13.0	17.3	19.7	24.7	27.6	28.6	N/A	N/A	N/A	N/A	N/A	N/A	21.8
2008	10.1	11.1	19.6	24.0	27.3	29.1	27.9	26.8	26.6	23.8	17.6	14.9	21.6
2009	14.7	16.5	20.8	23.8	27.6	28.7	28.1	27.5	26.5	22.6	17.0	13.9	22.3
2010	12.2	14.7	21.3	25.1	28	28.2	28.3	27.2	25.8	23.9	17.4	11.1	21.9
2011	11	14.5	19.7	23.1	27.1	28.8	27.8	28.6	26.5	N/A	N/A	N/A	N/A
2012	11.2	11.9	19.1	24.5	27.2	28.0	27.9	26.9	26.4	22.7	18.6	14.2	21.5
2013	11.6	15.1	19.2	24.2	27.1	29.3	28.0	26.6	25.5	25.4	18.1	13.0	21.9

Source: Pakistan Meteorological Department

4.1.2.2. Precipitation

The rain fall in the Karachi coastal zone is extremely low and erratic; therefore this region falls in the semi-arid climatic zone. Heavy rains exceeding 50 mm (sometimes 100 mm) in a day are common during the monsoon season in north-eastern humid and sub-humid parts of Pakistan and Kashmir which is known as the gateway of the monsoon for the country. However, such events only occasionally occur southward where the climate is mainly arid. Karachi's heavy downpour on 28 July 2003 is one such example. Table 4.3 shows the last thirteen years precipitation data recorded at Karachi Airport station. The record suggests that July and August are the wettest months and that the maximum rainfall recorded in Karachi during 2001-2009 & 2012-2013 period was 270.4 mm during the month of July 2003, while the maximum annual rainfall was 324.9 mm during the year 2003, followed by 301.1 mm in 2006 and 279.9 mm in 2009.

Table 4.3: Monthly Amount of Precipitation (mm) at Karachi Air Port

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	0.0	0.0	0.0	0.0	0.0	10.6	73.6	16.2	N/A	0.0	0.0	0.0	33.46
2002	0.0	2.4	0.0	0.0	0.0	N/A	N/A	52.2	N/A	0.0	0.5	0.4	13.87
2003	6.4	21.8	0.0	0.0	0.0	16.3	270.4	9.8	N/A	0.0	0.2	0.0	54.15
2004	13.7	0.0	0.0	0.0	0.0	N/A	3.0	5.6	N/A	39.3	0.0	4.3	13.18
2005	6.6	12.8	N/A	0.0	0.0	N/A	N/A	0.3	54.9	0.0	0.0	17.1	18.34
2006	N/A	0.0	N/A	0.0	0.0	0.0	66.2	148.6	21.9	0.0	3.1	61.3	60.22
2007	0.0	13.2	33.4	0.0	0.0	110.2	N/A	N/A	N/A	N/A	N/A	N/A	52.26
2008	8.0	Trace	1.1	0.0	0.0	0.0	54.0	37.5	Trace	0.0	0.0	21.0	24.32
2009	3.0	Trace	0.0	Trace	0.0	2.6	159.9	44.0	68.9	0.0	0.0	1.5	55.68
2012	0.2	0.0	0.0	0.0	0.0	Trace	Trace	8.1	121.0	0.0	0.0	22.8	152.1
2013	Trace	20.0	2.8	30.0	0.0	Trace	5.5	105.4	4.0	1.2	0.0	0.0	168.9

Source: Pakistan Meteorological Department

4.1.2.3. Wind Speed & Direction

The wind is another important feature of coastal region. It is variable and is faster in summer than in winter. The highest velocity has been observed during monsoon. The velocity increases from morning on wards to the evening. Northerly to North-Easterly winds prevail during the morning hours, changing to Westerly and South-Westerly directions for rest of the day. The wind usually blows from 7.4 to 20.5 Km/h during summer. The wind blows throughout the year with highest velocities, during summer it has direction from south-west to west. During winter, wind blows from north to northeast and shifts southwest to west in the evening hours. This high velocity wind usually carries sand and salt, resulting in erosion as well as corrosion. The wind velocity varies between 3-15 m/s. The wind direction and speed between the two monsoon seasons viz. summer and winter are rather unsettled or large variations are noted both with respect to speed and direction. The wind speed and wind direction of Karachi is given in Table 3.4 and Table 3.5.

Table 4.4: Mean Monthly Wind Speed (m/s) at 12:00 UTS (Karachi)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	2.6	3.4	4.3	5.6	7.5	8.1	6.8	7.3	5.5	3.7	2.0	2.4	4.9
2002	3.6	3.9	4.0	6.5	8.5	8.2	9.8	7.3	7.7	3.3	2.9	3.2	5.7
2003	4.0	5.0	5.4	5.2	7.7	8.8	6.7	7.1	6.0	3.2	3.1	3.0	5.4
2004	3.4	3.7	4.0	6.0	8.0	9.0	10.0	9.5	7.3	3.8	1.0	2.5	5.7
2005	3.6	4.2	4.8	5.1	7.1	7.5	9.0	6.9	6.4	3.9	2.0	1.5	5.2
2006	2.0	3.0	3.0	6.2	8.0	7.7	8.3	6.2	4.7	4.2	2.2	3.0	4.9
2007	2.0	3.7	4.0	4.0	6.0	6.3	N/A	N/A	N/A	N/A	N/A	N/A	4.3
2008	4.3	7.6	8.2	10.5	12.6	7.6	11.0	9.3	8.7	6.6	5.1	3.9	7.9
2009	7.0	7.2	7.9	9.3	9.8	9.7	9.5	9.3	9.1	6.1	5.0	3.9	7.8

Source: Pakistan Meteorological Department

Table 4.5: Mean Monthly Wind Direction at 12:00UTS (Karachi)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	S54W	S43W	S42W	S45W	S46W	S45W	N52W	S59W	S44W	N56W	S45W	S06W
2002	S67W	S52W	S51W	S55W	S51W	S42W	S54W	S45W	S48W	S56W	N54W	S41W
2003	S60W	N50W	S45W	S48W	S45W	S68W	S60W	S47W	S43W	S54W	S50W	S27W
2004	N27E	S46W	S53W	S49W	S52W	S54W	S54W	S62W	S56W	S47W	S45W	N86E
2005	N63E	S51W	S50W	S52W	S63W	S48W	S54W	S49W	S87W	S54W	S52W	N23W
2006	S48W	S62W	S50W	S57W	S64W	S60W	S67W	S78W	S51W	S53W	S49W	N79E
2007	S30W	S62W	S47W	S55W	S58W	S47W	S41W	S55W	S60W	S48W	S48W	N45E
2008	N45E	S47W	S54W	S51W	S52W	S39W	S50W	S52W	S46W	S39W	S38W	N45E
2009	N45E	S45W	S41W	S58W	S46W	S46W	S56W	S49W	S56W	S42W	S39W	S45E

Source: Pakistan Meteorological Department

4.1.2.4. Ambient Air Quality and Noise

The prime objective of the baseline air quality study was to establish the existing ambient air quality of the subproject area. Ambient Air Monitoring was conducted at Sundial Chowk near main gate of DJ science College in Subproject area by ESMP Consultant through an EPA certified laboratory on 07 August 2017. The readings were recorded at an interval of 15 minutes over a period of 16 hours. The ambient air quality was monitored for the priority pollutants such as carbon monoxide (CO), sulphur dioxide (SO2), ozone (O3), nitrogen oxide (NO), nitrogen dioxide (NO2), suspended particular matter and particulate matter (PM10 and PM2.5).

Figure 4.2: Ambient Air Quality monitoring at Sundial Chowk

The ambient air quality monitoring results are summarized in the tables below:

Table 4.6: Real-time air quality monitoring conducted in Subproject area

Date	Time	SO_2 ($\mu g/m^3$)	NO ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	CO (mg/m^3)	O_3 ($\mu g/m^3$)	Noise (dB)	SPM ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	Lead ($\mu g/m^3$)
SEQS (2016)		120	40	80	5	130	75	500	150	75	1.5
7/8/2017	8:00	62.0	14.5	45	2.5	48.5	55	432	174	40	0.5
7/8/2017	8:15	64.9	15.8	47	2.6	52.8	56				
7/8/2017	8:30	70.5	13.2	51	2.8	48.5	63				
7/8/2017	8:45	64.9	18.5	47	2.6	48.5	65				
7/8/2017	9:00	73.3	15.8	51	2.8	52.8	52				
7/8/2017	9:15	81.8	13.2	59	2.6	54.9	58				
7/8/2017	9:30	84.6	15.8	57	2.4	59.1	56				
7/8/2017	9:45	87.4	19.8	53	2.8	54.9	63				

7/8/2017	10:00	90.2	18.5	57	2.6	61.2	65				
7/8/2017	10:15	84.6	15.8	59	2.3	63.3	52				
7/8/2017	10:30	90.2	15.8	55	2.1	67.5	54				
7/8/2017	10:45	98.7	19.8	59	2.3	63.3	52				
7/8/2017	11:00	90.2	18.5	47	2.6	67.5	66				
7/8/2017	11:15	84.6	15.8	59	2.8	63.3	68				
7/8/2017	11:30	98.7	13.2	55	2.6	67.5	65				
7/8/2017	11:45	101.5	15.8	59	2.8	73.9	69				
7/8/2017	12:00	98.7	19.8	57	3.1	67.5	71				
7/8/2017	12:15	107.2	18.5	53	2.6	63.3	68				
7/8/2017	12:30	101.5	19.8	59	2.3	67.5	69				
7/8/2017	12:45	98.7	15.8	61	2.8	63.3	65				
7/8/2017	13:00	90.2	13.2	65	2.6	67.5	71				
7/8/2017	13:15	101.5	14.5	59	2.8	76.0	69				
7/8/2017	13:30	98.7	15.8	55	3.2	67.5	65				
7/8/2017	13:45	84.6	13.2	59	3.1	73.9	63				
7/8/2017	14:00	98.7	18.5	55	3.2	63.3	65				
7/8/2017	14:15	101.5	15.8	59	2.6	67.5	56				
7/8/2017	14:30	107.2	15.8	53	2.3	63.3	62				
7/8/2017	14:45	90.2	13.2	59	3.2	61.2	65				
7/8/2017	15:00	101.5	14.5	61	2.6	63.3	58				
7/8/2017	15:15	98.7	15.8	59	3.1	67.5	56				
7/8/2017	15:30	110.0	18.5	55	3.2	63.3	59				
7/8/2017	15:45	98.7	15.8	59	2.6	59.1	57				
7/8/2017	16:00	101.5	13.2	67	2.8	63.3	52				
7/8/2017	16:15	98.7	15.8	61	2.6	67.5	56				
7/8/2017	16:30	90.2	19.8	65	3.1	61.2	58				
7/8/2017	16:45	98.7	18.5	61	2.8	63.3	59				
7/8/2017	17:00	101.5	15.8	59	2.6	67.5	59				
7/8/2017	17:15	90.2	13.2	55	3.2	63.3	57				
7/8/2017	17:30	101.5	14.5	59	2.6	67.5	58				
7/8/2017	17:45	98.7	15.8	61	3.2	73.9	63				
7/8/2017	18:00	107.2	13.2	65	2.6	63.3	65				
7/8/2017	18:15	101.5	18.5	61	3.1	63.3	62				
7/8/2017	18:30	107.2	15.8	67	3.6	54.9	68				
7/8/2017	18:45	101.5	13.2	65	3.0	50.6	65				
7/8/2017	19:00	98.7	15.8	61	3.1	48.5	69				
7/8/2017	19:15	101.5	18.5	59	3.2	42.2	59				
7/8/2017	19:30	98.7	15.8	55	2.6	46.4	63				
7/8/2017	19:45	110.0	13.2	61	3.2	48.5	65				
7/8/2017	20:00	95.9	14.5	65	2.6	52.8	59				

The above results show that the parameters are with SEQS limits. The ambient air quality can be mainly affected by vehicular traffic and traffic congestion. However, no such deterioration of air quality has been reached in the subproject area yet.

The noise quality survey of the proposed project area was conducted by Consultant with the help of a noise measuring instrument. Table 3.7 shows the results of ambient noise at the subproject area.

Table 4.7: Ambient Noise Quality Results

S. No.	*Locations of the Project Area*	*Noise Level Measurements dB(A)*
1	Confluence of Burns road and Strachan Road	86
2	Dr. Ziauddin Ahmed Road	75
3	Burns Road (Muhammad Bin Qasim Road)	78

Table 4.7: Ambient Noise Quality Results		
S. No.	*Locations of the Project Area*	*Noise Level Measurements dB(A)*
4	Queensway Road	74
5	M.R. Kayani Road	77
6	Pakistan Chowk Roundabout	78
Avg.		**78.0**

The noise level at the subproject roads on the average is **78.0** dB(A), shows that the average noise measurements of the survey are within the limits of SEQS which is 85dB(A) from 7.5 m from the source as per vehicular noise standards. While considering the ambient noise for the commercial area, it is higher than the SEQS limits of 65dB(A) due to the traffic problems and heavy mass of traffic flow.


Noise Survey Conducted by Consultant

4.1.3. Topography

Karachi may be broadly divided into two parts; the hilly areas in the north and west and an undulating plain and coastal area in the south-east. The hills in Karachi are the off-shoots of the Kirthar Range. The highest point of these hills in Karachi is about 528m in the extreme north. All these hills are devoid of vegetation and have wide intervening plains, dry river beds and water channels.

The topography of Karachi includes the large shallow intertidal and sub-tidal areas spreading out to 1-5 km with a very gentle surface gradient of about 1:50. The Cape Monze cliff that projects into the Arabian Sea is part of the 3-9 meter contour that characterizes the coastline up to the Rann of Kutch. In the sand mass along the coastline there are 30 to 60m high cliffs that have been undercut by storm surges. Intense erosion resulted in cliffs, sea caves, arches and blow holes that can be observed on the coastline from Hawkes Bay to Manora Channel and onwards to Korangi Creek.

The coastal region of the synclinorium is seismically active and has been undergoing continuing uplift. The uplift has already resulted in the formation of rocky headlands and in exposing portions of continental shelf. Protected pocket bays and lagoons between the nearly formed headlands have been rapidly filled by alluvial and fluvial deposits. The material brought to the coast was taken over by currents and wind for the formation of wide sandy beaches, and migrating sand dunes.

The mean sea level elevation in the surrounding of the project area varies from 20ft to 35ft, sloping from north to south.

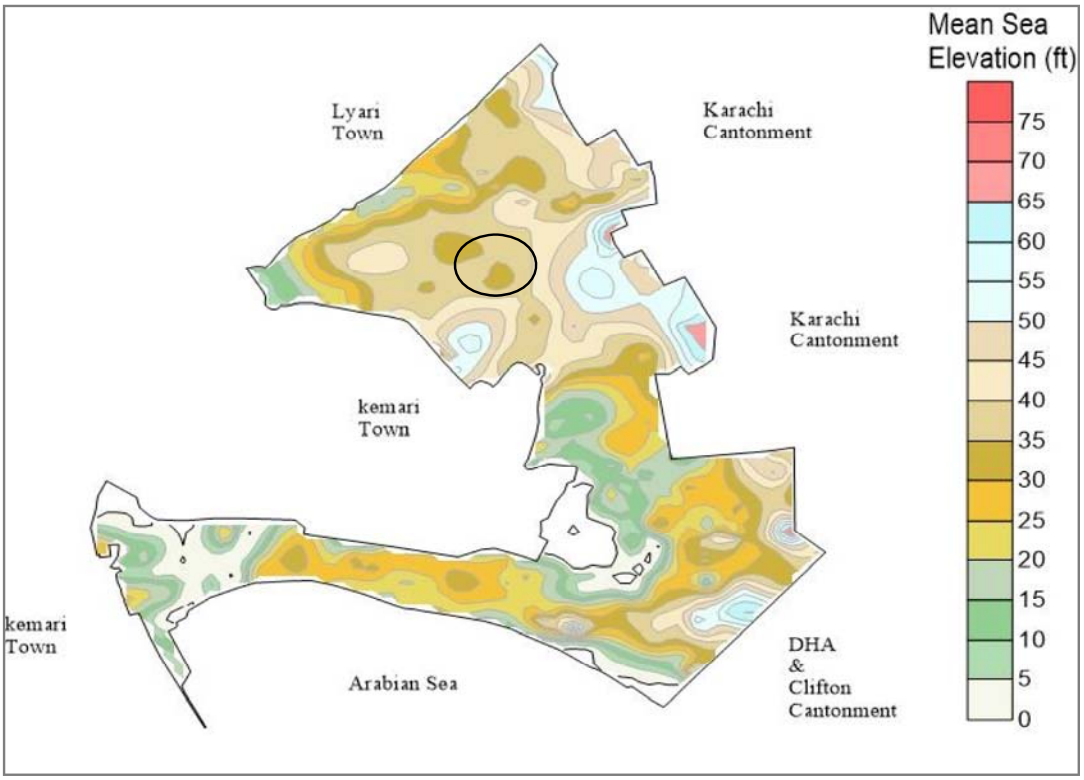


Figure 4.3: Mean Sea Elevation Map of District South, Karachi, Pakistan

4.1.4. Surface Water Resources

The surface water resource available in the macro-environment is seawater. There is no surface water resources exit in Year 1 subproject location.

A heavy storm drainage covered channel is passing in between the Burns Garden (outside the boundary of Burns Garden) and Arts council which is connected to the Arabian Sea. The concrete storm drainage channel was previously the natural storm water stream and was naturally taking all the rain water in the past; the contours of the nearby regions were predicted to be sloped towards the channel.

4.1.5. Hydrogeological Features[15]

Sub-project Areas Groundwater condition

Physico-chemical data of shallow groundwater (depth less than 30 meters) shows that the shallow wells, located in the vicinity of coast and in the proximity of polluted rivers, have relatively higher values of electrical conductivity, salinity and population of Coliform bacteria. In general, the bacteriological quality of shallow groundwater is quite poor and renders the water unfit for drinking purposes without prior treatment. The shallow groundwater is moderately saline, representing electrical conductivity values in the range of 1.1 to 1.9 mS/cm and salinity in the range of 1 ppt. The pH of shallow groundwater varies from mildly acidic (~6.3) to mildly alkaline values (~7.9). Areas with quite poor sanitary conditions have relatively low values of pH (~6.3 to 6.8). Shallow groundwater below 20 meters is slightly reducing. The dissolved oxygen is in the range of 1.5 to 7.9 mg/L. Turbidity of shallow groundwater varies between 3.6

[15] Preparatory Survey (II) on Karachi Circular Railway Revival Project, 2013, prepared by JICA

NTU and 95 NTU. The concentration of HCO_{3-} (356 – 514 ppm, n=4), Cl- (82 - 169 ppm, n=4) and SO_4^{-2} (38-117 ppm, n=4) in shallow groundwater is very reasonable.

Sample Code	Sample Location	Approx. Depth (meter)	pH	EC (mS/cm)	Salinity (ppt)
G-018	Saddar (shallow)	20	7.9	1.6	1.0

(Source: Groundwater Salinity in Coastal Aquifers of Karachi, A. Mashiatullah, R.M. Qureshi, N.A. Qureshi, E. Ahmad, M. A. Tasneem, M.I. Sajjad, H.A. Khan, December 2000)

4.1.6. Geology[16]

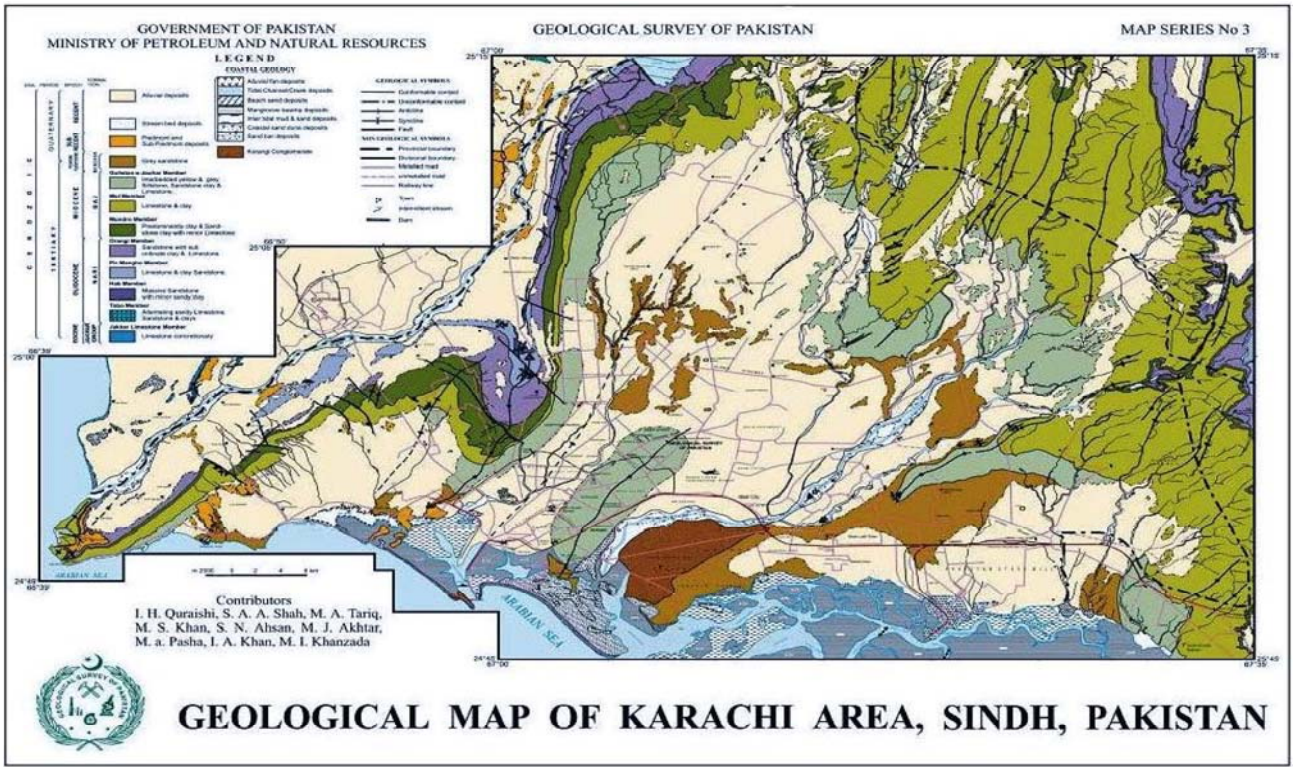
According to Bender and Raza (1995), the geological structural setup of Karachi region belongs (Southern India Basin which is a result of the rifting during Triassic, oblique collision of the Indo-Pakistan plate with the Afghan blocks during the Late-Cretaceous and Palaeogene, and by post collision deformation during Neogene and Quaternary periods. Tectonically, the counter clockwise movement of Indian plate during Eocene time, after its collision with Eurasian plate, has resulted in the formation of Karachi Embayment. It has remained as a trough in the recent geological time. It was followed by structural deformation in the late Pleistocene to middle Pleistocene related to the Himalayan Orogeny.

This arc forms the southern-most part of the Kirthar Mountain and the southwestern margin of Lower Indus Basin. It is bounded by Ornach-Nal Fault in the west and Hyderabad High in the East. The southern part of the embayment is submerged in the sea and still receiving sediments from different sources. It is comprised of a series of parallel to sub parallel short, narrow, serrate, accurate (convex to east) enechelon ridges and wide, dome-shaped anticlinal hills. It forms nearly 200 km long and 50 km wide zone between Karachi and Sehwan. The Bhit range, Bhadra range, Lakhi hills and Lakhra hills are some of its more prominent components. The altitude of the Hills varies from 250 m in the south to about 1,100m in the north. The Naing, Baram and Malir River are the main streams draining this region.

The Trough is characterized by thick Early Cretaceous sediments and also marks the last stages of marine sedimentation. This localized deposition represents a unique feature where no hiatus in sedimentation occurs. Sembar and Goru (Cretaceous) of several meters thickness, overlain Parh Mughal Kot and Pub formations. The Paleocene sequences are marked by Rani Kot formation. The Eocene is represented by Ghazij Shale and carbonates of Kirthar and Laki formation. The Oligocene is represented by the Nari formation which is underlain by Gaj formation of Miocene age. The submerged part of embayment is still receiving sediments from sources of proto Indus drainage system (Shoaib & Rafi, 2004). Figure 3.7 shows the geological features of Karachi District.

[16] Preparatory Survey (II) on Karachi Circular Railway Revival Project, 2013, prepared by JICA

Figure 4.4: Geological Map of Karachi[17]



[17] Geological Survey of Pakistan

4.1.7. Physical Cultural Resources (PCRs)

A list of archaeological sites protected under Antiquities Act 1975 is presented in "Guidelines of Sensitive and Critical Area developed by Pak-EPA in 1997". The list is a 1996 Publication by the Pakistan Heritage Society Peshawar-Lahore and has been prepared by Mr. M. Rafique Mughal. There is a total of 211 archaeological/historical sites situated in the Karachi District.

There are 05 buildings declared as "Protected Heritage" by the Government of Sindh (Under the Sindh Cultural Heritage (Preservation) Act 1994 on September 7, 1995)) which are located in Subproject area. The names and locations are listed in **Annex B**. The project interventions will not touch the said PCRs and as confirmed by ESMP Consultant engineer, there will be no impact on them during construction as they are located at considerable distance from the proposed interventions. The assessment of impact on PCRs is discussed in section 6.3.3.1.

4.2. Ecological Baseline[18]

Condition of the physical environment described above suggests that it would be difficult for natural vegetation to survive under harsh climatic conditions, accentuated by drought, and multiplied by land clearance activities demanded by the forces of urbanization. Natural vegetation is restricted all over the urban area to depression areas where moisture would be available for greater part of the year and longer period of time.

The native vegetation is of the desert scrub type comprising a wide variety of bushes and shrubs, including karir (*capris aphylia*), babul (*Acacia nilotica*), khor (*Acacia senegal*), khabar (*Salvadora oleoides*), kandi (*Prosopsis senegal*), kikar (*Acacia arabica*), lai (*Tamarix gallica*), *tamarix aphylla*, *populus euphratica* (willo or bahan), *Aerua javanica*, *Maerva arenaria*, *Abutilou sp*, *Amaranthus viridis*, *Cordia gharaf*, *Rhazya sticta*, karil (*capparis aphyila*), acacia or siris (*acacia lebbek*), papal (*ficus religiosa*) and tamarind (tamarindus indica).

The biodiversity of vegetation on the sandy plains and low hills of urban Karachi is characterized by ephemeral species plus trees and shrubs, including *Prosopis cineraria*, *Acacia nilotica*, *Tamarix aphylla*, *Lycium shawii*, *Salvadora oleoides*, *Zizyphus sp.*, *Calligonum polygonoides* and *Leptadenia pyrotechnica*. The shallow slopes with varied soils on recent and subrecent substrates at low altitudes chiefly on plains have the trees *Zizyphus nummularia*, *Salvadora oleoides*, and *Capparis decidua*, and shrubs *Grewia tenax*, *Seddera latifolia*, and *Rhazya stricta* that are the most commonly found species, together with the grasses *Ochthochloa compressa*, *Cymbopogon jawarancusa* and *Aristida funiculata*. With *Prosopis cineraria*, *Indigofera oblongifolia* and *Euphorbia caducifolia*, the above combination of species makes up most of the total vegetation coverage of Karachi Division.

4.2.1. Flora of Sub-Project Area

Development activities have substantially reduced the biodiversity of terrestrial flora of Karachi city. The area located along city's coastline still continuing with moisture in the ground has some natural vegetation mostly shrubs/bushes.

[18] Environmental Impact Assessment of proposed Bus Rapid Transit Project in Karachi, August 2014; Client: Karachi Metropolitan Corporation and prepared by EMC Pakistan Pvt. Ltd.

Educational and Cultural Zone (Priority Phase – I) Subproject has busy roads with extensive historical buildings, educational and commercial setup. The detailed floral inventory has been made by the Consultant in subproject area which is presented in the following table:

Dr. Ziauddin Ahmed Road (From Pakistan Chowk to Jan Press Roundabout)		**55 ft wide carriageway**
Left (Footpath)	*Right (Shoulder)*	
05 Mature *Conocarpus erectus*	07 Mature *Lignum vitae*	
40 Immature *Conocarpus erectus*	Small Island infront of Jang Press Roundabout contains 03 Mature *Lignum vitae*	
Strachan Road (From Pakistan Chowk to NED Old Campus)		**50 ft wide carriageway**
Left (Footpath)	*Right (Footpath)*	
03 Unknown species of trees	03 Mature *Conocarpus erectus*	
	02 Mature *Eucalyptus*	
M.R. Kayani Road		**78 ft wide carriageway**
Left (Footpath)	*Median*	*Right (Footpath)*
07 Mature *Delonix regia*	15 Mature *Conocarpus erectus*	09 Mature *Conocarpus erectus*
	16 Mature *Lignum vitae*	05 Mature *Delonix regia*
	01 Mature *Azadirachta indica*	05 Mature *Azadirachta indica*
		01 Mature *Ficus benghalensis*
Shahrah-e-Kamal		**106 ft. wide carriageway**
08 Immature unknown species of trees (03 dried out)		
Outside DJ Science College		
02 Mature *Ficus benghalensis* on Footpath		









Various trees planted along the ROW of Subproject Roads

4.2.2. Fauna of Sub-Project

The impoverished as well as degraded environment resulting from non-availability of surface as well as groundwater and discharge of untreated wastewater into Lyari and Malir Rivers has irreversibly reduced the biodiversity of the indigenous as well as introduced vegetation and hence it offers very little chance for the survival/growth of fauna in the macro environment of Karachi Division.

There are even otherwise no habitats of large and small animals, birds or reptiles within District South. Water availability is the main constraint for the distribution of many animal species. Large wild mammals are virtually absent in the subproject area. The common fauna in the project area comprises of stray dogs and cats. There are a few local bird species that have adapted to the urban environment in subproject areas. These include common mynah, pigeon, crow, kite, and house sparrow.

Chapter 5 SOCIO-ECONOMIC BASELINE OF SUBPROJECT AREA

This section of the Report presents specific existing socio-economic conditions of the sub-project area i.e. Educational and Cultural Zone (Priority Phase – I). Available secondary data from published literature, previous studies conducted by Consultant in the subproject area, and existing situation of subproject roads and infrastructure through detailed social surveys has been collated to develop the baseline profile.

5.1. Socioeconomic Profile of Subproject Area

This section presents a broad profile of the prevailing socioeconomic situation in subproject area. This baseline has been prepared based upon the secondary literature resources as well as social survey conducted in subproject area and neighborhood. The subsequent section will include the existing conditions of residents, public infrastructure, transport, education, health, demography, labor and employment etc.

Sampling frame for socioeconomic survey

The subproject area (as shown in Figure 2.1) is an educational and cultural hub including education institutions including DJ Science College, NED University City Campus, SM Arts and SM Law Colleges, and Cultural sites such as National Museum, Burns Garden, and Arts Council. The people attending these institutions include students, teaching and administrative staff of colleges and a university, and government servants. The five roads included in the subproject area are used by people belonging to the aforementioned institutions, a few public buses, rickshaw drivers, and pedestrians who live in surrounding areas and walk through the subproject areas.

A sample of students has been selected for consultation and collection of basic socioeconomic information. While these students are not residents of the subproject area, they are regular users of this largely non-residential area. The socioeconomic profile includes basic information regarding their residence locality, mode of transport from their residence to the subproject area, and size of household.

Other regular users of this area include transporter service providers. Transport service in the subproject area is limited. The few public buses which provide service to the subproject area mainly do not go beyond the Pakistan Chowk roundabout. While private rickshaws are available, their number varies during the day. The socioeconomic survey also includes the socioeconomic profile of a few randomly selected bus and rickshaw drivers.

The socioeconomic survey also includes a brief profile of a sample of government servants and teachers of educational institutions. The sample was selected based on the availability of teaching staff and government servants.

There are 30-35 households living in apartments in few buildings located along Dr. Ziauddin Ahmed Road and Strachan Road. In addition, there are 25-30 shops located on the ground floor of the aforementioned apartment's buildings. The households and shops are not included in subproject area; however, these shops and HHs use the subproject roads for commuting. Hence a 50% sample from the total number of HHs and shops was also randomly selected and profiled for the socioeconomic survey.

5.1.1. Demographic Profile

According to Table 5.1, Karachi Division has six districts. As the subproject is located in District South; the population based on 1998 Census of District South is 2,431,286. Estimated population of District South in 2015 is 660,164 (**Annex E**).

Table 5.1: Administrative Profile of Karachi Division

	Area (sq.km)	No of Districts	No of Union Councils	No of Mouza
Karachi	3,675	6	178	75

Source: City District Karachi, Pakistan Development Prospects 2013

5.1.1.1. Socio-Economic Profile of Students

The details of the social survey of students are given in the table below:

Table 5.2: Profile of Students in Subproject area

S #	Name[19]	Gender	Grade	Location of Residence	Mode of Transport	Family Members
DJ College						
1.	Respondent No.1	Male	BSc 2nd year	Soldier Bazar	Public Transport	05
2.	Respondent No.2	Male	BSc 2nd year	Pakistan Quarters	Public Transport	04
3.	Respondent No.3	Male	BSc 2nd year	Jacob Lines	Public Transport	03
4.	Respondent No.4	Male	BSc 2nd year	Khudad Colony	Public Transport	05
5.	Respondent No.5	Male	Inter 2nd year	Nazimabad	Public Transport	06
6.	Respondent No.6	Male	Inter 2nd year	F.B. Area	Bike	04
7.	Respondent No.7	Male	Inter 2nd year	Nazimabad	Public Transport	07
8.	Respondent No.8	Male	Inter 2nd year	PECHS	Public Transport	08
9.	Respondent No.9	Male	Inter 2nd year	Civil Lines	Public Transport	05
10.	Respondent No.1	Male	Inter 2nd year	Mehran Town	Motor Cycle	06
11.	Respondent No.11	Male	Inter 2nd year	Korangi	Public Transport	03
12.	Respondent No.12	Female	B.Sc. 1	Kala Pul	Public Transport	07
13.	Respondent No.13	Female	B.Sc. 1	Orangi	Public Transport	06
14.	Respondent No.14	Female	B.Sc. 1	Lyari	Public Transport	05
15.	Respondent No.15	Female	B.Sc. 1	Korangi 6	Public Transport	02
16.	Respondent No.16	Female	B.Sc. 1	Saddar	Public Transport	05
17.	Respondent No.17	Female	B.Sc. 1	Lyari	Public Transport	06
18.	Respondent No.18	Female	B.Sc. 1	Bihar Colony	Public Transport	10
19.	Respondent No.19	Female	B.Sc. 1	Zainab Market	Public Transport	04
20.	Respondent No.20	Female	B.Sc. 1	Korangi	Public Transport	06
21.	Respondent No.21	Female	B.Sc. 2	Delhi College	Motor Bike	04
22.	Respondent No.22	Female	B.Sc. 2	Grue Mandir	Motor Bike	05
23.	Respondent No.23	Female	B.Sc. 1	Saddar	Motor Bike	03
24.	Respondent No.24	Female	B.Sc. 1	Baldia Town	Public Transport	04
25.	Respondent No.25	Female	B.Sc. 2	Punjab Colony	Public Transport	05
26.	Respondent No.26	Female	B.Sc. 1	Liaqatabad	Public Transport	08
NED University						
27.	Respondent No.27	Male	3rd year	Saddar	Public Transport/ University Van	03
28.	Respondent No.28	Male	3rd year	Lyari	Public Transport/ University Van	05
29.	Respondent No.29	Male	3rd year	Jamshed Town	Public Transport/ University Van	06
30.	Respondent No.30	Male	Teacher	Nazimabad	Public Transport/	04

[19] Names of the respondents have not been disclosed as the ESMP is a publically disclosed document.

					University Van	
31.	Respondent No.31	Male	2nd year	Kharadar	Public Transport/ University Van	05
32.	Respondent No.32	Male	2nd year	Kemari	Public Transport/ University Van	05
33.	Respondent No.33	Female	2nd year	Gulshan e Iqbal	Public Transport/ University Van	07
34.	Respondent No.34	Female	2nd year	N Nazimabd	Public Transport/ University Van	06
35.	Respondent No.35	Female	2nd year	North Karachi	Public Transport/ University Van	05
36.	Respondent No.36	Female	2nd year	Garden	Public Transport/ University Van	07
37.	Respondent No.37	Male	4th year	F.B.Area	Public Transport/ University Van	05
38.	Respondent No.38	Female	4th year	Saforah	Public Transport/ University Van	04
39.	Respondent No.39	Male	4th year	Nazimabad	Public Transport/ University Van	05
40.	Respondent No.40	Female	2nd year	Defense	Public Transport/ University Van	03
SM Arts College						
41.	Respondent No.41	Male	B.Com Final	Baldia Town	Motor Cycle	10
42.	Respondent No.42	Male	B.Com Final	Landi Kotal	Public Transport	06
43.	Respondent No.43	Male	Inter 2nd year	F.B. Area	Public Transport	04
44.	Respondent No.44	Male	Inter 2nd year	Nazimabad	Motor Cycle	05
45.	Respondent No.45	Male	Inter 2nd year	Saddar	Public Transport	06
46.	Respondent No.46	Male	Inter 2nd year	Saddar	Public Transport	04
47.	Respondent No.47	Male	Inter 2nd year	Defence Phase VI	Public Transport	05
48.	Respondent No.48	Male	Inter 2nd year	Liaqatabad	Public Transport	02
49.	Respondent No.49	Male	Inter 2nd year	Lalukhet 10 No	Public Transport	11
50.	Respondent No.50	Male	Inter 2nd year	Saddar	Public Transport	04
51.	Respondent No.51	Male	Inter 2nd year	Boltan Market	Motor cycle	06
52.	Respondent No.52	Male	Inter 2nd year	Railway Colony	Public Transport	03
53.	Respondent No.53	Male	Inter 2nd year	Jubilee Chowk	Public Transport	07
54.	Respondent No.54	Male	Inter 2nd year	Dhobi Ghat	Public Transport	08
SM Law College						
55.	Respondent No.55	Male	LLB 2nd year	Korangi Crossing	Motor Cycle	04
56.	Respondent No.56	Male	Final year	Garden	Motor Cycle	05
57.	Respondent No.57	Male	LLB 2nd year	Sindhi Muslim Society	Public Transport	06
58.	Respondent No.58	Female	LLM 1st year	Saddar	Public Transport	05
59.	Respondent No.59	Male	LLM 1st year	Lyari	Public Transport	06
60.	Respondent No.60	Male	LLB 2nd year	Gulshan	Public Transport	04
61.	Respondent No.61	Female	LLB 2nd year	Korangi	Public Transport	03
62.	Respondent No.62	Female	LLB 2nd year	Jamshed Town	Public Transport	08
63.	Respondent No.63	Female	LLM 1st year	Korangi Creek	Personal Car	07
64.	Respondent No.64	Female	LLM 2nd year	Korangi Creek	Personal Car	04
65.	Respondent No.65	Female	LLM 2nd year	Defense	Personal Car	04

The above information indicates that the student population in these institutions belongs to different localities of Karachi. A majority uses public transport to come to college and almost all students walk from the public transport drop off point (Pakistan Chowk) to the subproject area.

5.1.1.2. Socio-Economic Profile of Government Servants, including teachers and contract employees, and transporters

National Museum Staff

There are a total of 8 staff members out of which 5 were selected for the survey. The details are given below:

Name[20]	Gender	Designation	Income PKR	Residence	Mode of Transport
Respondent No.1	Female	Assistant curator	35,000	Punjab Colony	Rickshaw
Respondent No.2	Female	Assistant curator	30,000	Landhi	Public
Respondent No.3	Female	Admin office	30,000	Liaquatabad	Public
Respondent No.4	Male	Production officer	60,000	N. Nazimabad	Van
Respondent No.5	Male	Electrician	25,000	Strachan Road	Walk

DJ Science College Staff

Name[21]	Gender	Designation	Income (PKR)	Residence	Family members	Mode of Transport
Respondent No.1	Female	Teacher	45,000	-	04	Rickshaw
Respondent No.2	Female	Teacher	45,000	Civil Lines	06	Public
Respondent No.3	Female	Teacher	45,000	North Nzimabad	05	Public
Respondent No.4	Female	Teacher	45,000	Landhi	07	Public
Respondent No.5	Male	Lab assistant	40,000	N. Nazimabad	20	Public
Respondent No.6	Male	Naib Qasid	20,000	Orangi Town	05	Public
Respondent No.7	Male	Canteen owner	35,000	N. Karachi	06	Motor cycle

SM Law College Staff

Name[22]	Gender	Designation	Income (PKR)	Residence	Family members	Mode of Transport
Respondent No.1	Male	Principal	Not disclosed	Clifton	04	Own Vehicle
Respondent No.2	Male	Library Incharge	Not disclosed	Saforah	08	Public transport

Local Government Servants

Name[23]	Gender	Designation	Income (PKR)	Residence	Family members	Mode of Transport
Respondent No.1	Male	DMC Employee	12,000	Pakistan Chowk	05	Motor Bike
Respondent No.2	Male	DMC	12,000	Pakistan	07	Motor Bike

[20] Names of the respondents have not been disclosed as the ESMP is a publically disclosed document.
[21] Ibid.
[22] Ibid.
[23] Ibid.

		Employee		Chowk		
Respondent No.3	Male	DMC Employee	12,000	Pakistan Chowk	08	Motor Bike
Respondent No.4	Male	Union Councilor	Not disclosed	Garhi Khuda Bux	04	Motor Bike

Transporters

Profile of transporters found in the subproject area is provided below:

Name[24]	Gender	Occupation	Monthly Income (PKR)	Residence
Respondent No.1	Male	Bus Driver	45,000	Garhi Khuda Bux
Respondent No.2	Male	Bus Driver	30,000	Garhi Khuda Bux
Respondent No.3	Male	Bus Driver	16,000	Liaquatabad
Respondent No.4	Male	Bus Driver	25,000	Orangi Town
Respondent No.5	Male	Bus Driver	28,000	Orangi Town
Respondent No.6	Male	Rickshaw Driver	18,000	Qayyumabad
Respondent No.7	Male	Rickshaw Driver	20,000	Jacob Lines
Respondent No.8	Male	Rickshaw Driver	15,000	Meetha Dar

5.1.1.3. Socio-Economic Profile of Households

Socio-economic profile of 16 randomly selected households (HH) living in apartments of few buildings located along Dr. Ziauddin Ahmed Road and Strachan Road has been developed and presented in below table. The buildings are not included in subproject area, but HH are using the subproject roads for commuting.

While conducting the survey about the socio-economic conditions of the HH, average size of the HH was found 6 persons. 37.5% of the HH lives in nuclear family system while rest 62.5% are living in combined family system. 44% of the HH have owned the apartments in which they are dwelling and the rest are on rental basis. Average earning hands per HH are 2 while the average monthly income per HH is Rs.36, 500/-. Most of the earning males are doing private jobs or own shops in the neighborhood. The socioeconomic data is presented in below tables.

Table 5.3: Socioeconomic Survey of Households

Respondent[25][26]	Address	Family Size	# of Women in HH	Family System	Ownership	Earning Member	Monthly Income	Source of Livelihood
1	Ismail Venture, Strachan Road	08	03	Combined	Rented	03	45,000	Catering Business
2	Alfalah Building, Strachan Road	15	04	Combined	Rented	03	40,000	Shop in Saddar Area
3	Alfalah Building, Strachan Road	08	01	Combined	Owned	03	35,000	Shop
4	Feroz Mansion, Dr.	05	01	Combined	Rented	01	25,000	Private

[24] Ibid.
[25] Ibid.
[26] All respondents are Males

	Ziauddin Road							Service
5	Thakur Das Gyan Chand Building, Strachan Road	03	01	Nuclear	Rented	03	25,000	Shop in Saddar
6	Thakur Das Gyan Chand Building, Strachan Road	08	02	Combined	Owned	03	35,000	Shop in Bolton Market
7	2nd floor Bismillah Manzil, Dr. Ziauddin Road	08	02	Combined	Rented	03	50,000	Employee in Shop in Bolton Market
8	3rd floor Bismillah Manzil, Dr. Ziauddin Road	12	03	Combined	Owned	04	50,000	Private Job
9	1st floor Shahab Manzil, Dr. Ziauddin Road	05	02	Combined	Rented	01	25,000	Private Job
10	3rd floor Umer Nawab Manzil, Dr. Ziauddin Road	04	01	Nuclear	Rented	02	22,000	Printing Press Shop
11	3rd floor Umer Nawab Manzil, Dr. Ziauddin Road	05	01	Combined	Rented	02	50,000	Printing Press Shop
12	2nd floor Feroz Mansion, Dr. Ziauddin Road	07	02	Combined	Owned	03	Not disclosed	Private Job
13	1st floor Shelter homes, Strachan Road	02	0	Nuclear	Owned	01	Not disclosed	Private Job
14	4th floor, Kohinoor square, Strachan Road	05	01	Nuclear	Rented	01	28,000	Private Job
15	4th floor, Kohinoor square, Strachan Road	05	01	Nuclear	Owned	01	35,000	Private Job
16	2nd floor, Kohinoor square, Strachan Road	03	01	Nuclear	Owned	01	25,000	Private Job

5.1.1.4. Socio-Economic Profile of Businesses

Socio-economic profile of 14 randomly selected shops doing businesses at the ground floor of apartments of few buildings located along Dr. Ziauddin Ahmed Road and Strachan Road is based on survey which is given below. The shops are not included in subproject area, but the shop personnel use the two roads for commuting.

While conducting the survey about the socio-economic conditions of the shops, it was observed that all shops are located at the ground floor of dwelling buildings and are all made up of RCC structure. The average number of employees per shop is five. 64.3% of the shop owners owned the building and the rest are on rental basis. The average monthly income per shop is Rs.37,700/-. The socioeconomic data is presented in below tables.

There is Charged Parking along Shahrah-e-Kamal which is managed by DMC South (Local Government Department) and its employees. Rs.20 to 30 per vehicle is charged for the parking. The timings of parking are from 09:00 am to 05:00 pm from Monday to Friday.

Table 5.4: Socioeconomic Survey of Businesses

Respondents[27] [28]	Address	Type of Business	# of Employees	Ownership of Shop	Type of Structure	Monthly Income
1	Kohinoor square, Strachan Road	Travel Agency	04	Owned	RCC	35,000
2	Sultan Maher Building, Dr. Ziauddin Road	Card Printing	02	Owned	RCC	25,000
3	Plot# SR 102/9	Card Printing	08	Owned	RCC	50,000
4	Sarnagati Building, Strachan Road	Tailoring and Stitching	01	Owned	RCC	45,000
5	Muslim Commercial Bank, Road, Dr. Ziauddin Road	Banking	15	Owned	RCC	Not disclosed
6	Allied Bank, Dr. Ziauddin Road	Banking	06	Owned	RCC	Not disclosed
7	Sarnagati Building, Strachan Road	Printing Press	02	Rented	RCC	30,000
8	RB-3/19/1_Strachan Road	Computers and Printing Press	07	Rented	RCC	50,000
9	Thakur Das Gyan Chand Building, Strachan Road	Stationery Selling	01	Owned	RCC	25,000
10	Feroz Mansion, Dr. Ziauddin Road	Printing Press	02	Rented	RCC	35,000
11	Feroz Mansion, Dr. Ziauddin Road	Printing Press	04	Rented	RCC	50,000
12	Allied Bank, Goddu Mal Building	Banking	09	Owned	RCC	Not disclosed
13	Abdullah Khan Building		10	Owned	RCC	50,000
14	Umer Nawab Manzil	Printing Press	02	Rented	RCC	20,000

5.1.2. Existing Land Use

Existing land uses in the subproject area include educational, cultural activities and recreation all owned by Government of Sindh (provincial government). The blue dotted line in below picture shows public property (provincial government) and the dotted green line shows the private property. The subproject roads are also government property (owned by the provincial government).

[27] Names of the respondents have not been disclosed as the ESMP is a publically disclosed document.
[28] All respondents are Males

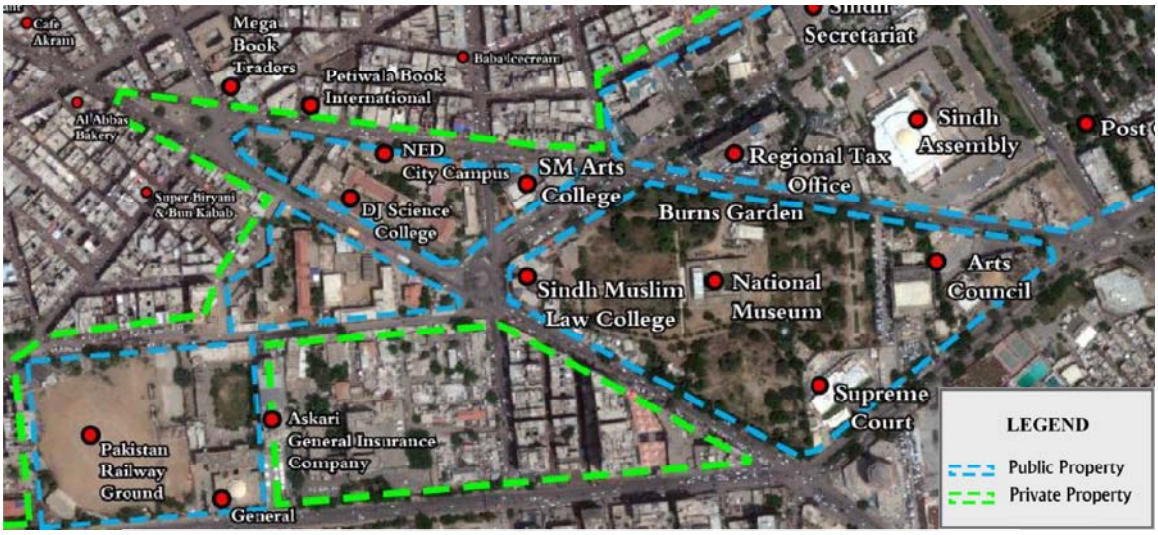


Figure 5.1: Land use of year 1subproject area in terms of possession of land (Source: Detailed Concept Note of project shared by PIU)

The zone is the center of education with institutions as NED University, DJ Science College, SM Art College and SM Law College (all are Government institutions and also the land developed on provincial government land. Supreme Court is also a government institution. Arts Council is land is government property as stated in its website (http://artscouncil.org.pk/acp/index.php/history/). Burns Garden and National Museum are managed by Culture Department, Government of Sindh and located on government land. There are no pending claims on them as communicated by principals of the respective caretakers during consultations. Subproject roads are managed by Transport and Communication Department of KMC, Government of Sindh and also acquired by Government of Sindh. For subproject interventions, only Arts Council and subproject roads will be used. NED University, DJ Science College, SM Art College, SM Law College, Burns Garden, National Museum and Supreme Court will not be affected or touched. Therefore, there is no requirement of land acquisition for the subproject. Below table presents the land screening for the subproject interventions:

Table 5.5: Land screening for the subproject interventions

S#	Intervention	Land Needs	Acquisition of Land
1.	Rehabilitation of subproject roads	42' to 54' ROW depends on the road will be required for rehabilitation	Not required as the existing ROW of subproject roads is available with more width than required.
2.	Rehabilitation of existing utilities and road infrastructure	Existing ROW	Not required as the existing ROW will be used
3.	Shahrah-e-Kamal Development (sublevel parking and student piazza)	32 m wide ROW of existing Shahrah-e-Kamal	Not required as the existing ROW of Shahrah-e-Kamal is available with more width than required.
4.	D J Science College Student Piazza	One lane of Dr. Ziauddin Ahmed Road	Not required as the existing ROW of Dr. Ziauddin Ahmed Road is available and enough for one way traffic in operation phase of subproject.
5.	Muhammad Bin Qasim Road Parking Plan	Existing ROW of Portion of Burns Road (Muhammad Bin Qasim Road)	Not required as the existing ROW will be used
6.	Arts Council Development	Rehabilitation of pavement	Not required as only existing

			pavement and not the buildings will be used for rehabilitation.
7.	Existing parking	Muhammad Bin Qasim Road which is included in the proposed plan will be used for parking of construction vehicles and for placement of construction crew porta cabins.	Not required.
8.	Construction Material Storage	Most of the construction material for roads development and infrastructure rehabilitation nowadays procured in the form of a premix which requires less space and uses the construction site / roads for storage. Therefore one lane of the subproject road where construction is ongoing will be used for material storage. Also for underground parking construction material storage, Muhammad Bin Qasim road which will be closed for traffic during construction will be used.	Not required.

5.1.3. Gender

According to the social survey, the female student population in educational institutions is 20 % (Table 5.6) while the female staff constitutes 50%. The survey further reveals that no women work as transport providers. The majority of 25% female residents living in surrounding localities are housewives.

5.1.4. Poverty

A poverty profile for the area was developed on the basis of the survey of residents and businesses living and working in the subproject area and surrounding areas. The income of the surveyed HHs and shops is above Rs.12, 000 (poverty line). In addition, no unemployed HH heads were identified during the survey. The main users of the area profiled in the socioeconomic survey also fall in income category which is above the poverty line.

5.1.5. Katchi Abadi/ Slums

There are no Katchi Abadis, Slums or Goths (villages) located in the subproject area.

5.1.6. Security & Law and Order Situation

The Security and Law & Order Situation in the subproject area is better than the other areas of Karachi. Due to its location in the central business district of the city and the heavy presence of government around the area, the subproject location is serviced by a well-functioning security system including CCTV cameras and regular spot checks by security personnel. Strict surveillance and checking is done at several points by the Sindh Police and Rangers.

5.2. Infrastructure Profile

5.2.1. Healthcare Facilities

Health issues of the Project Area are generally associated with the lifestyle. Lifestyle-related diseases like hypertension, diabetes and depression are commonly reported in subproject area. There is only one health facility located in subproject area i.e. Haji Shahabuddin Almadni Memorial Dispensary which is located in Strachan Road. It is a small basic health unit run by one private doctor who provides medicines for common disease. The nearby households living along Strachan road use to visit the dispensary (reveled by them during consultations).

Figure 5.2: Haji Shahabuddin Almadni Memorial Dispensary is located along the Strachan Road

5.2.2. Educational Facilities

Educational facilities in the subproject area are excellent. Availability and access to all levels of education is well provided because of efficient and effective management system to facilitate and promote higher education. Literacy rate among females in the subproject area is comparable with males. Some of the prominent educational institutes in the subproject area include:

Table 5.6: Educational institutes located in Subproject area

S#	Facility	Total no. of Students	No. of Male Students	No. of Female Students
1.	NED University City Campus	1,800	1,200	600
2.	SM Arts College (Boys)	3,000	3,000	0
3.	SM Law College	600	320	280
4.	DJ Science Government College	2,000	1,300	700
	Total	7,400	5,820	1,580

5.2.3. Water Supply

Some of the main water and sewerage lines running from the zone have been recently rehabilitated by the KW&SB. Water supply lines are being properly hooked up with the existing main lines feeding to this zone. The existing system is depicted in below picture in which the lines showing the water mains running along the subproject roads.

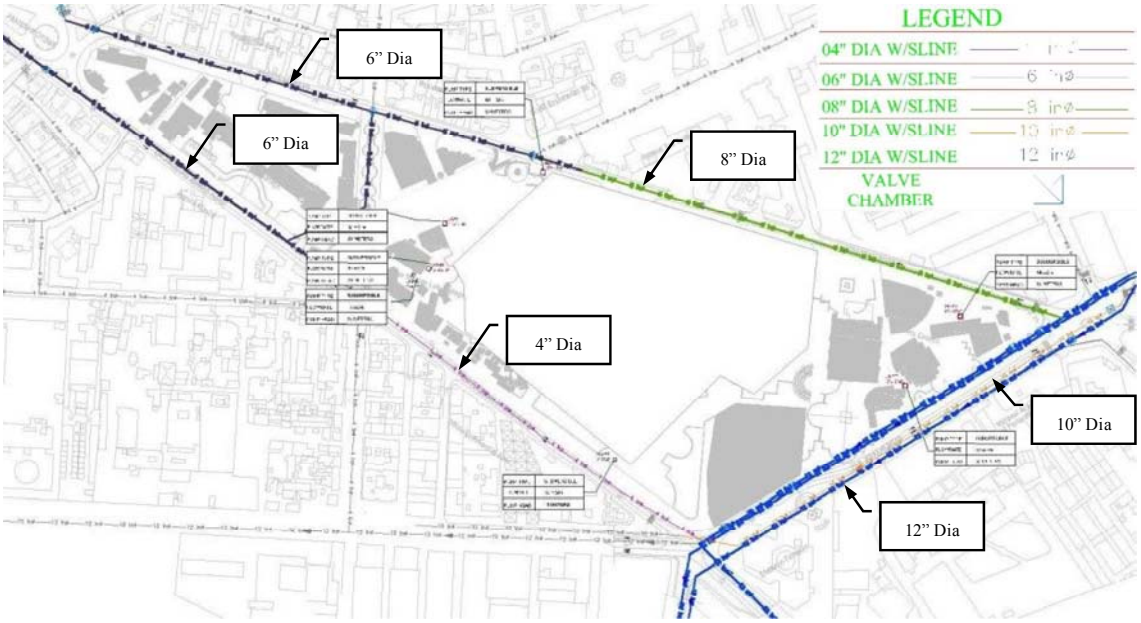


Figure 5.3: Existing Water Supply System

5.2.4. Sewerage and Sanitation

The observed haphazard placement of manholes depicts that the sewerage system has kept on being modified with the construction of new buildings over a period of time and is not maintained as originally planned.

Figure 5.3 shows the existing sewerage lines located along the project roads. The red arrow showing the line of 18-24 inch dia line running from Pakistan Chowk to Shaheen Complex and along burns road (Muhammad Bin Qasim Road) to Sundial Chowk and further extended to Clifton pumping station. Along Strachan Road, a newly built line is laid very recently as shown in Figure 5.4 which is currently ill-maintained and sewerage is flowing on the streets.

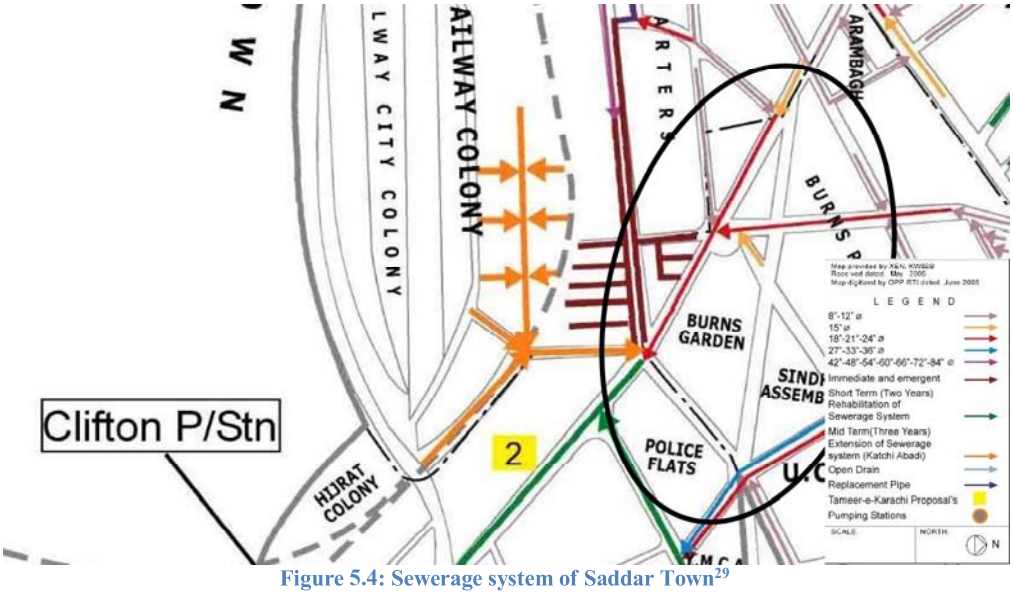


Figure 5.4: Sewerage system of Saddar Town[29]

[29] Korangi Pilot Project Research and Training Institute

Figure 5.5: Picture of ill maintained newly buried sewerage line at Strachan road with open manhole

5.2.5. Solid Waste management in subproject area

The solid waste management for the whole city is now lodged under Sindh Solid Waste Management Board (SSWMB) who has started placing its dust bins all over the City and doing front end collection from generation points to landfill sites. There are two dustbins located inside the subproject area as shown in below pictures. SSWMB dustbins (in yellow and white color) are also placed near the KMC constructed old bin areas. As per the analysis of interviews conducted from households and shop owners, the cleanliness near the dust bins is however required at frequent intervals and also the lifting frequency should be increased. Also, street sweeping is not undertaken at Strachan Road due to improper sewerage system.

Dustbin located near Sundial Chowk at confluence of Burns Road and Dr. Ziauddin Road

Dustbin located near Pakistan Chowk at Strachan Road

5.2.6. Parking Facilities in Subproject area

5.2.6.1. Subproject Areas Roads system

Educational and Cultural Zone (Priority Phase – I) Subproject is an area of approximately 1-2 square kilometers located within the city center and comprises prominent spaces such as various higher education institutions and government/ administrative buildings, Pakistan Chowk area (a square comprising two traffic islands and serving as a junction for five roads), and significant cultural spaces including the National Museum (located in Burns Garden). The Subproject Area roads inventory is presented in Table 5.4.

5.2.6.2. Traffic Volume

The peak traffic volume of Pakistan Chowk area was estimated by Consultant Group (CG) – Design Consultant of Educational and Cultural Zone (Priority Phase – I) Subproject. The peak volumes at Pakistan Chowk and Jang Press Roundabout are presented in the below figures:

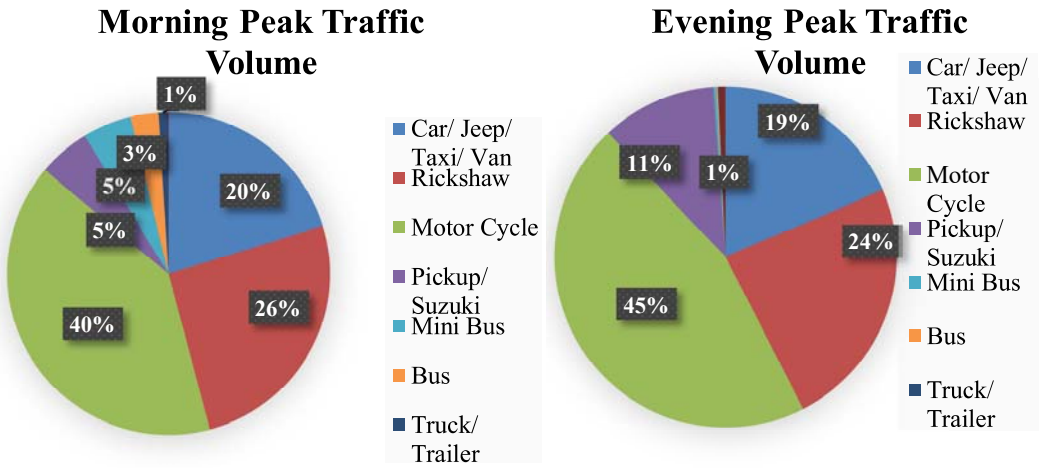


Figure 5.6: Peak Traffic Volume of Pakistan Chowk Roundabout

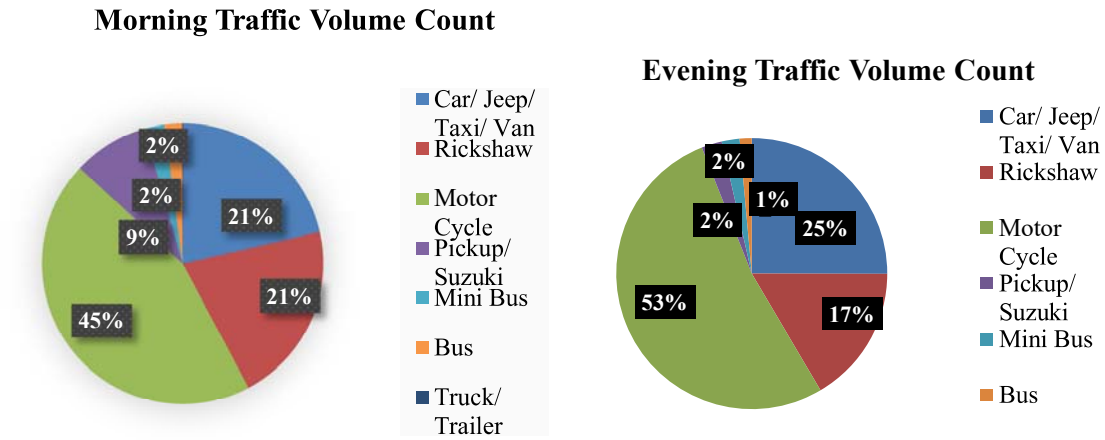


Figure 5.7: Peak Traffic Volume of Jang Press Roundabout

Table 5.7: Subproject roads infrastructure

S#	Type	Road Name	Length	No. Of Lanes	Footpath	Median	Parking	Traffic Direction	Public Transport	Manhole	Electric Poles	PMT Pole	Street Light	Telephone Pole	Pedestrian Crossing
			KM							No.	No.	No.	No.	No.	No.
1	Main Road	Dr. Ziauddin Ahmed Road	0.868	2+	Yes	No	Yes	Two way	Yes	54	26	8	21	3	01
2	Main Road	M.R Kiyani Road	0.228	2+	Yes	Yes	Yes	Two way	Yes	8	3	10	-	-	-
3	Main Road	Strachan Road	0.371	2+	Yes	No	Yes	Two way	Yes	5	9	4	5	-	-
4	Main Road	Shahrah e Kamal	0.176	2+	Yes	No	Yes	Two way	No	3	2		7	-	-

Source: Consultant Group (CG) – Design Consultant

5.2.6.3. Public Transport

The bus stops made by government in the subproject area are deficient in numbers and only 03 were found on MR Kyani Road. These stops are in good condition as depicted in the picture below:

Figure 5.8: A bus stop present at M.R. Kyani Road

Following Bus routes are available in subproject area:

Bus Number	Route Name	Major Bus stops in subproject area
F-14	Bhittai colony to Fisheries	Pakistan Chowk, Ziauddin Ahmed Road
U-11	Manghopir to Chamra Chowrangi	Pakistan Chowk
U6	Manzoor Colony to Rasheedabad	Pakistan Chowk, Strachan Road
Rainbow Coach	North Karachi Sector 2 to Korangi No.1	Pakistan Chowk, Shaheen Complex
Rainbow Flying Coach	North Karachi Sector No.2 to Gulshan-e-Hadeed Phase 3	Pakistan Chowk, Shaheen Complex
Rehman Coach	Orangi No.14 to Khayaban-e-Shamsher	Pakistan Chowk, Dr.Ziauddin Road, Shaheen Complex
Star Line Coach	Metroville no iii to Naval Colony	Strachan Road
Source: http://www.apnapoint.com/BusRoutes.aspx		

5.2.6.4. Pedestrian Volume

The pedestrian volume of Pakistan Chowk area was estimated by Design Consultant of subproject. The volumes are presented in the below figures:

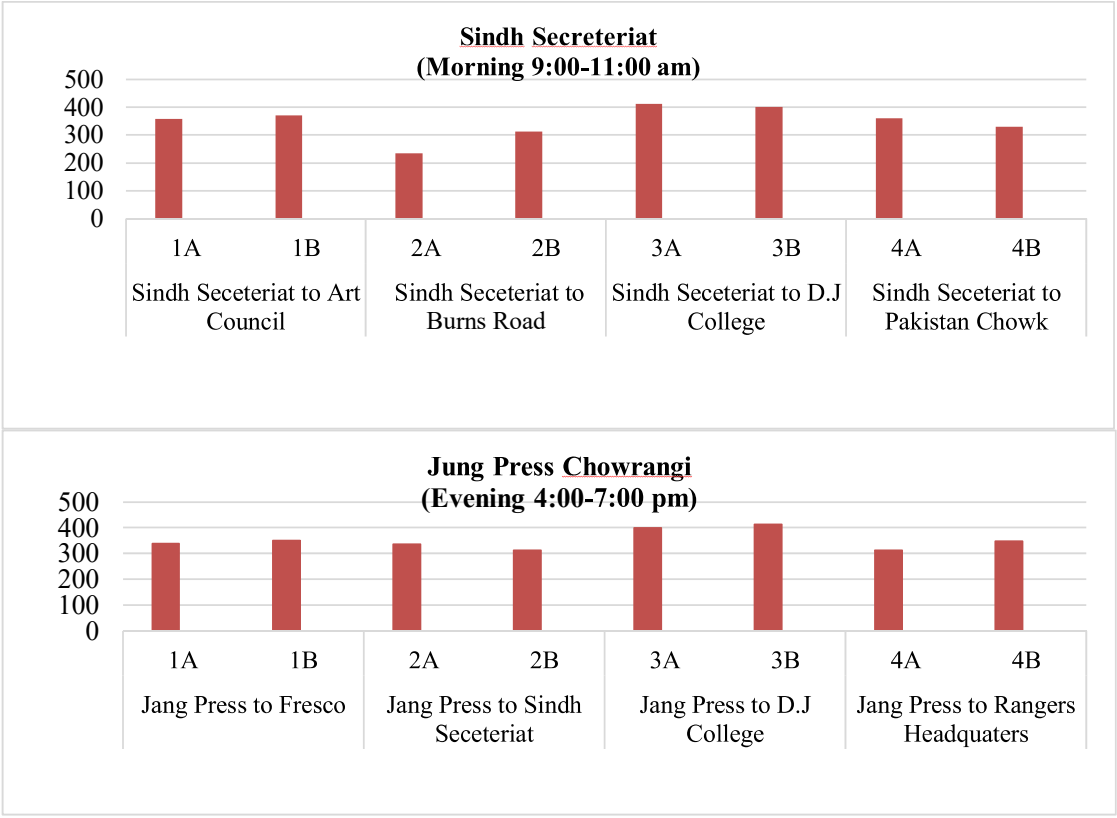


Figure 5.9: Pedestrian Volume of Subproject Roads

It is analyzed from the above graphs that significant population of Pedestrians commuting from these two locations while using the subproject area.

5.3. Findings of Environmental and Social Surveys of Subproject Area

After initial information was collected and reviewed, detailed environmental and social survey in subproject area was conducted by ESMP Consultant on 10 January, 2017, 08-10 June 2017 and 20-23 June 2017 to collect primary information and screening for the sub-project. The pictures taken during Survey are shown below.

	
Parking on carriageway on Dr. Ziauddin Ahmed Road	Trees on footpaths in front of DJ Science College

	
Charged parking on Shahrah-e-Kamal	Charged parking along carriageway and a haphazard network of electric wires and transformers at Dr. Ziauddin Ahmed Road
	
Park at Pakistan Chowk	A view of Burns Garden and National Museum
	
Old and large trees present in Burns Garden	Two Way Road from Arts Council to SM Arts College

	
Two way M.R. Kiyani Road with median and underground utility network as seen on the carriageway	Road behind SM Arts college with parking on carriageway and old buildings on the right side
	
Charged parking at Shahrah-e-Kamal and few immature trees located along the median	Strachan Road from SM College to Pakistan Chowk. Parking along the carriageway
	
Newly laid sewerage network along Strachan Road from SM College to Pakistan Chowk	Jan Press Roundabout

	
Dr. Ziauddin Ahmed Road from Pakistan Chowk to Jan Press Roundabout. Parking on both sides of carriageway	DJ Science College Pedestrian Bridge connecting old and new buildings across the road. The entry and exist of the bridge is located inside the buildings. No connection from the road.
	
NED University Old Campus along Strachan Road	A view of Shahrah-e-Kamal from Jan Press Roundabout where underground parking is proposed.
	
Start of Burns Road (Muhammad Bin Qasim Road) behind SM Arts college where Student Piazza is proposed	Mosque located along Strachan Road portion behind SM Arts college

	
MR Kiyani Road portion in front of Arts Council. Vehicles stops in lanes due to a traffic signal ahead.	View inside DJ Science College. This portion will not be disturbed as the interventions are proposed outside the boundary of this college.

Chapter 6 IMPACTS AND MITIGATION

This Chapter assesses the potential environmental and social impacts of the proposed subproject on environment and people. Also provided in the Chapter are the subproject-specific mitigation measures to minimize if not eliminate the potentially negative impacts, in order to ensure that the interventions under the subproject do not cause environmental and social impacts beyond the acceptable levels.

6.1. Environmental Safeguards Processing Steps

Implementation of environmental requirements after the ESMP preparation will follow the following steps closely linking with activity planning, design and implementation steps.

- Step 1: Screening of Projects for impacts
- Step 2: Inclusion of Environmental Specifications and Environmental Management Plan in Supervision Consultant/Contractor(s) bidding documents
- Step 3: Compliance and Monitoring

6.2. Screening of Impacts

All interventions proposed for the subproject will undergo initial screening through a number of filters that include screening environmental and social impacts. Subprojects with any significant, long-term or medium term, irreversible environmental and social negative impacts will be avoided to the extent possible. The ESMF of KNIP categorizes subprojects on the basis of their nature of activities, and potential impacts on environment and or people. The ESMF presents a rapid assessment checklist for screening of sub-projects which is used here to screen the impact of Educational and Cultural Zone (Priority Phase – I) Subproject and filled as per the environmental and social survey conducted for the subproject area:

Environmental & Social screening checklist

The rapid assessment checklist as presented in project ESMF is used here and divided in three parts i.e. A) land use screening, B) screening of environmental impacts and C) screening of social impacts.

A. Subproject Land use (siting)
Is the project area…

SCREENING QUESTIONS	Yes	No	REMARKS
Presence of any environmentally sensitive areas?			
- Protected area		✓	The sub-project road is not located inside or near any gazette protected area
- Wetland		✓	The sub-project road is not located near any protected wetland
- Mangrove		✓	The sub-project road is not located near any mangrove habitat.
- Estuarine		✓	The sub-project road is not located near estuarine habitat.
- Buffer zone of protected area		✓	The sub-project road is not located inside or near any buffer zone of protected area
- Special area for protecting biodiversity		✓	Not present along or near the sub-project alignments.
- Physical Cultural Resources / Heritage sites	✓		There are 05 buildings declared as "Protected Heritage" by the Government of Sindh (Under the Sindh Cultural Heritage (Preservation) Act 1994 on September 7, 1995)) which are located in Subproject

			area. The names and locations are listed in Annex B. The project interventions will not touch the said PCRs and as confirmed by ESMP Consultant engineer, there will be no impact on them during construction as they are located at considerable distance from the proposed interventions. The assessment of impact on PCRs is discussed in section 6.3.3.1. However, the possible discovery of archeological sites or random findings during the execution of civil works will require measures to manage chance finds. This ESMP includes "Chance Find" procedures for protection of cultural property and contracts for subcontractors will include "Chance Find" procedures.
Current Land use of Year 1 subproject			
- Residential Area	✓		The neighborhoods surrounding the subproject area include a few pockets of residential areas. These are not within the subproject area.
- Commercial Area	✓		The neighborhoods surrounding the subproject areas include a few shops including printing presses, electrical appliances, pharmacies etc. these do not lie within the subproject area.
- Industrial Area		✓	None
- Other	✓		The sub-project area comprises of educational as well as cultural institutions which attract a large volume of people including pedestrians. .

Land screening for the subproject interventions

S#	Interventions	Land Needs	Acquisition of Land
1.	Rehabilitation of subproject roads	42' to 54' ROW depends on the road will be required for rehabilitation (owned by provincial government)	Not required as the existing ROW of subproject roads is available with more width than required.
2.	Rehabilitation of existing utilities and road infrastructure	Existing ROW (owned by provincial government)	Not required as the existing ROW will be used
3.	Shahrah-e-Kamal Development (sublevel parking and student piazza)	32 m wide ROW of existing Shahrah-e-Kamal (owned by provincial government)	Not required as the existing ROW of Shahrah-e-Kamal is available with more width than required.
4.	DJ Science College Student Piazza	One lane of Dr. Ziauddin Ahmed Road (owned by provincial government)	Not required as the existing ROW of Dr. Ziauddin Ahmed Road is available and enough for one way traffic in operation phase of subproject.
5.	Muhammad Bin Qasim Road Parking Plan	Existing ROW of Portion of Burns Road (Muhammad Bin Qasim Road) (owned by provincial government)	Not required as the existing ROW will be used
6.	Arts Council Development	Rehabilitation of pavement (owned by provincial government)	Not required as existing pavement except buildings will be used for rehabilitation.
7.	Existing parking	Muhammad Bin Qasim Road which is included in the proposed plan will be used for parking of construction vehicles and for placement of construction crew porta cabins.	Not required.

8.	Construction Material Storage	Most of the construction material for roads development and infrastructure rehabilitation nowadays procured in the form of a premix which requires less space and uses the construction site / roads for storage. Therefore one lane of the subproject road where construction is ongoing will be used for material storage. Also for underground parking construction material storage, Muhammad Bin Qasim road which will be closed for traffic during construction will be used.	Not required.

B. Potential environmental impacts
Will the project cause…

SCREENING QUESTIONS	Yes	No	REMARKS
Noise and dust from construction activities?	✓		It is envisaged that during rehabilitation and up-gradation of sub-project roads, noise and dust will be generated due to construction activities. Measures as presented in EMMP will be followed by project implementation agencies. It will be ensured that the noise/dust emissions from subprojects construction remain within acceptable limits.
Alteration of hydrology of waterways?		✓	Not envisaged. There are no surface water bodies located near the Year 1 subproject. Also the local storm water drain will be cleaned and used for the same purpose as it was meant to be.
Aggravation of solid waste problems in the area?		✓	It will be ensured that solid waste generated from sub-projects will be handled carefully and disposed in environmental friendly way while avoiding contamination to local sewerage system. Measures as presented in EMMP will be followed by project implementation agencies.
Inadequate protection of sewage collection, leading to pollution of water supply?	✓		It is envisaged that during construction, the water mains may get damaged and water supply may get contaminated with excavated soil or sewerage. During operations, the development of toilet facilities will be equipped with septic tanks and further connected to existing sewerage system.
Conflicts in abstraction of raw water for water supply with other beneficial water uses for surface and ground waters?		✓	It is envisaged that the water requirements of road rehabilitation works will be minimal and will be fulfilled through bowsers and water tankers available in Karachi City and it will not create the local water shortage. After development, the water requirements for irrigation purposes will be fulfilled through extracted groundwater from basement parking floor at Shahrah-e-Kamal. The water for toilets and kiosks will be in limited quantity and provided from the existing network of water supply.
Creation of temporary breeding	✓		It is likely that due to construction activities, the storm

habitats for diseases such as those transmitted by mosquitoes and rodents?			water may accumulate at one place or waste disposal is not adequate. Proper stormwater and wastewater collection systems will be designed as per EMMP recommendations.
Hazardous driving conditions where construction interferes with pre-existing roads?	✓		It is most likely that up-gradation works during construction phase may create hazardous driving condition due to diversions and road closure. Safety elements in road design are also provided. However, the Traffic management plan will be introduced to manage smooth flow of vehicular traffic and to avoid traffic jam and accidents.
Vehicular emissions resulting from increased traffic volume during construction or operation?	✓		Rehabilitation works on the sub-project roads may increase vehicular emissions due to vehicle idling, slow speed on diversions and road closure. Traffic management plan will be introduced to manage smooth flow of vehicular traffic and to avoid traffic jam and accidents. Monitoring of ambient air quality will be conducted as per EMMP during construction phase. It is unlikely that vehicular emissions are going to increase after road rehabilitation as the traffic will become smoother.

C. Potential social impacts
Will the project cause…

SCREENING QUESTIONS	Yes	No	REMARKS
Dislocation or involuntary resettlement of people?		✓	It is observed from the social survey that physical as well as economic displacement will not be involved as there are no PAPs found on subproject boundary and ROW of subproject roads. Therefore no resettlement or livelihood restoration measures are required.
Impediments to movements of local people (pedestrian trips)?	✓		It is evident that during rehabilitation of sub-project road, pedestrian trips may be hindered if no mitigation measures will be applied. Traffic and pedestrian diversions will be provided to re-route the vehicular and human traffic. Measures as presented in SMMP will be followed by project implementation agencies.
Social conflicts arising from economic displacement of businesses?	✓		No economic displacement is required for the subproject. However, conflicts may occur between neighborhood communities, businesses and subproject personnel during construction. These conflicts will be managed as per Grievance Redress Mechanism (GRM) and ongoing consultations.
Disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?	✓		According to the HH survey and shops survey, it is concluded that subproject area do not comprise marginalized population and vulnerable groups. However, impacts on women and children using the existing roads will be catered for as per SMMP.
Potential social conflicts arising from land tenure and land use issues?		✓	Not envisaged as the sub-project land belongs to Government of Sindh (the project owner) and the existing ROW of road will be used for the rehabilitation works.
Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		✓	Not envisaged. Local labor available in Karachi will be used. 30-40 construction labor are required for the development of subproject interventions. This number will not affect the local services available. The requirement of water for labor will be fulfilled through bowsers and water tankers available in Karachi City and it will not create the local water shortage.

Impacts on labor?	✓		It is envisaged that during construction, accidents and injuries to labor may occur if labor is not working according to safety plan. A site specific Labor Health and Safety Management plan will be developed by CC and implemented accordingly. Also wearing of PPE will be made mandatory in all construction sites. In addition, the contractor will ensure that there is no child or enforced labor and that relevant labor laws and regulations such as for minimum wage and working hours will be upheld.
Community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project commencement?	✓		It is envisaged that during rehabilitation and up-gradation of sub-project roads as well as development of underground parking space at Shahrah-e-Kamal, safety risks will be there for the commuters and community members using the roads. It will be ensured that construction site is appropriately cordoned off with hard barricade while also providing safe access to adjacent areas. However, after construction, the improved roads will provide safety features and pedestrian crossings which are absent on the existing road and does not involved any elements where their failure can result in injury to the community.

6.3. Assessment of Potential Impacts and Generic Mitigation

The positive and potentially negative impacts identified in the project ESMF are assessed in detail in the subsections below for Educational and Cultural Zone (Priority Phase – I) Subproject. The specific mitigation measures for sub-project impacts have also been provided hereunder.

6.3.1. Positive Socio-economic and Environmental Impacts of Subproject

Most of the subproject's environmental and social impacts will be beneficial, including for example the ease of mobility, pedestrian-only areas for the convenience of general public, dedicated food streets for the public to enjoy delicious cuisines in auspicious environment and business-friendly infrastructure development. The beneficial impacts of both, the interventionist and the institution capacity building and investment preparedness components of KNIP are described briefly hereunder:

- Shorter travel time on the target roads will contribute to the economic development in Subproject area.
- Development of pedestrian crossings on the target roads will benefit directly to women, children and elderly people.
- Employment generation for the businesses is also envisaged from the proposed project as the workforce may commute with ease and more frequent between their residence and business districts.
- Health of the general public is expected to improve as there will be less vehicular emissions due to less traffic jams, vehicle-free road corridors, as well as lower noise pollution.
- By adding road safety features in the design, vulnerable road users and children will benefit and feel more secure.
- Pole mounted transformers shall be replaced by Surface mounted Dry Type transformers which are more reliable in terms of safety.

- Currently, there is no firefighting system available in all the zones of Pakistan Chowk. It was also observed that due to the disordered wiring and disorganized metering any sort of hazard could take place. The wiring will become underground and firefighting network will be laid along the streets.
- Due to the improvement in local road network, removal of mobile vendors in walkways and improved bus facilities, pedestrians including women and children have better access to crossing facilities and walkways.
- Increased mobility of traffic in the Central Business District (Saddar Area) increases the mobility of goods and consequently increases the businesses of the locals.
- The infrastructure development will reduce traffic congestion. As a result, precious time will be saved and could be utilized in the productive activities, which would otherwise be lost because of jams and other barriers because of underdeveloped infrastructure.
- The subproject itself is expected to directly generate several jobs, particularly during the construction phase.

6.3.2. Impacts and Mitigation Measures

The impacts associated with these activities are impacts on PCRs, temporary traffic congestion, safe disposal of transformers and other electrical equipment, dust emissions, water/groundwater contamination, soil contamination, solid waste management, noise pollution, traffic management, occupational and community risks with regards to health and safety and restriction of access for commuters including residents, businesses and students.

6.3.3. Subprojects Siting

Following is a description of impacts on each environmental and social component along with the specific mitigation measures:

6.3.3.1. Impact on Residents and Businesses

According to the social survey, there are few buildings located at one side of Strachan Road and Dr. Ziauddin Road, in which households are living in apartments and at the ground floor, shops are situated. These buildings are outside the boundary of subproject area but people are using these roads for commuting. The existing width of Dr. Ziauddin Road and Strachan Road including footpaths will be 67 ft. and 62 ft. respectively. The required width for rehabilitation of these two roads as per section 2.3.1 will be 54 ft. Therefore 8-13ft. wide access will be available for these residents and businesses. Therefore there will be no impact on residents and businesses.

Mitigation Measures:

Since there is no impact, mitigation measures are not required

6.3.3.2. Land Acquisition and Encroachments

According to section 6.2, the screening land use, Educational and Cultural Zone (Priority Phase – I) Subproject area interventions will be planned on existing ROW of roads and on the spaces of government acquired land, and therefore no land acquisition is involved. In addition, there are no squatters, encroachers, or mobile vendors/hawkers (termed as per OP 4.12 as Project Affected Persons (PAPs)) found in Year 1 Subproject area and roads. Therefore, no involuntary resettlement or impacts of livelihoods is involved.

Mitigation Measures:

Since there is no impact, mitigation measures are not required

6.3.3.3. Impact on PCRs

Proposed interventions under subproject will be initiated near 05 protected PCRs as listed in **Annex B**. The nearest PCRs (red areas) from the interventions (yellow areas and red lines) are presented in the below figure:

Figure 6.1: Nearest PCRs located near the intervention locations

Table 6.1 below presents the assessment of impact on PCRs conducted by ESMP Consultant Engineer.

Table 6.1: Land screening for the subproject interventions

S#	Intervention	Nearest PCRs	Assessment of Impact
1.	Rehabilitation of subproject roads and existing utilities located on the roads	Structure of DJ Science College	Distance from Dr. Ziauddin road is 75 ft. No impact envisaged for the proposed rehabilitation on the existing structure.
		Structure of NED University	Distance from Strachan road is 10 ft. No impact envisaged for the proposed rehabilitation on the existing structure.
		Burns Garden	No structure exist in Burns Garden. However, distance from Dr. Ziauddin road and Strachan road to the grill of Burns Garden is 6 ft. No impact envisaged for the proposed rehabilitation on the Burns garden
		Victoria Museum (Supreme Court building)	Distance from M.R. Kyani Road is 110 ft. No impact envisaged for the proposed rehabilitation on the existing structure.
		Structure of Extension of DJ Science College	Distance from Strachan road is 10 ft. No impact envisaged for the proposed rehabilitation on the existing structure.
2.	Cleaning of Main stormwater drainage channel via removal of	Burns Garden	The drainage channel is outside burns garden limits. Therefore no impact envisaged for the proposed cleaning.

	concrete slabs over the channel.		
3.	Shahrah-e-Kamal Development (sublevels parking and student piazza)	Structure of NED University	Distance from proposed parking footprint is 35 ft. No impact envisaged for the proposed development of sublevel parking on the existing structure.
		Structure of Extension of DJ Science College	Distance from proposed parking footprint is 30 ft. No impact envisaged for the proposed development of sublevel parking on the existing structure.
4.	DJ Science College Student Piazza	Structure of DJ Science College	Distance from proposed piazza is 75 ft. No impact envisaged for the proposed rehabilitation on the existing structure.
5.	Muhammad Bin Qasim Road surface parking plan	Structure of NED University	Distance from proposed parking footprint is 10 ft. No impact envisaged for the proposed development of surface parking.
		Structure of Extension of DJ Science College	Distance from proposed parking footprint is 20 ft. No impact envisaged for the proposed development of surface parking.
6.	Arts Council Development	Burns Garden	Distance from Arts Council to the grill of Burns Garden is 65 ft. No impact envisaged for the proposed development on the Burns garden
		Victoria Museum (Supreme Court building)	Distance from Arts Council is 90 ft. No impact envisaged for the proposed development on Supreme court building.

The footprints of the subproject interventions as discussed in Chapter 2 and assessment of impact as discussed in above table describe that there will be no intrusion as well as no impact envisaged on the PCRs. However, the stability will be ensured during construction stage by PSC structural engineer. Also, there will be a chance of discovery of historical remains due to excavation. Following measures needs to be applied:

Mitigation Measures

- A guideline for protection of PCRs for the subproject is provided in **Annex C**. It also includes "Chance Find" procedures for protection of cultural property and bidding documents for Contractors will include “Chance Find” procedures.
- Structural Engineer of PSC will assess regularly the stability of PCRs during construction stage.

6.3.3.4. Social Impacts

Major social concerns and conflicts during the construction project activities will arise if all the stakeholders are not adequately informed, consented and taken into confidence about the project or its schedule of operations, before the commencement of project activities.

- If the proposed construction site is not appropriately cordoned off to restrain outsiders from entering the site, issues of trespassing and safety issues of trespassers may arise.
- Quarrels between commuters due to traffic congestion may arise if traffic management is not in place.
- Nuisance to local community and shop vendors is envisaged due to traffic detours and dust and noise emissions.

Mitigation Measures

- Extensive consultation with stakeholders will be carried out as per plan described in table 7.1 and their feedback; concerns and input will be taken into account in the project planning and execution.
- A site plan showing the subproject area and planned interventions, and a tentative schedule of construction activities will be displayed prominently in the area.
- It will be ensured that the construction site is appropriately cordoned off with hard barricade (as shown as an example in below figure) and also it will be ensured that safe and continuous access to all adjacent shops and residences during construction will be provided. It is estimated that to cover all the construction sites of Year 1 Subproject area, 5.6 km long barricade will be require. However, work on all areas of subproject shall not be underway at once and will be planned as per detailed construction plan.

Figure 6.2: Hard barricade for construction site along the road with access to pedestrian

- Traffic plan will be prepared in consultation with government departments including traffic police and Transport and Communication Department, GOS
- Provide alternative traffic arrangement/detours, if necessary so that traffic can be distributed and move on different roads; and, ensure that public/residents association is informed about such traffic diversions.
- Diversions signs will also be placed.
- It is proposed that one track of M.R Kiyani Road at a time will be used for construction and the other for traffic diversion and pedestrian movement. In case of single track roads e.g. Dr. Ziauddin Ahmed Road, alternative diversion like Strachen Road access will be provided. However, the specific traffic management plan will be developed by CC based on the detailed construction plan.
- Information to the public through media – daily newspapers and local cable television (TV) services will be provided about the need and schedule of work, and alternative routes.
- Leaflets on road diversions and traffic rerouting will be disseminated to residents, nearby shops and institutions.
- Designated temporary parking places will be provided during the construction phase.

6.3.3.5. Air Quality Deterioration

The use of heavy construction machinery operated on diesel can generate exhaust emissions including SO_2, NOx, Smoke and Particulate Matter (PM). Similarly, development of Student Piazzas at DJ Science

College and SM Arts College, construction work in Arts Council and excavation for Shahrah-e-Kamal development will generate dust emissions. Removal of old pavement of roads as well as rehabilitation of footpath and laying of utility lines requiring excavation and exposed surfaces may also result in increased dust emissions. Furthermore, rerouting of traffic and diversions may lead to traffic congestion on roads, resulting in increased dust and exhaust emissions from vehicles. Another possible cause of air deterioration is handling and transportation of cement, mortar, concrete, other dusty materials, and handling and storage of aggregates in concrete plants. Construction of various infrastructural elements may lead to dust generation and nuisance to the general public, commuters, pedestrians and nearby households. However, these impacts will be temporary and localized to the year 1 subproject area.

Below figure describes the locations for which significant construction activity including excavation is proposed. Also in Karachi, the wind blows from SW direction over 9 month's period and NE direction in 3 months period.

Figure 6.3: Location of significant construction activity proposed (White arrows show the direction of average wind direction)

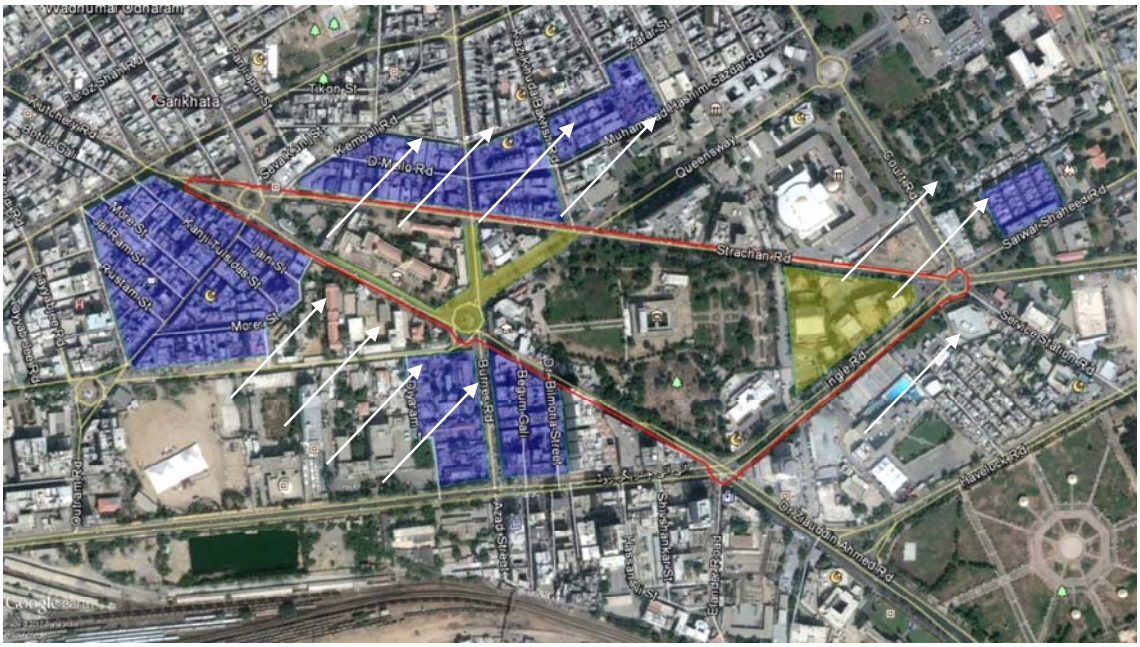


Figure 6.4: Locations of Residential areas near the Year 1 Subproject area

Mitigation Measures

Different options are available to control dust and exhaust pollution. They are listed below:

- ***Dust Containment Measures***

- PVC Laminated Polyester Fireproof Mesh Sheet (with small mesh size) which is easily available in the local market should be installed at least 8-10 ft. in height from existing ground level to contain dust inside the construction site. This barrier can be added over a hard barricade for the construction site and if provided in double layers with a gap of about 1 inch can reduce the noise substantially. It is estimated that 5.6 km long sheet will be require. However, work on all areas of subproject shall not be underway at once and will be planned as per detailed construction plan.

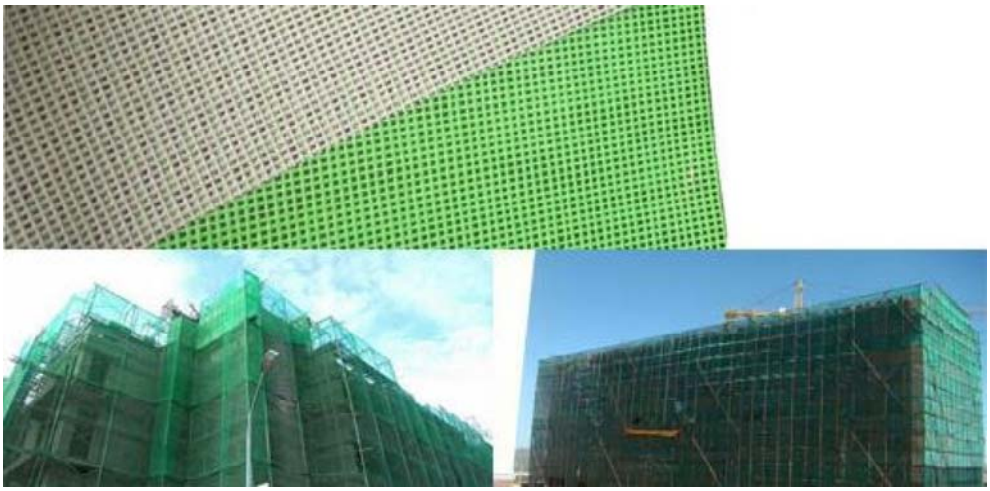


Figure 6.5: PVC Laminated Polyester cover for dust and noise containment

- The exposure of construction workers to dust should be minimized by provision of dust masks and mandating the workers to wear them.

➢ ***Dust Reduction Measures***

- Water should be sprinkled daily to wet all the expose surfaces.
- Use of water suppression for control of loose materials on paved or unpaved road surfaces. Oil and oil by-products is not a recommended method to control road dust[30].
- Truck loads should be covered with tarpaulin.
- Construction site including soil and material piles at the site should be barricaded to avoid material escape, generation of dust.
- Ready-mix can be used in the stages of the project wherever and whenever required and deemed appropriate.
- Road construction operations should be carefully planned and scheduled and when the traffic movement is minimal e.g. early morning.
- Careful handling and working under moist conditions and monsoon season will be avoided as much as possible.

➢ ***Exhaust emission reduction measures***

- Construction machinery, vehicles should be properly tuned and kept in good working condition, minimizing exhaust and vehicular emissions. It should be ensured that exhausts from these equipment and vehicles comply with relevant SEQS.
- Excessive engine idling should be discouraged and machinery causing excessive pollution (i.e. visible clouds of smoke) should be banned from sites.
- Open burning of solid wastes, whether hazardous or nonhazardous, is not considered good practice and should be avoided, as the generation of polluting emissions from this type of source cannot be controlled effectively[31].

6.3.3.6. Noise

During the construction works, noise will be generated from the operation of machinery, project-related vehicles and material transport. These activities will cause discomfort to students of colleges and university, local residents, shops, and pedestrians and may contribute to the existing noise pollution in the city. Following table shows the noise levels of different construction equipment that will be used during Year 1 subproject interventions.

Table 6.2: Typical noise levels of construction equipment (noise level in dB (A) at 15 m)

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 and Earth Moving		Air compressor	74-87
Bulldozer	80	Pneumatic tools	81-98

[30] WBG EHS Guidelines
[31] WBG EHS Guidelines

Table 6.2: Typical noise levels of construction equipment (noise level in dB (A) at 15 m)			
Clearing		**Structure Construction**	
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 Compaction		**Landscaping and clean-up**	
Grader	80-93	Bulldozer	80
Roller	73-75	Backhoe	72-93
		Truck	83-94
Paving		Front and 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, Noise from Construction Equipment and Operations. Building Equipment and Home Appliance. NJID. December 31, 1971

Figure 6.5 shows the locations of residential areas around the subproject area that will be affected during construction activity.

Figure 6.6: Locations of Residential areas which are receptors of Construction Noise

Mitigation Measures

Different options are available to control dust and exhaust pollution. They are listed below:

- *Noise Containment Measures*

  - PVC Laminated Polyester Fireproof Mesh Sheet as discussed in the earlier section will be used with hard barricade to reduce the noise levels and check the noise levels outside the barricade periodically for different type of construction activity through a hand held noise meter. If the noise levels exceeds the SEQS levels, construction activity should be halted and the Polyester sheets will be replaced with noise deflectors / acoustic barriers as shown below:

Figure 6.7: Acoustic barriers

- High noise activities should cease between 22:00 and 06:00 hrs.

➢ *Noise Reduction Measures*

- Equipment and vehicle noise can be reduce at source by regular maintenance & repair of construction machinery and equipment.
- Mufflers or silencers should be mandatory to be equipped by all project-related vehicles.

6.3.3.7. Storm water drainage

The monsoon period starts from May, lasts till August and can be prolonged till September. Therefore, if the interventions start immediately, there will be chance of flooding of existing roads during rain because the existing drainage may be blocked due to digging/excavation of soil/earth for laying of new drainage lines along the roads. The design report estimates that a total of 110.73 cu. ft / sec of storm water may generate from the Year 1 subproject area and the side drains are designed according to that flow.

As per the design report, Assistant Engineer of KMC reported that this main storm drainage line needs to be cleared in future as it contains garbage and will overflow after rains. The drainage line is presented in figure 6.8:

Mitigation Measures

- The existing main storm drainage line passing in between the Burns Garden (outside the boundary of Burns Garden) and Arts council will be cleaned before the start of rehabilitation of roads.
- The clearing of drain line will be done by removing the concrete slabs cover and cleaning via back hoe loader and transferred the garbage into the dump trucks. The dump truck will then transfer this garbage to Jam Chakro Landfill site as it contains simply the municipal waste.
- Strom water channels/side drains as included in the design (as shown in the below figure) should be constructed earlier to reduce flooding.

Figure 6.8: Main Storm Drainage Line (Outside the boundaries of Burns garden and Supreme Court building)

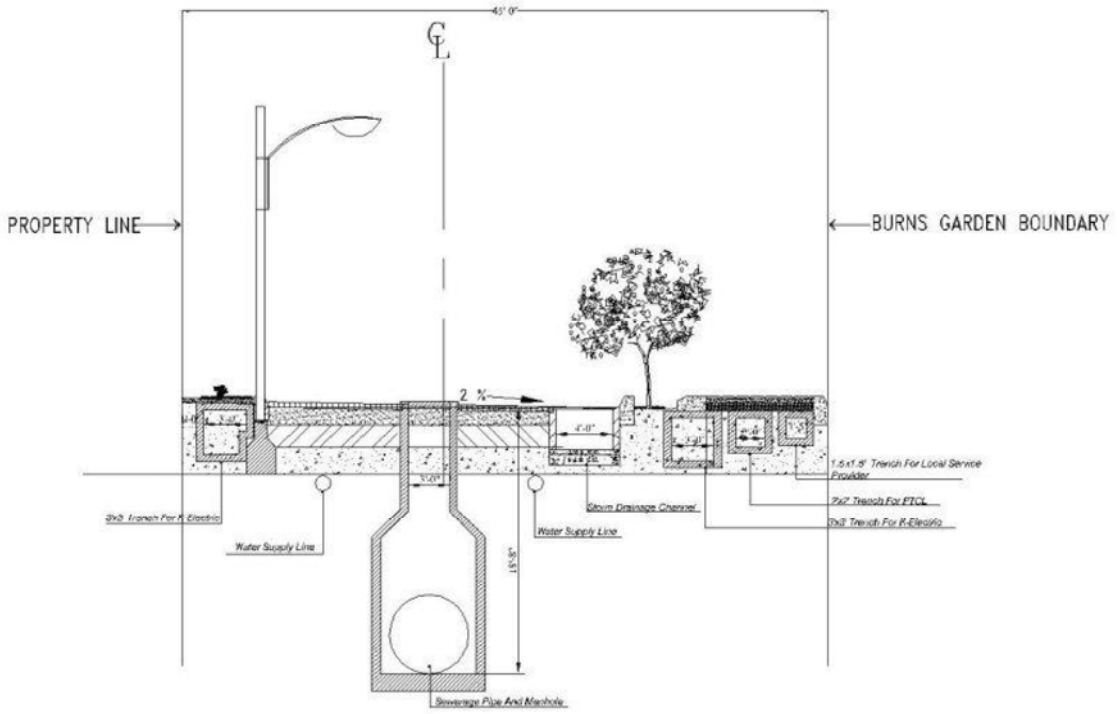


Figure 6.9: Propose road infrastructure including sewerage and stormwater drainage channels

- The main storm drainage line should be checked for any blockage and keep cleared if any blockage occurs immediately during construction activities.
- Awareness programs for the public will be initiated to avoid throwing of garbage in the main and proposed stormwater drains during construction and operations.
- Sign post will also be applied over the drains to disseminate the information.

- Waste and soil pile should be barricaded and covered with tarpaulin to avoid erosion from storm water and clogging of existing drains.

6.3.3.8. Surface and Ground Water Quality

Spills from construction equipment fuel, construction vehicles during construction may resulting in contamination of groundwater in conditions like post-monsoon season; Inadequate storage at construction site and disposal to nearby areas of waste material will result in contamination of land, nuisance to the public, pedestrian and residents;

Also the removal of pole mounted oil filled transformers may have chance of oil spillage. The existing transformers are the property of KE, and as per consultation with KE, it is a common practice of KE that all used/faulty/damaged transformer are transferred by KE to its Transformer Switchgear Workshop located in S.I.T.E. area, Karachi, where they are repaired and reused.

Mitigation Measures

- Coordination with KE should be ensured during the removal of transformers and an HDPE lining must be put beneath the transformer mounted poles to avoid soil contamination.
- KE will take all the transformers to its switchgear workshop, so no need to dispose the transformers.
- It will be ensured that the wastes generated from construction activities should be stored in a proper interim location onsite which should be adequately barricaded and covered to avoid ingress of storm water. The location of onsite waste storage site will be selected by PSC as per detailed construction plan.
- Excavation material /civil works related solid waste should be disposed to KMC Jam Chakro Landfill site.
- There will be no labor camp for residing the workers as local labor will be hired. Only Porta cabins of Resident Engineers and PSC staff will be provided that will also serve as the shelter for labor during construction and provision of water. Therefore no generation of wastewater will be envisaged.

Impacts from Generation of Wastewater

- After the construction and development of underground parking facility and toilet blocks and kiosk, wastewater will be generated of two types:

1) Municipal wastewater from toilets and kiosk
2) Excess groundwater removed by sump pumps from basement of parking facility and stored in sump tanks.

Mitigation Measures

- Municipal wastewater will be routed and connected to proposed sewerage network which is connected to existing network outside the subproject area. The municipal wastewater normally complies SEQS and therefore it can be connected to the sewerage system. However, it is proposed that drains of toilets and kiosks should be connected to concrete septic tanks. For one block of toilet and kiosks, one double compartment septic tank having enough capacity to contain the sewerage water for 2 days will be proposed.
- As per design report, the excess groundwater will be used for horticultural purposes.

6.3.3.9. Excavation

An average 8m deep excavation is required for the development of 2 level underground parking at Shahrah-e-Kamal. Excavation can pose following impacts:

- Person falling into the pit
- Contact with buried utility lines
- Flooding in the pit due to excessive rains / underground water
- Stability of nearby structures
- Movement of vehicles / equipment close to the edge of the pit

Mitigation Measures

- In addition to the control of construction site cordoned off through hard barricade as discussed in sections above, the excavation pit at Shahrah-e-Kamal should be equipped with guard rails with warning signage to avoid falling of construction crew. Approximately 500 m of guardrail will be required to cordon off the excavation pit.
- The excavation pit will also be protected with shoring protection or if recommended by PSC structural engineer, by a retaining wall. The excavated soil will be temporarily stored at Muhammad Bin Qasim road away from the pit before disposal.
- Regarding the utility lines, all utility agencies will be taken onboard before construction to locate any existing utilities and provide suggestion for their protection.
- Digging will be done manually near buried utilities to locate the exact position.
- Suitable size of dewatering pump will be installed if groundwater found during excavation or rainwater ingression. The water will be discharged into the existing storm water drains.
- At least 2m distance will be maintained for vehicles to operate near the excavation pit.

6.3.3.10. Utilities

Interruption of electricity and water availability are not envisaged as the new systems are laid before removing or cutting down the existing lines. All the poles and electric lines are removed after the laying of ducting and underground cables and installation of dry type transformers.

The design report estimated average load of the zone about 1.0-1.3 MW. Since this is an educational and cultural zone and their load is already established, the electrical load is unlikely to be increased significantly in the future. However, in order to keep the system adaptable of catering changes in future, 15%-20% provisions are being kept in the system design.

The water requirements for Kiosks and toilets are 16,050 US Gallons per day and 2,250 US Gallons per day respectively i.e. total water requirement is 18,300 US Gallons per day and will be catered from the existing supply of water for the area. After consultation with KWSB, the main lines have enough capacity to cater the additional water requirements and can be easily met after the introduction of in loop circuit water distribution system.

It is envisaged that during construction, the water mains may get damaged and water supply may get contaminated with excavated soil or sewerage.

Mitigation Measures

- Relevant institutions such as KE and KWSB should be well-informed and taken on-board before and during the commencement of any activities and their recommendations should be well-incorporated.
- While working near water mains, KWSB will be taken on-board and KWSB site engineers will be present at the site to locate the water mains.
- Water supply should be cut down while rehabilitation and connecting of new water supply lines to water mains as well as working near the water mains.
- If water mains get damaged, it should be repaired without delay and as per KWSB practices.
- Communities near Pakistan Chowk area will be pre-informed and consulted if cutting down these utilities is necessary.
- As per design report, LEDs are the most favorable option for street lighting and landscape lighting as well since they have good luminous intensity per unit energy consumption.
- Day and night lighting control system has also been proposed for the street illumination which may result in higher energy conservation with a most efficient illumination system.
- Replacement of oil filed transformers with dry type transformers

Advantages of Dry type transformer

Multiple site visits have been arranged to correspond with KE by the Design Consultant. Meetings with H.T and L.T Department of K-Electric have also taken place. Subproject Detailed design is prepared in coordination with KE.

Figure 6.10: Several meetings with KE by Design Consultant (Source: Final Design Report)

It is proposed that existing oil filled pole mounted transformers will be replaced by dry type transformers. There are many advantages of dry type over oil filled transformers as discussed below:

- Safety for people and property
- Maintenance and pollution-free solution
- Easy installation
- Side clearance is less
- Environmentally friendly

- Excellent capacity to support overloads
- Reduced cost on civil installation works and fire protection systems
- Excellent performance in case of seismic events
- No fire hazard
- Excellent resistance to short circuit currents
- Long lasting due to low thermal and dielectric heating
- Suited for damp and contaminated areas

6.3.3.11. Waste Management

Typical solid waste generated during construction include waste concrete, empty cement bags, excavated material, chemical waste generated by general site practices, municipal waste by the site workers etc. The solid waste has the potential to cause negative impact on the surroundings if not properly managed and disposed of. It is likely to block nearby drainage channels that can ultimately cause localized flooding during the monsoon and nuisance to the public.

Waste generated from road construction and up-gradation includes bituminous material, empty bituminous drums, existing wearing and base course scrap etc. The waste generated from scraping of existing carriageways of Subproject roads will be approximately 2,325m3 (considering road length of 2.5m with average carriageway width of 18.3m and scraping of approx. 3") ~ 2,610 tons (considering 1,126.26 kg/m3 sp. Gravity of scrap material32) which is equal to 75 dump trucks having an average capacity of 35 tons per trip.

Waste generated from excavation of an average 6m deep for Shahrah-e-Kamal development (underground parking) will be approximately 22,116m^3 ~ 31,900 tons (considering 1,442 kg/m^3 sp. Gravity of moist excavated earth[33]) which is equal to 912 dump trucks having an average capacity of 25 tons per trip.

Poor waste management practices would result in short term negative impact on the aesthetics of the surrounding. It can also deteriorate air quality.

As shown in Figure 6.9 above, it is evident that the roads will be excavated to 18 ft. for the rehabilitation / addition of sewerage lines and other utilities. However, the excavated earth will be used to refill the void after laying of utility lines. Therefore there will be no waste generated in terms of rehabilitation of utilities.

The existing water supply and sanitation network comprises of PE/PVC pipes. However, it is envisaged that some old asbestos cement pipes may be found during excavation.

Mitigation Measures

- The existing wearing and base course scrap can be reused in sub-base course of the new roads or disposed at KMC Jam Chakro Landfill site via tarpaulin covered dump trucks.
- Empty drums of bituminous material as well as bituminous material itself will be reused as far as possible, recycled back to the asphalt mixer or ultimately disposed at KMC Jam Chakro Landfill site.

[32] http://www.csgnetwork.com/specificgravmattable.html
[33] http://www.csgnetwork.com/specificgravmattable.html

- All hazardous waste like Paint Waste (Waste Paint, Drums and Rollers/ Brushes), will be handled and disposed through incineration via EPA certified hazardous waste contractor hired by CC.
- All asbestos cement pipes if discovered during rehabilitation, will be handled, transported and safely disposed to the designated landfill site through EPA certified hazardous waste contractor hired by CC.
- Construction Contractor's HSE Plan shall clearly include a section on Asbestos Management that will ensure disposal in a manner that keeps the material in predominantly whole pieces to be considered non friable. Sanding, sawing, grinding, chipping, or the use of power tools shall not be allowed. The asbestos containing pipes will be kept wet during removal and wrapped in plastic to avoid escape of asbestos fibers into the air.
- Recycling of solid waste will be carried out as far as possible and practical like cement bags, steel scaffoldings, empty drums, wood planks, discarded bricks etc.
- No wastes should be dumped at any location outside the site boundary/designated disposal site.
- Training should be provided to working personnel for identification, segregation, and management of waste.
- The Year 1 subproject waste management plan will be developed by CC.

Waste Segregation

All hazardous waste if found shall be segregated from nonhazardous wastes at the point of generation of waste. During construction phase, suitable containers with following color coding shall be kept to collect and segregate common wastes at all facilities:

Waste material	Color code
Concrete/ Campsite Debris	Blue
Metal	Green
Plastic	White
Oily Rags	Black
Used Oil	Red
Rubbish/Trash	Yellow

Recycling

Recycling and reuse minimizes the quantity of waste requiring disposal. Some of the wastes can be reused within the construction site while others can only be recycled (Table 6.11). There is a great recycling potential for few of these wastes in the recycling market at Karachi. Waste shall be sold to the third party contractors/ companies, who have proper recycling facilities.

CC will suggest/recommend recycling of the paper, glass, plastic wastes in their respective processing units. Iron/steel waste would be sent to re-rolling mills.

Table 6.3: Waste management options (different categories)

S#	Waste Type	Category	Disposal Options
1.	Excavation Material	Non-hazardous	Reuse for backfill
2.	Construction debris including Scrap	Non-hazardous	Recycle, reuse or sell to third party contractor.
3.	Metals	Non-hazardous	Store cuttings in designated area for reuse. Remove surplus materials and use them at other sites, where feasible.
4.	Concrete	Non-hazardous	Store unused concrete blocks for later reuse.

Table 6.3: Waste management options (different categories)

S#	Waste Type	Category	Disposal Options
			Recycle, reuse or sell to third party contractor.
5.	Bricks	Non-hazardous	Reuse for footings and broken bricks.
6.	Plastic and vinyl	Non-hazardous	Recycle, reuse or sell to third party contractor.
7.	Corrugated Cardboard	Non-hazardous	Recycle, reuse or sell to third party contractor.
8.	Woods	Non-hazardous	Recycle
9.	Empty Drums and Containers	Non-hazardous	Disposed them off through recycler.
10.	Oily Rags (Used)	Non-hazardous	Dispose to Sanitary Landfill.
11.	Paint Waste (Waste Paint, Drums and Rollers/ Brushes)	Hazardous	Handled and disposed through incineration via EPA certified waste contractor hired by CC.
12.	Sanitary Wastewater	Non- hazardous	Treat wastewater in septic tanks before disposal.
13.	Sludge	Hazardous	Dispose sludge removed during cleaning septic tank in sanitary landfill.
14.	Trash	Non-hazardous	1. Segregate glass, metal, plastic from trash. 2. Recycle all recyclable items. 3. Designed landfill.
15.	Asbestos cement Pipes	Hazardous	Handled and disposed in landfill via EPA certified waste contractor hired by CC.

The Waste Tracking Form, attached below shall be used to record this information by CC, while waste is being dispatched outside construction site. It is the responsibility of respective EPA certified waste contractor to assign a suitable person to sign off the record of waste tracking before the waste is dispatched outside.

WASTE TRACKING FORM

Location of Generation:

Reporting Team:

Submitted by (Name):

Submitted on (Date):

Waste	Disposal Location
Excavation Material	
Concrete	
Bricks	
Metal	
Card board	
Tiles	
Plasterboard	
Timber	
Wires	
Bitumen	
Green waste	
Drums and Containers (Empty)	
Oil Contaminated Soil	

Paint Waste	
Sanitary Wastewater	
Sludge	
General Trash	

Checked and Signed: _____ **Dated:** _____

6.3.3.12. Soil Contamination

Soil at the construction site can get contaminated from either spills, due to stagnant water or degradation due to activities in the microenvironment of the site.

Even though emulsified asphalt and asphalt mixture may temporarily cause odor nuisance during construction, its impact is temporary and not expected to trigger soil contamination.

Mitigation Measures

- Fuel oils and lubricants for construction machinery will be stored in covered diked areas, underlain with HDPE membrane.
- Washing and maintenance of vehicles will be restricted onsite and contractor is mandated to get entry of well-maintained and cleaned machinery.
- Regular inspections will be carried out to detect leakages in construction vehicles and equipment.
- Appropriate implements such as shovels, plastic bags and absorbent materials will be made available near fuel and oil storage areas for removal of oil and contaminated soil.

6.3.3.13. Traffic Management

It is envisaged that there would be substantial traffic disruption, congestion, diversion and spillover effect during the construction activities. Vehicular traffic management will have to be undertaken seriously to restrain unnecessary traffic jams that may cause annoyance to the commuters as they project intervention activities may encompass residential, commercial and business areas of Karachi.

Mitigation Measures

- A detailed traffic management plan will be developed by CC and implemented in letter and spirit.
- Traffic management and diversion plan would be prepared in consultation with traffic police, Transport and Communication Department, and other relevant GOS departments and authorities
- It is suggested that the work on connecting roads should not be done simultaneously e.g. the development of underground parking at Shahrah-e-Kamal shall not be started with work along Strachen Road or Dr. Ziauddin Ahmed Road.
- Regarding parking for different type of project/construction vehicles, existing subproject roads within the subproject area will be used which are the property of Government of Sindh, e.g., for development of underground parking at Shahrah-e-Kamal and Student Piazza at DJ Science College, **portion of Burns Road (Muhammad Bin Qasim Road)** behind SM Arts college will be used. Also one lane of each subproject roads will be rehabilitated and the other lane will be used for parking of construction vehicles. It is normal practice in Karachi that construction vehicles are parked at the under construction roads and construction commences in portions.

- Traffic management plan will be introduced to manage smooth flow of vehicular traffic and to avoid traffic jam and long queues.
- Traffic management plan will also cater the pedestrian movement.
- Sign postings, warning signs, diversion signs and barriers will be installed to alert public of all potential hazards including limited access to construction sites.
- Ensure safe and continuous access to all shops and residences during construction. It is suggested that interventions that involves traffic management like provision of parking spaces, designated parking, prioritization of roads for pedestrian only should be implemented first to avoid traffic congestion while civil work continues on roads.
- Movement of construction material to the project sites should be planned in a way that it will not hamper major transport activity e.g. during night time or early in the morning when the local trips are minimum. However care must be taken at residential locations and the transfer of material should not be done during late hours.

6.3.3.14. Seismic Hazard

Seismicity has to be considered in particular for the construction of parking plazas.

Mitigation Measures

- No specific mitigation measure other than construction of the underground parking facility will be designed in accordance with the Unified Building Codes and Karachi lies on Seismic Zone 2B as per the Codes for which the Peak Ground Acceleration' (PGA) value of 0.20g is expected.

6.3.3.15. Impacts on Flora

Clearing of planted mature trees, in particular the old trees of the prevalent species in Karachi, is not allowed or envisaged as per the footprints of the Year 1 Subproject. However, it is confirmed that 8 immature trees on Shahrah-e-Kamal will be cut down.

Mitigation Measures

- Damage to trees will be avoided and trees located along roadside will be protected during construction.
- For Shahrah-e-Kamal development, compensatory plantation is required and it will be already fulfilled by incorporating the tree plantation strip proposed along the project roads as shown in below figure:

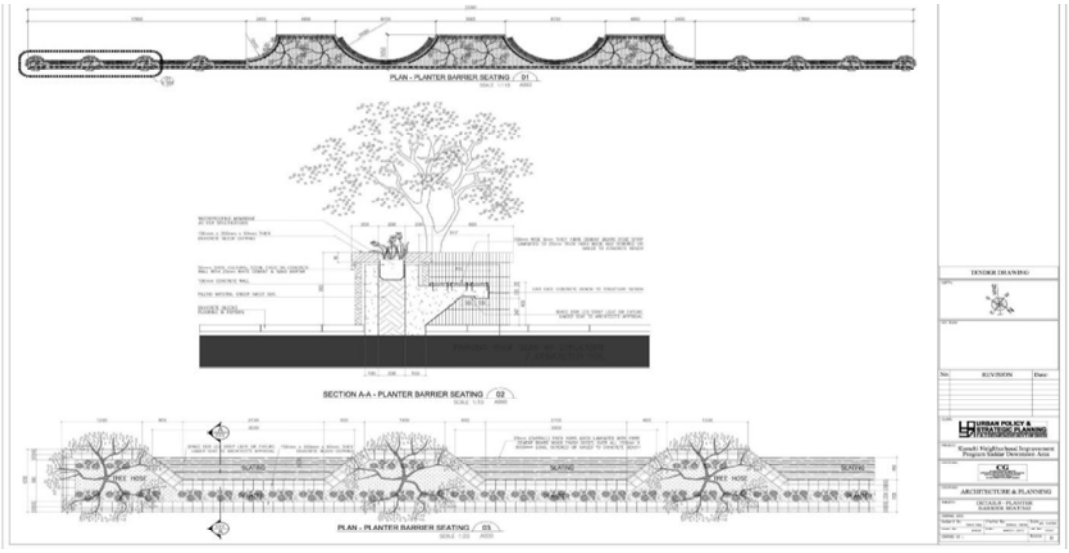


Figure 6.11: Tree plantation arrangements

- There are 84 mature trees located in year 1 subproject roads as mentioned in chapter 4 and these trees will be marked and cordoned off with fencing and their roots will be protected. All the works along the roads on footpaths will be done outside these tree fences.
- The tree plantation plan should include the plantation of native trees and *Conocarpus* specie must be avoided.

6.3.4. Labor Issues

- The construction of civil works such as road rehabilitation, utility works, development of Piazzas and underground parking, development in Arts Council, etc. poses an inherent risk of injury to labor from accidents.
- Poor housekeeping practices will lead to stagnant water as breeding grounds for insect vectors (causing malaria etc.).
- Hazards from handling equipment, ergonometric stress, lifting heavy materials etc. may cause injury to the labor.

Mitigation Measures

Site-specific labor health and safety hazards are also critical to identify based on job safety analysis or comprehensive hazard or risk assessment. Health and safety management planning should include the adoption of a systematic and structured approach for prevention and control of physical, chemical, and biological health and safety hazards. Use of PPE should be made mandatory. Only trained and experience crane, forklift, etc. operators should be hired. CC shall ensure that Job Hazard Analysis (JHA) is performed prior to commencing jobs. It shall also be ensured that the JHA is reviewed after the following:

- Whenever work is stopped
- Every time work conditions or the job scope changes
- Persons working the job shall review and acknowledge the JHA by their signature

6.3.4.1. Crane and Lifting Operations

For all Crane & Lifting Operations CC shall ensure full compliance with standard operating procedures. CC shall develop a site specific pre-lift checklist which includes the following at minimum:

- Crane rigging capacity adequately for load
- Condition of slings
- Rigging condition adequate for load
- Area of swing or travel unobstructed
- Multiple crane use
- Power line approach distance maintained
- Stability and footing
- Taglines and spotters
- Illumination and weather
- Signal operator
- Job hazard analysis and other permits

All lifting and rigging activities shall be supervised and conducted by a competent person or team, CC shall maintain a lifting gear registry for all lifting gear on-site inclusive of a listing of all lifting gear, copies of equipment certificates (manufacturer, safe working load, serial number) and the inspection/recertification frequency.

6.3.4.2. Forklifts and Non-Road Vehicles

CC should ensure forklift and non-road vehicles are fit for purpose and operated according to manufacturer's requirements. Only competent operators are permitted to operate forklifts and non-road vehicles.

At minimum, all forklifts and non-road vehicles shall be equipped with following equipment:

- Seat belts
- Horn
- Emergency Brake
- Wheel chock
- Labeled Controls
- Fire Extinguishers
- First Aid Kit
- Back-up Alarm

6.3.4.3. Scaffolding

CC is responsible to establish periodic inspection, certification and recertification program for scaffold works. Only qualified worker is authorized to erect, inspect and certify scaffold. All scaffolds should have a guardrail system on each open side, up to the access point. It should be equipped with toe boards having suitable access ladder.

6.3.4.4. Trenching Activities

- Never enter an unprotected trench
- Always use a protective system for trenches feet deep or greater.
- Shoring to protect workers by installing supports to prevent soil movement for trenches that do not exceed 20 feet in depth.
- Shielding to protect workers by using trench boxes or other types of supports to prevent soil cave-ins
- Always provide a way to exit a trench--such as a ladder, stairway or ramp--no more than 25 feet of lateral travel for labors in the trench.
- Keep spoils at least two feet back from the edge of a trench.
- Make sure that trenches are inspected by a competent person prior to entry and after any hazard-increasing event such as a rainstorm, vibrations or excessive surcharge loads.

6.3.4.5. Over-exertion

Over-exertion, and ergonomic injuries and illnesses, such as repetitive motion, over-exertion, and manual handling, are among the most common causes of injuries at construction site.

Mitigation Measures

Recommendations for their prevention and control include:

- Workers will be trained with lifting and materials handling techniques before the construction of the project, including the placement of weight limits above which mechanical assists or two-person lifts are necessary.
- Work site layout will be planned to minimize the need for manual transfer of heavy loads.
- Tools will be selected and work stations would be designed to reduce force requirements and holding times, which promote improved postures, including, where applicable, user adjustable work stations.
- Administrative controls, such as job rotations and rest or stretch breaks will be implemented into the work processes.

6.3.4.6. Slips and Falls

Slips and falls on the same elevation associated with poor housekeeping, such as excessive waste debris, loose construction materials, liquid spills, and uncontrolled use of electrical cords and ropes on the ground, are also among the most frequent cause of lost time accidents at construction site.

Mitigation Measures

Recommended methods for the prevention of slips and falls from, or on, the same elevation include:

- Good house-keeping practices, such as the sorting and placing loose construction materials in established areas away from foot paths, would be implemented.
- Excessive waste debris and liquid spills will be cleaned up regularly.

- Electrical cords and ropes will be located in common areas and marked corridors.
- Slip retardant footwear will be used.

6.3.4.7. Work at Heights

Falls from elevation associated with working with ladders and scaffolding are among the most common cause of fatal or permanent disabling injury at construction site. If fall hazards exist, a fall protection plan will be in place which includes one or more of the following aspects, depending on the nature of the fall hazard.

Mitigation Measures

- Training and use of temporary fall prevention devices, such as rails or other barriers able to support a weight of 200 pounds, when working at heights equal or greater than two meters or at any height if the risk includes falling into operating machinery, into water or other liquid, into hazardous substances, or through an opening in a work surface.
- Training and use of personal fall arrest systems, such as full body harnesses and energy absorbing lanyards as well as fall rescue procedures to deal with workers whose fall has been successfully arrested.
- Use of control zones and safety monitoring systems to warn workers of their proximity to fall hazard zones, as well as securing, marking, and labeling covers for openings in floors, roofs, or walking surfaces.

6.3.4.8. Struck By Objects

Construction activities of the project may pose significant hazards related to the potential fall of materials or tools, as well as ejection of solid particles from abrasive or other types of power tools which can result in injury to the head, eyes, and extremities.

Mitigation Measures

Techniques for the prevention and control of these hazards include:

- Maintaining clear traffic ways to avoid driving of heavy equipment over loose scrap.
- Temporary fall protection measures in scaffolds and out edges of elevated work surfaces would be used, such as hand rails and toe boards to prevent materials from being dislodged.
- Appropriate PPE such as safety glasses with side shields, face shields, hard hats, and safety shoes, would be wore.

6.3.4.9. Moving Machinery

Vehicle traffic and use of lifting equipment in the movement of machinery and materials on a construction site may pose temporary hazards, such as physical contact, spills, dust, emissions, and noise.

Heavy equipment operators have limited fields of view close to their equipment and may not see pedestrians close to the vehicle. Center-articulated vehicles create a significant impact or crush hazard zone on the outboard side of a turn while moving.

Mitigation Measures

Techniques for the prevention and control of these impacts include:

- The location of vehicle traffic, machine operation, walking areas, and controlling vehicle traffic will be planned and segregated through the use of one-way traffic routes, establishment of speed limits, and on-site trained flag-people wearing high-visibility vests or outer clothing covering to direct traffic.
- The visibility of personnel will be ensured through the use of high visibility vests when working in or walking through heavy equipment operating areas as well as training of workers to verify eye contact with equipment operators before approaching the operating vehicle.
- Inspected and well-maintained lifting devices will be used that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job-site elevations.

6.3.4.10. Other Site Hazards

Construction of site may pose a risk of exposure to dust, hazardous or flammable materials, and wastes in a combination of liquid, solid, or gaseous forms.

Mitigation Measures

- Only authorized personal should be allowed at the construction site
- Identify and minimize, so far as reasonably practicable, the causes of potential hazards to workers, including communicable diseases such as HIV/AIDs and vector borne diseases;
- Avoid stagnation of water and initiate drainage/cleanup of stagnant water;
- Provide for the provision of appropriately stocked first-aid equipment at work sites;
- Provide for appropriate personal protective equipment (PPE) to minimize risks, such as but not limited to appropriate outerwear, boots and gloves; safety helmets;
- Provide training for workers for the use of PPE;
- WB Group's Environment, Health and Safety (EHS) Guidelines (attached at the end of this document) will be implemented;
- No bonded and child labor will be permitted at site;
- Major labor laws will be followed e.g. Minimum Wage, Harassment of women in the work place Hours of work, Overtime Payment.
- Also laborers will be trained on appropriate interaction with local people especially women;
- Include procedures for documenting and reporting accidents, diseases, and incidents; and
- All safety precautions will be taken to address safety hazards for the nearby community. These precautions may include safety/warning signage, safety barrier around the construction site.
- Lighting provided for labor during night time work should be adequate but spot lights that should not create nuisance to nearby local residence.
- CC will include appropriate clauses to protect environment and public health. The sub-project ESMPs will be included in the bidding document;
- There will be no labor camp for residing the workers as local labor will be hired. Only Porta cabins of Resident Engineers and PSC staff will be provided that will also serves as the shelter for labor

during construction and provision of water. Therefore no generation of wastewater will be envisaged;

- The location of Porta cabins will be decided by PSC based on detailed construction plan.
- WB Group's Environment, Health and Safety (EHS) Guidelines (attached at the end of this document) will be implemented.

6.3.4.11 Harassment of women in the work place

A Code of Conduct at the Workplace will be developed by CC to provide protection and safety to women against harassment.

6.3.5. Pedestrian Crossings

Adequate crossing facilities will be proposed in the design as presented in the below figures:

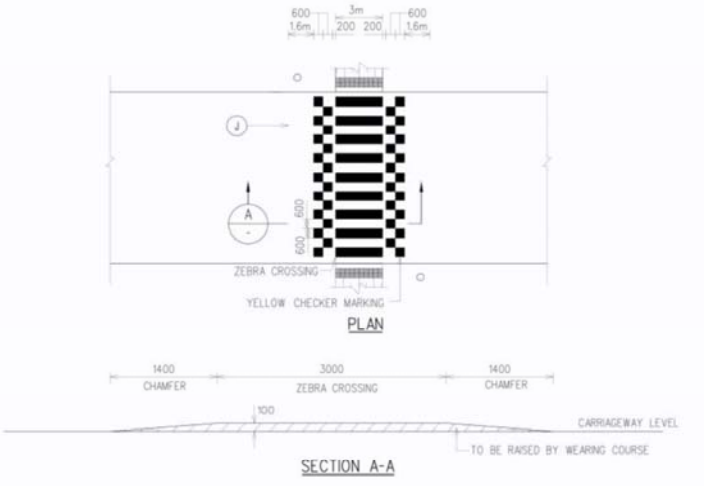


Figure 6.12: Raised pedestrian crossing

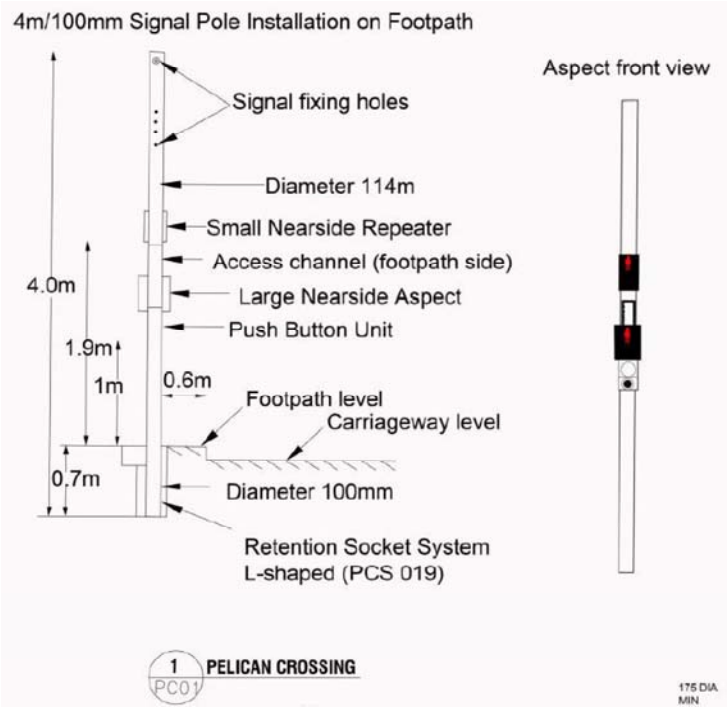


Figure 6.13: Pelican crossing

Road signage is also proposed to be installed along the roads. Bus and car drop off location are also planned in road design as shown below:

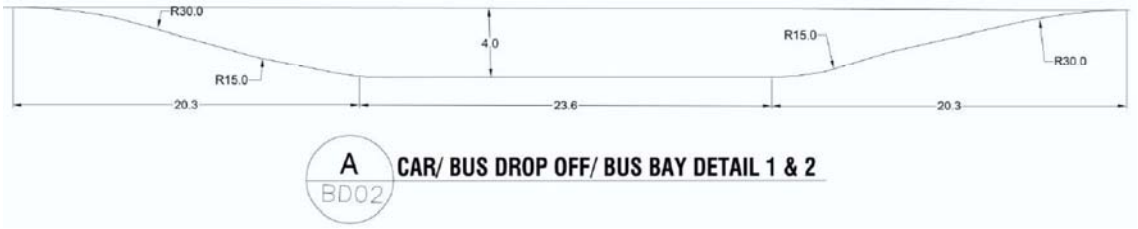


Figure 6.14: Bus and car drop off

Mitigation Measures

- While analyzing the detailed location plans of road crossings, it is proposed that two more crossings should be provided: 1) in front of Ayesha Masjid and proposed science college student piazza and 2) in front of NED City Campus at intersection of Strachan Road and Burns Road (Muhammad Bin Qasim Road) to facilitate students to cross the roads within the educational facilities.

6.4. Grievance Redress Mechanism (GRM)

6.4.1. Overview and Scope

The Grievance Redress Mechanism proposed here spans Educational and Cultural Zone (Priority Phase – I) Subproject implementation and will cater to all subproject affected population/beneficiaries.

The PIU office will serve as the secretariat for the Grievance Redress Committee (GRC-Project) that will be responsible for providing oversight on the entire GRM process at a strategic level and monitoring of complaints management.

6.4.2. Objectives of Grievance Redress Mechanism

The grievance redress mechanism (GRM) will be consistent with the requirements of the World Bank safeguard policies as well as local laws including women harassment at workplace act to ensure mitigation of community concerns, risk management, women harassment at workplace and maximization of environmental and social benefits. The overall objective of the GRM is therefore to provide a robust system of procedures and processes that provides for transparent and rapid resolution of concerns and complaints identified at the local level.

The GRM will be accessible to diverse members of the subproject area community, including women, senior citizens and other vulnerable groups. Culturally-appropriate communication mechanisms will be used at subproject location to spread awareness regarding the GRM process as well as complaints management.

6.4.3. Communication & Awareness raising on GRM

The final processes and procedures for the GRM will be translated in to local language (i.e. Urdu) and disseminated at sub-project area. These shall be made available (in both leaflet and poster format) to subproject location with CC Project Manager on site and in the offices of DC Office South.

6.4.4. Proposed Institutional Mechanisms

It is proposed to establish the following prior to commencing subproject implementation activities including pre-construction activities:

- Any person can access PIU website or office to record grievances and also write a formal letter in the name of Project Director, PIU. The person can also visit the PIU office in person and log complaints.
- The PIU Office will maintain an electronic database that will provide a summary of complaints received and action taken. The PIU Office will also provide an analysis of the grievances using a pre-designed M&E template that will give insight into the type of complaints received and qualitative and quantitative review of grievance redress (including time taken to process a complaint and complainants' satisfaction with the outcome). The PIU Office will also be responsible for uploading the actions and results for each grievance on a periodic basis to the PIU website. The grievance data will be disaggregated according to gender, income level, employment category etc. A periodic analysis of the GRM data will also be conducted by the social development specialist in the PIU to identify weaknesses in design and or implementation and highlight the need, if any, for course correction.
- Apart from the electronic database that will be maintained at the PIU level, a manual register and complaint box of all complaints and actions taken will be maintained at construction site by CC. GRM sign boards on which Compliant numbers (PIU numbers) will also be displayed at construction site.

- Grievance Focal Points (GFPs) will be chosen from local community / from educational institutions like principal of NED or DJ Science College. Two GFPs (1 male and 1 female) will be selected for the subproject area.
- The PIU and the local government bodies will issue public notices to inform the public within the project area of the Grievance Redress Mechanism. The PIU's phone number, fax, address, email address will be disseminated to the people through displays at the respective DC offices as well.
- The PIU staff will maintain a complaints database and communicate with Executing agencies, and DC offices and also with complainants for the resolution of grievances.
- The PIU officers will log complaints and date of receipt onto the complaint database and inform the ESS staff of PIU;
- PIU will coordinate with local government to "capture" complaints made directly to them;
- The PIU staff, with the help of PSC, will investigate the complaint to determine its validity, and to assess whether the source of the problem is due to project activities, and identify appropriate corrective measures. If corrective measures are necessary, PIU, through the PSC, will instruct the CC to take necessary action;
- The decision/findings of the GRC would be binding upon the contractor;
- The PIU will inform the Complainant of investigation results and the action taken;
- If complaint is transferred from local government agencies, the PIU will submit interim report to local government agencies on status of the complaint investigation and follow-up action within the time frame assigned by the above agencies;
- The PIU will review with the help of PSC, the CC response on the identified mitigation measures, and the updated situation;
- The PIU will undertake additional monitoring, as necessary, to verify as well as review that any valid reason for complaint does not recur.

Grievance Redress Committee (Grass Root level)

One Grass Root level Grievance Redress Committee will be established in which GPF of subproject, RE Engineer(s) of PSC, CC Project Manager, PIU Engineer and prominent local people will be present that will manage GRM aspects for all sub-project locations including decisions to be taken, actions and monitoring of complaints resolution at sub-project level.

Grievance Redress Committee (Departmental Level)

One Grievance Redress Committee (Departmental Level) will be established and chaired by the Project Director PIU and will include proportionate representation from local government, community representatives, civil society organizations and project team. The GRC will function as an independent body that will regulate the grievance redress process. It will comprise of, PD, ESS staff of PIU, Senior Engineers from LG/GOS, Representative of DC office South and senior members from civil society and business associations in subproject areas.

6.4.5. Procedures

The tracking and documenting of grievance resolutions will include the following elements: (i) tracking forms and procedures for gathering information from project personnel and complainant(s); (ii) dedicated staff to update the database routinely; (iii) systems with the capacity to analyze information so as to

recognize grievance patterns, identify any systemic causes of grievances, promote transparency, publicize how complaints are being handled, and periodically evaluate the overall functioning of the mechanism; (iv) processes for informing stakeholders about the status of a case; and (v) procedures to retrieve data for reporting purposes, including the periodic reports to the Contractor(s) and into the monthly ESMP Compliance monitoring report to the World Bank.

- Field level Grievances like entries in GRM register, complaints dropped in the Complaint box, will be dealt and resolved by Resident Engineer(s) of PSC by instructing CC staff and reports to GRC-grass root level. If unaddressed instantly, it will be referred to GRC-grass root level.
- The Grievance Redress Committee at the grass root level will review and identify actions to be taken to address the complaints within one week.
- If not satisfactorily resolved by the GRC-grass root level, the grievances will be referred to consideration by GRC at the Department level within one week.
- Every effort will be made to address or resolve grievances within fixed time-lines, which will be an indicator against the performance of the handling system. Acknowledgement of a written submission will be issued to the complainant within three working days. If not resolved earlier by the CC on site, grievances will be tabled for discussion/resolution during Committee meeting within one week of receipt of the written submission.
- If the complainant is not satisfied, the complaint will have the option to seek redress through court of law or go to the Mayor of Karachi.

6.5. Training, Capacity Building and Awareness Raising Requirements

To ensure the successful implementation of the environmental and social precautions and mitigation measures for the subproject, a strengthening of relevant and fundamental competencies is essential through trainings.

The objectives of the environmental and social trainings include providing basic knowledge and information on the key environmental and social issues associated with the proposed interventions to the key subproject personnel including the PIU, Contractor(s) staff and general public. Trainings of the subproject staff and project beneficiaries will be carried out for the environmental and social management of this subproject.

Project interventions like roads and utilities rehabilitation, development of sub-level parking space at Shahrah-e-Kamal, and traffic management in the subproject area will require comprehensive trainings & demonstrations for successful implementation of subproject & long-term sustainability. The environmental and social aspects identifications and mitigations integrated with the training effort will equip the subproject implementers for a keen sight of project component related environmental issues and their solutions.

Project Supervision and Contract Management Consultant (PSC) / Construction Contractor(s) (CC) will execute the training programs. PSC will also be responsible for preparing the reports for each of the trainings conducted. Additionally, Construction Contractor (CC) will be responsible to provide trainings to their field staff and workers under supervision of PSC and they will also document the trainings. The manuals and materials of capacity building, awareness raising and detailed training will be prepared by PSC / CC before the start of training program.

Different groups of participants required different type of training session like detailed trainings, capacity building or awareness raising. The requirements for the trainings for these various groups is presented in the training plan presented below, which provides the training requirements, their frequency, training responsibility for various groups. However, the list of trainings mentioned here is only indicative and subject to change as per requirements of the PSC/CC during the implementation phase.

Table 6.4: Training Plan

Training Aspects/Requirements	***Various Groups of Participants***				***Frequency***	***Training Responsibility***	***Training Budget (PKR)***
	Project Director	*PIU ESS Staff*	*Contractor(s) Staff*	*Sub-Project Beneficiaries**			
ESMP implementation	**S**				One time before commencement of construction	PSC	4-day workshop @ Rs.100,000 inc. expenses
		S			One time before commencement of construction		
			T		One time before commencement of construction		
				-	-		
Community consultations and Engagement with local communities esp. women	**S**				One time before commencement of construction	PSC	
		C			Quarterly		
			T		Quarterly		
				-	-		
GRM	**S**				One time before commencement of construction	PSC	
		T			Quarterly		
			T		Quarterly		
				A	Weekly in the first month than monthly		Handbills and pamphlets, disseminated, @ Rs.10,000 = 70,000/-
Traffic Management	**S**				One time before commencement of construction	CC	2-day workshop @ Rs.25,000 per workshop inc. expenses for 1 year = 300,000/-
		A			Monthly		
			T		Monthly		
				A	Weekly in the first month than monthly		Handbills and pamphlets

Table 6.4: Training Plan

Training Aspects/Requirements	*Various Groups of Participants*				*Frequency*	*Training Responsibility*	*Training Budget (PKR)*
	Project Director	*PIU ESS Staff*	*Contractor(s) Staff*	*Sub-Project Beneficiaries**			
							disseminated, @ Rs.5,000 = 35,000/-
Dust and Noise Abatement	**S**				One time before commencement of construction	CC	Monthly, 2-day workshop @ Rs.25,000 per workshop expenses for 1 year = 300,000/-
		A			Monthly		
			T		Monthly		
				-	-		
Best available techniques for civil works and excavation	**S**				One time before commencement of construction	CC	1-day workshop @ Rs.20,000 per workshop inc. expenses for 1 year = 80,000/-
		A			Quarterly		
			T		Quarterly		
				-	-		
Barricading construction site and excavation	**S**				One time before commencement of construction	CC	1-day workshop @ Rs.20,000 per workshop inc. expenses for 1 year = 80,000/-
		A			Quarterly		
			T		Quarterly		
				A	Quarterly		Handbills and pamphlets disseminated, @ Rs.5,000 = 20,000/-
Safe replacement of utility lines and working near utility lines	**S**				One time before commencement of construction	CC	1-day workshop @ Rs.20,000 per workshop inc. expenses for 1 year = 80,000/-
		A			Quarterly		
			T		Quarterly		
				-	-		

Table 6.4: Training Plan

Training Aspects/Requirements	***Various Groups of Participants***				***Frequency***	***Training Responsibility***	***Training Budget (PKR)***
	Project Director	*PIU ESS Staff*	*Contractor(s) Staff*	*Sub-Project Beneficiaries**			
Storage and transportation of waste material	**S**				One time before commencement of construction	CC	1-day workshop @ Rs.20,000 per workshop inc. expenses for 1 year = 80,000/-
		A			Quarterly		
			T		Quarterly		
				-	-		
Construction material storage plan and location maps	**S**				One time before commencement of construction	CC	1-day workshop @ Rs.20,000 per workshop inc. expenses for 1 year = 80,000/-
		A			Quarterly		
			T		Quarterly		
				-	-		
Provision of access to commuters	**S**				One time before commencement of construction	CC	1-day workshop @ Rs.20,000 per workshop inc. expenses for 1 year = 80,000/-
		A			Quarterly		
			T		Quarterly		
				A	Weekly in the first month than monthly		Handbills and pamphlets disseminated, @ Rs.5,000 = 35,000/-
Handling and disposal of Asbestos pipes	**A**				One time before commencement of construction	CC	1-day workshop @ Rs.100,000 per workshop inc. expenses for 1 year
		A			One time before commencement of construction and when need arise		
			T		One time before commencement of construction and when need arise		
				-	-		

Table 6.4: Training Plan

Training Aspects/Requirements	***Various Groups of Participants***				***Frequency***	***Training Responsibility***	***Training Budget (PKR)***
	Project Director	*PIU ESS Staff*	*Contractor(s) Staff*	*Sub-Project Beneficiaries**			
Storm water management	**S**				One time before commencement of construction	CC	1-day workshop @ Rs.50,000 per workshop inc. expenses for 1 year
		A			One time before commencement of construction and when need arise		
			T		One time before commencement of construction and when need arise		
				-	-		
Protection of trees	**S**				One time before commencement of construction	CC	1-day workshop @ Rs.50,000 per workshop inc. expenses for 1 year (both aspects will be covered)
		A			One time before commencement of construction and when need arise		
			A		One time before commencement of construction and when need arise		
				-	-		
Use of community Dust bins	**S**				One time before commencement of construction	CC	
		S			One time before commencement of construction		
			A		One time before commencement of construction		
				-	-		
Occupational health and safety aspects	**S**				One time before commencement of construction	CC	1-day workshop @ Rs.20,000 per workshop inc. expenses for 1 year =
		A			Quarterly		

Table 6.4: Training Plan

Training Aspects/Requirements	*Various Groups of Participants*				*Frequency*	*Training Responsibility*	*Training Budget (PKR)*
	Project Director	*PIU ESS Staff*	*Contractor(s) Staff*	*Sub-Project Beneficiaries**			
			T		Quarterly		80,000/-
				-	-		
Use of PPEs	**S**				One time before commencement of construction	CC	1-day workshop @ Rs.20,000 per workshop inc. expenses for 1 year = 80,000/-
		A			Quarterly		
			T		Quarterly		
				-	-		
Diversions and rerouting Plans	**S**				One time before commencement of construction	CC	1-day workshop @ Rs.20,000 per workshop inc. expenses for 1 year = 80,000/-
		A			Quarterly		
			T		Quarterly		
				A	Weekly in the first month than monthly		Handbills and pamphlets disseminated, @ Rs.5,000 = 35,000/-
Parking rules and planned parking location maps	**A**				One time before commencement of construction	CC	1-day workshop @ Rs.20,000 per workshop inc. expenses for 1 year = 80,000/-
		A			Quarterly		
			A		Quarterly		
				A	Weekly		Handbills and pamphlets disseminated, @ Rs.5,000 = 35,000/-
Compliance with labor laws	**S**				One time before commencement of construction	PSC	5-day workshop @ Rs.150,000 inc. expenses
		A			One time before commencement of		

Table 6.4: Training Plan

Training Aspects/Requirements	***Various Groups of Participants***				***Frequency***	***Training Responsibility***	***Training Budget (PKR)***
	Project Director	*PIU ESS Staff*	*Contractor(s) Staff*	*Sub-Project Beneficiaries**			
					construction		
			T		One time before commencement of construction		
				-	-		
Compliance with SEQS	**S**				One time before commencement of construction	PSC	
		A			One time before commencement of construction		
			T		One time before commencement of construction		
				-	-		
Ability to capture and report on environmental/social issues outlined in ESMP	**S**				One time before commencement of construction	PSC	
		C			One time before commencement of construction		
			T		One time before commencement of construction		
				-			
Ability to monitor and ensure compliance with ESMP	**A**				One time before commencement of construction	PSC	
		C			One time before commencement of construction		
			-		-		
				-	-		

Table 6.4: Training Plan

Training Aspects/Requirements	*Various Groups of Participants*				*Frequency*	*Training Responsibility*	*Training Budget (PKR)*
	Project Director	*PIU ESS Staff*	*Contractor(s) Staff*	*Sub-Project Beneficiaries**			
Ability to review environmental/social reports (Progress reports)	**S**				One time before commencement of construction	PSC	
		C			One time before commencement of construction		
			-		-		
				-	-		
Ability to monitor and supervise work	**S**				One time before commencement of construction	PSC	
		C			One time before commencement of construction		
			T		Quarterly		
				-			
Assessment of Environmental and Social Progress in accordance with ESMP	**S**				One time before commencement of construction	PSC	
		C			One time before commencement of construction		
			-		-		
				-	-		
					Total Training Budget		2,080,000/-

Legend: ***T*** *= Detailed training,* ***C*** *= Capacity-building,* ***S*** *= Sensitization to the issues,* ***A*** *= Awareness-raising*

** Including Students, teachers, transporters, neighborhood businesses and households, commuters, government servants etc.*

Chapter 7 STAKEHOLDER CONSULTATION

7.1. Context

In preparation for the ESMP, two major groups of stakeholders were identified: (i) local communities who are the direct beneficiaries of the project interventions and therefore identified as the primary stakeholders (ii) institutions who have an important role in enabling the realization of the project interventions and therefore identified as the secondary stakeholders.

This chapter provides an overview of the stakeholder consultation process that was adopted by the consultants and presents the findings of the stakeholder engagements with primary and secondary stakeholders. The key aspects, including consultation objectives, consultation tools/methodologies and stakeholders' feedback are discussed in the following sections.

7.2. Identification of Stakeholders

The major stakeholder groups involved in consultation process at ESMP stage are divided into two types:

Primary Stakeholders – Direct Beneficiaries

The subproject area is an educational and cultural hub including education institutions such as DJ Science College, NED University City Campus, SM Arts and SM Law College and Cultural buildings such as National Museum and Burns Garden and Arts Council. The people attending these institutions include students, teachers and administrative staff of colleges and a university and government servants. There are five roads included in the subproject area which are used by the people attending the above institutions, transport providers (private rickshaws and a few public buses), and pedestrians walking from the neighborhood. These people are the direct beneficiaries of the subproject interventions and considered as Primary stakeholders.

Secondary Stakeholders – Indirect Beneficiaries

There are 30-35 households living in apartments of a few buildings located along Dr. Ziauddin Ahmed Road and Strachan Road. Also, there are 25-30 shops on the ground floor of the apartments buildings located along Dr. Ziauddin Ahmed Road and Strachan Road. The households and shops are not included in subproject area, but these shops and HHs use the subproject roads for commuting. Stakeholders also include, line agencies such as K-Electric, KWSB, SSGC and PTCL and Department of Antiquities, GOS, DMC South, Hindu Community and Transport Ittehad. These stakeholders are indirect beneficiaries of the subproject interventions and considered as secondary stakeholders.

Table 7.1: Guide for Consultation – Base Matrix

Information Shared	Feedback / Comments	Actions to be taken	Design Modifications
Background information of the subproject including parking plan	Problem of parking along the streets	Adequate parking space to be provided to cater the area vehicles parking	In addition to provision of 400 cars parking at Shahrah-e-Kamal, one lane of MR Kiyani Road and Dr. Ziauddin Road is dedicated for parking
Background information of the subproject including roads cross-sections	Access of locals and pedestrians in project interventions	Adequate and continuous access to be provided during construction to all project beneficiaries	Revised road cross-sections show that the proposed development on the roads will not

			utilize the whole width of existing roads and left footpath of varying width which will be used as access.
Background information of the subproject including development of student piazzas	Security measures should be provided at all pedestrianized places and student piazzas	Security measures i.e. CCTV cameras installation and monitoring, are already included in the plan	No need for design modifications.
Background information of the subproject including subproject interventions	Project delay and long construction time	CC and PIU to follow the subproject schedule in letter and spirit. Also construction along the roads and in the excavations should be completed as fast as possible.	-
Background information of the subproject including subproject interventions	Extensive measures should be taken during excavation of Shahrah-e-Kamal	Measures devised in section 6.3.3.9 to be implemented.	Protection of excavation through different technique is included in the design.
Background information of the pedestrian crossing and signals plan	Lack of traffic signals near educational institutions	Pedestrian signal crossings to be included near the educational institutions	No need for design modifications.
Background information of the subproject including parking plan	Unavailability Parking space for the students	Adequate parking space to be provided to cater the area vehicles parking	In addition to provision of 400 cars parking at Shahrah-e-Kamal, one lane of MR Kiyani Road and Dr. Ziauddin Road is dedicated for parking
Background information of the project including rehabilitation of roads plan and stormwater drainage	Road levels should not be increased from the buildings such that the stormwater makes ingress into the buildings.	Existing road levels to be maintained with proper stromwater drainage system	Already included in the design.
Background information of the project including rehabilitation of utilities	New water lines should be laid carefully and to avoid damaging existing lines.	While working near water mains, KWSB to be taken on-board and KWSB site engineers to be present at the site to locate the water mains.	-
Background information of the project including rehabilitation of utilities	Traffic rerouting should be implemented during rehabilitation of utilities.	Traffic management and rerouting plan to be developed by CC in consultation with GoS departments.	-
Background information of the project including rehabilitation of utilities	It is most important that the KWSB to be taken on board during construction and a site engineer of KWSB will be present at all times	It is to be ensured (letter of consent / MOU to be taken) before construction that KWSB is taken onboard during rehabilitation of water and sewerage	-
Background information	Traffic congestion on	Reduction of traffic	It is included in the

of the project including rerouting plan in operation phase	roads	congestion by on-way traffic segregation	design that to separate the traffic as one-way movement on main roads

7.3. Consultation with Primary Stakeholders

For subproject area, a series of targeted consultations (interviews) as presented below were conducted with primary stakeholders. The summary of concerns of stakeholders raised during interviews is presented as follows:

Consultation with Muhammad Humayun, Principal, SM Law College – 15 September, 2017

ESMP Consultant briefed about the project interventions proposed in subproject area. The principal said that the development should be going on for the betterment of the area and the people. We are with the proposed project and present here to provide any support to the government if need be.

Consultation with Prof. Hafeez ur Rahman, Principal, & PS of the Principal Sindh Muslim Government Arts and Commerce College – 11 August, 2017

ESMP Consultant briefed about the project interventions proposed in subproject area. The Principal had an opinion that all the residential and commercial buildings must have their own parking. But now the buildings are constructed, the problem of parking existed. Regarding the development of student piazzas, the piazzas must not be closed with grills and can also be accessed by pedestrians. Also they should be monitored by CCTV cameras as to address law and order and security needs and concerns.

Consultation with Prof. Dr. Noman Ahmed, Chairman, NED University City Campus - 11 August, 2017

Dr. Noman had a view that ongoing Government of Sindh projects in the neighborhood should be linked with this project and an overall impact assessment for the whole Saddar or in fact Karachi will be assessed. ESMP Consultant explained that an ESMF has been developed for the interventions proposed under KNIP, to be implemented in select localities of Karachi.

Consultation with Prof. Shehzad Muslim Khan, Principal, D. J. Science College - 15 August, 2017

Prof. Shehzad Muslim had a view that due to the large pedestrian movement and traffic congestion in the area, people may suffer in case the project is delayed. It should therefore be completed on time and construction timeline should be limited as to lessen the time period of disturbance. He enquired about the potential impacts on the surrounding areas, if this area is uplifted and others left unattended. ESMP Consultant explained that the project will be implemented in overall Saddar and some other parts of

Karachi after completion of this subproject. He was of the opinion that extensive measures should be taken during excavation of Shahrah-e-Kamal.

Consultation with DJ College, NED University and SM Arts College Students

Targeted consultations were conducted with students (name list provided below) of educational institutions located in subproject area (dates for consultations of each institution is provided in below table) and students were asked about the problems they are facing from the current situation of the area and suggestions they may have for the project during the construction phase.

Following are the problems faced by the students:

- Damaged roads cause delays
- No traffic signal near college
- Traffic congestion
- Unavailability of seating arrangements for the students
- Unavailability Parking space
- Transportation
- Load shedding in the College

Following are the suggestions proposed by students to minimize the problems that may arise during construction phase:

- In case of route diversion of public buses, students should be informed through notices or brochure prior to implementation to avoid trouble
- Work should be carried out in phases
- Plant shady trees
- Project should be completed within the specified timeline
- Construction around educational institutes should be completed as quickly as possible
- Provide parking space for students' vehicles
- Water sprinkling to control dust pollution

S #	Name[34]	Gender	Grade	Location of Residence	Mode of Transport
DJ College			**Date of Consultation:** 15 August 2017 & 14 September 2017		
1.	Respondent 1	Male	BSc 2nd year	Soldier Bazar	Public Transport
2.	Respondent 2	Male	BSc 2nd year	Pakistan Quarters	Public Transport
3.	Respondent 3	Male	BSc 2nd year	Jacob Lines	Public Transport
4.	Respondent 4	Male	BSc 2nd year	Khudad Colony	Public Transport
5.	Respondent 5	Male	Inter 2nd year	Nazimabad	Public Transport
6.	Respondent 6	Male	Inter 2nd year	F.B. Area	Bike
7.	Respondent 7	Male	Inter 2nd year	Nazimabad	Public Transport
8.	Respondent 8	Male	Inter 2nd year	PECHS	Public Transport
9.	Respondent 9	Male	Inter 2nd year	Civil Lines	Public Transport
10.	Respondent 10	Male	Inter 2nd year	Mehran Town	Motor cycle
11.	Respondent 11	Male	Inter 2nd year	Korangi	Public Transport

[34] Names of the respondents have not been disclosed as the ESMP is a publically disclosed document.

12.	Respondent 12	Female	B.Sc. 1	Kala Pul	Public Transport
13.	Respondent 13	Female	B.Sc. 1	Orangi	Public Transport
14.	Respondent 14	Female	B.Sc. 1	Lyari	Public Transport
15.	Respondent 15	Female	B.Sc. 1	Korangi 6	Public Transport
16.	Respondent 16	Female	B.Sc. 1	Saddar	Public Transport
17.	Respondent 17	Female	B.Sc. 1	Lyari	Public Transport
18.	Respondent 18	Female	B.Sc. 1	Bihar Colony	Public Transport
19.	Respondent 19	Female	B.Sc. 1	Zainab Market	Public Transport
20.	Respondent 20	Female	B.Sc. 1	Korangi	Public Transport
21.	Respondent 21	Female	B.Sc. 2	Delhi College	Motor Bike
22.	Respondent 22	Female	B.Sc. 2	Grue Mandir	Motor Bike
23.	Respondent 23	Female	B.Sc. 1	Saddar	Motor Bike
24.	Respondent 24	Female	B.Sc. 1	Baldia Town	Public Transport
25.	Respondent 25	Female	B.Sc. 2	Punjab Colony	Public Transport
26.	Respondent 26	Female	B.Sc. 1	Liaqatabad	Public Transport
NED University			**Date of Consultation:** 10 August 2017 & 12 September 2017		
27.	Respondent 27	Male	3rd year	Saddar	Public transport/ university van
28.	Respondent 28	Male	3rd year	Lyari	Public transport/ university van
29.	Respondent 29	Male	3rd year	Jamshed Town	Public transport/ university van
30.	Respondent 30	Male	Teacher	Nazimabad	Public transport/ university van
31.	Respondent 31	Male	2nd year	Kharadar	Public transport/ university van
32.	Respondent 32	Male	2nd year	Kemari	Public transport/ university van
33.	Respondent 33	Female	2nd year	Gulshan Iqbal	Public transport/ university van
34.	Respondent 34	Female	2nd year	N Nazimabd	Public transport/ university van
35.	Respondent 35	Female	2nd year	North Karachi	Public transport/ university van
36.	Respondent 36	Female	2nd year	Garden	Public transport/ university van
37.	Respondent 37	Male	4th year	F.B.Area	Public transport/ university van
38.	Respondent 38	Female	4th year	Saforah	Public transport/ university van
39.	Respondent 39	Male	4th year	Nazimabad	Public transport/ university van
40.	Respondent 40	Female	2nd year	Defense	Public transport/ university van
SM Arts College			**Date of Consultation:** 11 August 2017 & 17 August 2017		
41.	Respondent 41	Male	B.Com Final	Baldia Town	Motor Cycle
42.	Respondent 42	Male	B.Com Final	Landi Kotal	Public Transport
43.	Respondent 43	Male	Inter 2nd year	F.B. Area	Public Transport
44.	Respondent 44	Male	Inter 2nd year	Nazimabad	Motor Cycle
45.	Respondent 45	Male	Inter 2nd year	Saddar	Public Transport
46.	Respondent 46	Male	Inter 2nd year	Saddar	Public Transport
47.	Respondent 47	Male	Inter 2nd year	Defence Phase VI	Public Transport
48.	Respondent 48	Male	Inter 2nd year	Liaqatabad	Public Transport
49.	Respondent 49	Male	Inter 2nd year	Lalukhet 10 No	Public Transport
50.	Respondent 50	Male	Inter 2nd year	Saddar	Public Transport
51.	Respondent 51	Male	Inter 2nd year	Boltan Market	Motor Cycle
52.	Respondent 52	Male	Inter 2nd year	Railway Colony	Public Transport
53.	Respondent 53	Male	Inter 2nd year	Jubilee Chowk	Public Transport
54.	Respondent 54	Male	Inter 2nd year	Dhobi Ghat	Public Transport
SM Law College			**Date of Consultation:** 15 September 2017		
55.	Respondent 55	Male	LLB 2nd year	Korangi Crossing	Motor Cycle
56.	Respondent 56	Male	Final year	Garden	Motor Cycle
57.	Respondent 57	Male	LLB 2nd year	Sindhi Muslim Society	Public Transport
58.	Respondent 58	Female	LLM 1st year	Saddar	Public Transport
59.	Respondent 59	Male	LLM 1st year	Lyari	Public Transport
60.	Respondent 60	Male	LLB 2nd year	Gulshan	Public Transport
61.	Respondent 61	Female	LLB 2nd year	Korangi	Public Transport
62.	Respondent 62	Female	LLB 2nd year	Jamshed Town	Public transport
63.	Respondent 63	Female	LLM 1st year	Korangi Creek	Own Car

64.	Respondent 64	Female	LLM 2nd year	Korangi Creek	Own Car
65.	Respondent 65	Female	LLM 2nd year	Defense	Own Car








Consultation Sessions with Students

Consultation Session with DJ Science College – 12 January, 2017

A consultation session was arranged by Design Consultant at DJ College Conference Hall focusing Saddar area generally and subproject area interventions specifically. Following participants were participated in the session:

- Shahzad Muslim Khan (Principal -DJ Science College)
- Tahira Maqbol (Professor- DJ Science College).
- Munir Alam (Asst Professor- DJ Science College)
- Prof.Iqbal (Professor- DJ Science College)
- Tariq Ahmed Rind (G.M Technical-CG)
- Ahmed Ali Memon (Town Planner- CG)

- Saba Baig (Architect –CG)
- Ahsan Rao (Planning Engineer- CG)
- Faculty of DJ Science College …… 06 Members
- Students of DJ Science College ……50 Students

Discussion Points

Students described that they face problems like parking issues, no proper disposal system within the area etc. Traffic management, organizing parking, possible interventions such as enforcement of parking fee collection, adding cycling lanes, leveraging on municipal car parking structures could be option to cater the needs.

Almost every participant present in the Conference hall was touched that the idea should be focused for its present users who are mostly the Students but it can further be extended for tourists and others interested in socializing, cultural diversity, entertainment, and recreation etc.

Furthermore the students recommended the need of green areas, pedestrian friendly streets, increasing motivation for walkability, re-routing should be considered, existing vehicular patterns to be looked.

Almost all students agreed that the area be revived in accordance to its past glory which was dominated by its cultural diversity and intermixing of activities.

Principal DJ Science College then spread light over several issues like Traffic hazards faced by students, lack of organized open spaces, Unavailability of basic facilities like washroom, drinkable water, auditorium and other facilities to regard student facilitation.

Consultation Session with NED University – 24 November, 2016

A consultation session was arranged by Design Consultant at NED (DAP) Conference Hall focusing Saddar area generally and subproject area interventions specifically. Following participants were participated in the session:

- Jaffer Sadok Fria (Program Leader- WB)
- Dr. Noman Ahmed (Chairman- NED (DAP)
- Anila Naeem (Professor NED (DAP, Head of heritage cell)

- Mumtaz Halepoto (Director, Urban Policy & Strategic planning Government of Sindh)
- Farhan Anwar (Urban planner, Executive Director Sustainable Initiatives/World Bank Consultant)
- Muhammad Faiz Kidwai (Partner -CG)
- Hafeez Habibi (Partner- CG)
- Tariq Ahmed Rind (G.M Technical-CG)
- Saba Baig (Architect –CG)
- Faculty of NED(DAP)……. 20 Members
- Students of NED (DAP)……...50 Students

Discussion Points

- Students actively responded to the thought, they discussed how they feel walkability of the area should be improved, through proper infrastructure and making eco-friendly environment.
- Most participants felt that we are losing the character of old town and some action be initiated to not just preserve them but also for their adaptive reuse and sustainably.
- The discussion was made on how to knit destinations of public visitation in a manner that promotes improved public access and through facilitating patterns of circulation that are pedestrian in nature rather than motorized.
- Dr. Noman Ahmed in few words comprehensively described the historical background of Pakistan Chowk.

Focus Group Discussion with Women (Primary Stakeholders) – 17 March, 2017

A gender responsive consultation session was arranged by Design Consultant at Arts Council. About 100 participants were participated including students and faculty members of D.J Science College, N.E.D University, and Women of Arts Council. The presentation on design proposal of subproject was presented by Architect Saba Baig of Consultants Group (CG).

Several aspects were highlighted which are defined as under:

- Freedom of movement, with no restriction shall be basic parameter
- Women were concerned for the public facilities, which to them was made ensured through design proposal

- Control points within the area, was another point of concern, where audience suggested behavioral control should be ensured in order to provide a healthy environment.
- Audience were amazed by the vision and the proposal, but showed concern for implementation of such ambitious projects, based on their past experiences
- Faculty members of reputed institutes raised questions as to how will the students commute as a result of the traffic re-routing plan since most of the students use public transport. To which the presenter confirmed that the point is already incorporated in design and facilities like bus stops and proper drop offs are designed to accommodate them.
- Audience appreciated the idea of crosswalks and pedestrian crossing, as well as reducing the vehicular movement area and increasing pedestrian movement zone. They cherished the idea of pedestrian centric approach.
- Assuring the sustainability of such design was questioned to which architect assured that the plan for its sustenance is being made.
- Absence of Proper system for garbage disposal was concern, to which audience asked whether such improvements are part of proposal or not. In response to it architect elaborated the services that are part of the proposal and ensured that they have been taken care of.

Consultation with Government Servants, Teachers and education centers staff

Consultation team met male and female teachers and staff (on the dates as mentioned below) of DJ College, SM Law and SM Arts College as well as Government servants of National Museum and local council and briefed them about the project. They were already aware of the proposed project and pointed out the following problems facing by them in that area:

- Cleanliness issue and presence of no dust bin
- Transportation facilities are limited
- No bus stops
- No sweeping on the roads on regular interval
- No parks and sitting areas
- Poor lighting on roads
- No Parking space

The Staff suggested to cater the above problems in the design of the project.

Mr. Mehmood, Mr. Rafique and Mr. Noor (**KMC Charged Parking Employees, DMC South)** has been consulted and briefed about the project. They said that the parking is managed by DMC South and if the government wants a development here, they will do it as DMCs are also working under GOS. We have no issues regarding the development as it should happen for the betterment of the area.

Following tables presents list of staff and government servants consulted:

National Museum Staff – 11 & 13 September, 2017

S No.	Name[35]	Gender	Designation
1	Respondent 1	Female	Assistant Curator
2	Respondent 2	Female	Assistant Curator
3	Respondent 3	Female	Admin Office
4	Respondent 4	Male	Production Officer
5	Respondent 5	Male	Electrician

Arts Council Staff – 12 September, 2017

S No.	Name[36]	Gender	Designation
1	Respondent 1	Female	Project Officer
2	Respondent 2	Female	Program Executive

[35] Names of the respondents have not been disclosed as the ESMP is a publically disclosed document.
[36] Ibid.

DJ Science College Staff – 14 September, 2017

S No.	Name[37]	Gender	Designation
1	Respondent 1	Female	Teacher
2	Respondent 2	Female	Teacher
3	Respondent 3	Female	Teacher
4	Respondent 4	Female	Teacher
5	Respondent 5	Male	Lab Assistant
6	Respondent 6	Male	Naib Qasid
7	Respondent 7	Male	Canteen Owner

SM Law College Staff - 15 September, 2017

S No.	Name	Designation
1	Muhammad Humaiyun	Principal
2	M. Sarfaraz	Library Incharge

[37] Ibid.

Local Government Servants – 11 August, 2017

S No.	Name[38]	Designation
1	Respondent 1	Charged Parking DMC Employee
2	Respondent 2	Charged Parking DMC Employee
3	Respondent 3	Charged Parking DMC Employee
4	Mr. Majid Gaddi	Union Councilor

Consultation with Transporters (Local Bus Service) and other mode of transport – 16 September, 2017 & 11 September, 2017

ESMP Consultant briefed the drivers and transport manager about the subproject area and interventions proposed. He also briefed that roads in subproject area will become one way and during construction, one lane of the roads will be closed for traffic for construction. The transporters have supported the proposed project as the existing situation is worse due to traffic jams and congestion on the road. They were of the view that roads should be one way as the existing two way roads get chocked at places where roads are damaged. Transporters, while providing feedback during interview, facing problems in the area includes damaged roads causing traffic jams, poor sewerage system at some locations which accumulates sewage on the roads etc. Following table provides the list of transporters consulted.

[38] Ibid.

S. No	Name[39]	Gender	Occupation	Residence
1	Respondent 1	Male	Bus Driver	Garhi Khuda Bux
2	Respondent 2	Male	Bus Driver	Garhi Khuda Bux
3	Respondent 3	Male	Bus Driver	Liaquatabad
4	Respondent 4	Male	Bus Driver	Orangi Town
5	Respondent 5	Male	Bus Driver	Orangi Town
6	Respondent 6	Male	Rickshaw Driver	Qayyumabad
7	Respondent 7	Male	Rickshaw Driver	Jacob Lines
8	Respondent 8	Male	Rickshaw Driver	Meetha Dar

[39] Ibid.

7.4. Consultation with Secondary Stakeholders

Consultation with Mr. Shafi Muhammad Shah, Special Secretary, Department of Antiquities, GOS

ESMP Consultant briefed the Sp. Sectary and his team about the subproject area and interventions proposed. Sp. Sectary who is responsible for implementation of Sindh Cultural Heritage Act said that there are few protected antiquities located in the project area like DJ Science College. The Sp. Sectary emphasized that however, the project interventions are outside the boundaries of protected antiquities, special care must be taken during construction phase that the protected sites must not be affected and also there should be no intrusion into the protected antiquities. Coordination with Antiquities department should be maintained by the developer during construction phase.

Consultation with Hindu Community Representative

Issues highlighted by representative of Hindu Community residing in the neighborhood are, a) road levels should not be increased from the buildings such that the stormwater makes ingress into the buildings, b) The drainage system in Saddar is 30-40 years old and the lines should be revived and it will be make sure that the revived system should be sustained for 10-15 years and an MOU may be signed with the line agencies, c) old heritage building façade should be addressed and included in the project components.

Consultation with Mr. Ijaz Kazmi, Project Director, KWSB

Mr. Kazmi told that the project interventions should be planned based on the prepared ESMP and all mitigation measures will be taken. New water lines should be laid carefully and to avoid damaging existing lines. Traffic rerouting should be implemented during rehabilitation of utilities. It is most important that the KWSB to be taken on board during construction and a site engineer of KWSB will be present at all times.

Consultation with Transport Ittehad

A targeted consultation with Mr. Irshad Hussain Bukhari, President of Karachi Transport Association (Transport Ittehad) and its team was conducted by Design Consultant. Mr. Irshad emphasized that the development should be done and after developing the subproject area, the traffic congestion of the area will be eliminated. The area lacks road infrastructure like proper bus stops and pedestrian crossings that should be included in the design.


Consultation with Pakistan Telecommunication Company Limited (PTCL)

A targeted consultation with Mr Riaz Ahmed Soomro, Senior Business Manager / Director PTCL and its team was conducted by Design Consultant. The documents related to existing infrastructure will be shared with both teams and coordination support will be provided by PTCL during construction phase.

Consultation with K-Electric

A targeted consultation with Ashfaque Ahmed (Transmission Manager, KE) and Ghullam Hussain Mallah (IBC Saddar Manager, KE) was conducted by Design Consultant. The documents related to existing infrastructure will be shared with both teams and coordination support will be provided by KE during construction phase.


Consultation with Karachi Water and Sewerage Board (KWSB)

A targeted consultation with Mr, Nadeem (AE, KW&SB) was conducted by Design Consultant. The documents related to existing infrastructure will be shared with both teams and coordination support will be provided by KWSB during construction phase.

Consultation with Sui Southern Gas Company (SSGC)

A targeted consultation with Nadeem Qayyum (DGM (DIST) East and his team was conducted by Design Consultant. The documents related to existing infrastructure will be shared with both teams and coordination support will be provided by SSGC during construction phase.

Consultation with Local Communities and Businesses

Local communities, students and businesses are the direct beneficiaries of Educational and Cultural Zone (Priority Phase – I) Subproject. Community / students / businesses perceptions of the expected outcomes and the implementation process are necessary ingredients for ascertaining project success and adjustments to planned interventions. Moreover, organized community groups have an important role in promoting the program concepts and monitoring project activities at the local level.

Consultations with communities/students/businesses were carried out in line with the following objectives:

- Inform the local communities/students/businesses of the project concepts and planned project interventions
- Ascertain the communities/students/businesses perceptions of the project concepts and planned project interventions
- Identification of potential positive and negative social and environmental impacts

Consultations were conducted in subproject area with residents (16 no. of samples in the neighborhood), businesses (general shopkeepers of printing press, hardware, merchants, grocery stores, banks etc.) (14 no. of samples in the neighborhood) located outside the boundary of the subproject area. The consultations were conducted on 1st August and 15th August, 2017.

100% of the respondents were not satisfied with the current situation of utilities, traffic, garbage and sewerage, no street lights, accidents due to open manholes and damaged roads and infrastructure in their areas and it caused major nuisance as well as health issues.

Consultation with women living in the HH revealed that traffic congestion, flowing manholes of sewerage, absence of road crossings etc. are the main problems faced by women in the neighborhood.

Most of the respondents had positive views of the proposed project interventions but they said that planning for road improvements and taking view from the public had been done several times in the past but there is no improvement on ground till to date and people suffer continuously. 90% of the respondents envisaged that the problems of the area will be resolved after this project.

90% of the respondents agreed with the idea that if the cars parked at roadside moved to Shahrah-e-Kamal basement parking. They said that it will improve the traffic situation on the roads. The remaining 10% respondents said they would prefer to park besides the roads. They preferred to park near their shops on the road.

100% of the respondents will cope the disturbance created during construction phase. However, some of them suggest the dust mitigation measures to be taken like water spraying.

100% of the respondents were in favor of two minor roads to be vehicle free and respondents who owns vehicles will use the proposed car parking if the fares are reasonable. Some said due to the distance, they will park cars nearby.

100% of the respondents were in favor of underground electric wires and utilities. Almost all of them were willing to accept temporary disruption of services during the construction phase in view of the long term benefits associated with the project.

About the temporary disruption of businesses during construction, 90% of businesses said they can comprehend that some of the area would be excavated as it was done several times in the past. But they would be fine with temporary disruption if they could reap the benefits of the improvement of roads and utilities in long term.

Most of the respondents suggest that the project should be completed within the defined timeframe and delays usually aggravate the problems.

Generally, respondents had positive views for the proposed project interventions and they hoped that his time something could be seen improving, as compared with the previous unfulfilled promises and futile surveys and consultations. Benefits envisaged by the respondents are as follows:

- One way roads are good for traffic maneuvering
- The drainage and sewerage of the area will be improved
- Traffic jams will be eliminated
- Piazzas will provide spaces for recreation for residents
- Overall positive impact to the area residents and businesses

The pictorial evidence of Consultations is presented hereunder.

7.5. Disclosure of subprojects Information

The sub-project ESMP will be uploaded on the project websites, hard copies shall be sent to all institutional stakeholders and all KMC / DMC offices. The sub-project ESMP will be disclosed internally within the Bank. Before start of physical works on the subproject, the sub-project ESMP executive summary will be translated in local languages and communicated to all primary stakeholder including students, transporters, government servants, communities/ businesses in the neighborhood and will be uploaded on the PIU website - http://www.urbandirectorate.gos.pk/ or P&D website. The subproject specific RAPs/ARAPs will also be disclosed and available on abovementioned PIU website.

7.6. Consultation Plan

The stakeholder consultation is a continuous process, and should be carried out throughout the life of project. The consultations carried out during the present ESMP stage and reported are essentially among the initial steps in this process. During the subsequent project phases as well, participation of the project stakeholders need to be ensured. Table 7.1 charts out the proposed consultation plan during different project phases.

Table 7.2: Consultation Plan

Project Stage	Stakeholders	Consultation Tools	Responsibility	Frequency and location
Project Inception	Institutional Stakeholders incuding implementation partners: PIU/ESS Staff, Line agencies, LG, KMC, NGOs	Inception Workshop for: • Discussion on Implementation Plan • Finalization of roles and responsibilities for implementation partners • Finalization of Documentation, M&E, Reporting requirements	ERU in association with PSC	One time only at PIU office
	Target Communities (including representation from women and vulnerable groups where relevant)	Focus Group Discussions at both road sites: • Information disclosure using background information document and Implementation Plan • Community Feedback regarding Implementation Plan, including role of PIU and LG departments, GRM, Institutional Coordination, and M&E	ERU in association with PSC	01 FGDs in each subproject road (i.e. 05 FGDs)
Project implementation	Contractor(s) and Line Agencies	Project Launching Workshop providing all relevant project details as per WB's information disclosure requirements	ERU in association with PSC	One time only at PIU office
	Beneficiaries and field-level implementation teams	Weekly local-level monitoring and reporting of field-level activities using pre-designed monitoring templates	ERU in association with PSC	Weekly at construction site
	Beneficiaries and field-level implementation teams	Bi-monthly DMC-level monitoring and reporting for compliance of ESMP and environmental and social issues identified through GRM procedures	ERU in association with PSC	Bi-monthly at local government / KMC office

Chapter 8 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

The subproject-specific mitigation plan prepared on the basis of impact assessment discussed in the previous section is presented in Table 8.1. This subproject ESMP shall form part of the project contract specifications.

8.1. Environmental Management and Monitoring Plan

The Table 8.1 environmental mitigation and monitoring plan during the design phase and Table 8.2 presents mitigation measures of each environmental effects and monitoring parameters with responsibilities defined separately for each aspect during the construction phase.

Table 8.1: Environmental Mitigation and Monitoring Plan during Design Stage

S#	Environmental Effect A	Potential Significance B	Pre-Construction Mitigation Measure(s) C	Mitigation Responsibility D	Monitoring Parameters / Location E	Monitoring Responsibility G
1.	Impact on PCRs during construction	Medium	✓ Ensure that PCRs are excluded from the project and not including in the technical drawings	PSC	Tender documents	PIU
2.	Preference for construction material that don't contain hazardous (asbestos) materials	Medium	✓ Include provision in the bidding document that discourage use of hazardous construction materials especially asbestos	PSC	Tender documents	PIU
3.	Preparation of site specific plans	Medium	✓ Contractor to prepare site specific plans. These plans would include site specific ESMP, traffic diversion plan and any other necessary for implementation of this ESMP	CC	Site specific plans	PSC/PIU
4.	Compliance with Pakistani environmental regulations and WB safeguard policies and EHS guidelines	Medium	✓ This ESMP to be made part of the bidding/tender documents ✓ The bid documents shall note that Pakistani laws and regulations and WB EHS guidelines relating to the environment, labor and working conditions, health and safety, gender equality, and child protection, will be followed during the construction phase.	PSC	Tender documents	PSC/PIU

Table 8.2: Environmental Mitigation and Monitoring Plan during construction phase

S#	Environmental Effect A	Potential Significance B	Mitigation Measure(s) C	Mitigation Responsibility D	Monitoring Parameters / Location E	Monitoring Frequency F	Monitoring Responsibility G	Cost and Source of Funds H
5.	Impact on PCRs during construction	Medium	✓Intrusion into PCRs will not take place as project interventions are outside of the PCR limits. ✓A guideline for protection of PCRs for the subproject is provided in **Annex C**. **Annex C** also includes "Chance Find" procedures for protection of cultural property and bidding documents for Contractors will include "Chance Find" procedures.	CC	Construction near PCRs	Weekly certification by PSC that intrusion into PCRs is not taken place and as per Chance Find procedures	PSC	Nil
6.	Air Quality deterioration due to dust and exhaust emissions	Medium	✓PVC Laminated Polyester Fireproof Mesh Sheet (with small mesh size) which is easily available in the local market should be installed atleast 8-10 ft. in height from existing ground level to contain dust inside the construction site. This barrier can be added over a hard barricade for the construction site and if provided in double layers with a gap of about 1 inch can reduce the noise substantially. It is estimated that 5.6 km long sheet will be require. However, work on all areas of subproject shall not be underway at once and will be planned as per detailed construction plan.	CC	Check the adequacy and integrity of barricade and mesh sheet.	Daily	PSC	Cost of barricade and PVC laminated sheets will be included in Contractual Cost borne by Contractor and will be assessed after finalization of construction plan
			✓The exposure of construction workers to dust should be minimized by provision of dust masks and mandating the workers to wear them. ✓Truck loads should be covered with tarpaulin. ✓Construction site including soil and material piles at the site should be barricaded to avoid material escape, generation of dust. ✓Ready-mix can be used in the stages of the project wherever and whenever required and deemed appropriate. ✓Road construction operations should be carefully planned and scheduled and when the traffic movement is minimal e.g. early morning.	CC	Ambient Air Quality parameters (SPM, NO, NO2, SO2, PM10, CO, PM2.5) – Mobile air quality Van will be used. Vehicular Emissions for Construction Vehicles (Smoke, CO, NOx, PM,	Initially fortnightly and when found within limits to quarterly	PSC	Cost of PPE, water spraying, vehicles tuning will be included in Contractual Cost borne by Contractor and will be assessed after finalization of construction plan Rs.35,000 for

Table 8.2: Environmental Mitigation and Monitoring Plan during construction phase

S#	Environmental Effect A	Potential Significance B	Mitigation Measure(s) C	Mitigation Responsibility D	Monitoring Parameters / Location E	Monitoring Frequency F	Monitoring Responsibility G	Cost and Source of Funds H
			✓Careful handling and working under moist conditions and monsoon season will be avoided as much as possible. ✓Construction machinery, vehicles should be properly tuned and kept in good working condition, minimizing exhaust and vehicular emissions. It should be ensured that exhausts from these equipment and vehicles comply with relevant SEQS. ✓Excessive engine idling should be discouraged and machinery causing excessive pollution (i.e. visible clouds of smoke) should be banned from sites. ✓Open burning of solid wastes, whether hazardous or nonhazardous, is not considered good practice and should be avoided, as the generation of polluting emissions from this type of source cannot be controlled effectively.		Noise) – Mobile exhaust analyzers will be used. Monitoring conducted as per SEQS. The location of air quality monitoring is presented below location plan.			8hr ambient air monitoring per location, as per column F Rs.10,000 per vehicle for vehicular emission monitoring, as per column F
			✓Use of water suppression for control of loose materials on paved or unpaved road surfaces. Oil and oil by-products is not a recommended method to control road dust. ✓Water should be sprinkled daily or whenever there is dust problem on all exposed surfaces to suppress emission of dust.	CC	Monitor Dust emissions (SPM) Monitoring conducted as per SEQS.	Daily, if required	PSC	Water sprinkling cost is included in Contractual Cost borne by Contractor and will be assessed after finalization of construction plan
7.	Traffic management	Medium	✓Subproject roads within the subproject area will be used for parking of project/construction vehicles. For development of underground parking at Shahrah-e-Kamal and Student Piazza at DJ Science College, portion of Burns Road	CC	Designated parking spaces	Weekly	PSC	Nil

Table 8.2: Environmental Mitigation and Monitoring Plan during construction phase

S#	Environmental Effect A	Potential Significance B	Mitigation Measure(s) C	Mitigation Responsibility D	Monitoring Parameters / Location E	Monitoring Frequency F	Monitoring Responsibility G	Cost and Source of Funds H
			(Muhammad Bin Qasim Road) behind SM Arts college will be used. Also one lane of each subproject roads will be rehabilitated and the other lane will be used for parking of construction vehicles.					
			✓ Traffic management plan will be introduced in consultation with the relevant GoS departments to manage smooth flow of vehicular traffic and to avoid traffic jam and long queues. ✓ Traffic management plan will also cater the pedestrian movement. ✓ Sign postings, warning signs, diversion signs and barriers will be installed to alert public of all potential hazards including limited access to construction sites. ✓ It is suggested that the work on connecting roads should not be done consecutively e.g. the development of underground parking at Shahrah-e-Kamal shall not be started with work along Strachen road or Dr. Ziauddin Ahmed Road. ✓ Movement of construction material to the project sites should be planned in that way it will not hampered major transport activity e.g. material may be transported at night time or early in the morning when the local trips are minimum. However care must be taken at locations where residents are located and the transfer of material should not be happened during sleeping hours.	CC	Flow of routine traffic	Daily	PSC	Cost of sign postings and diversion aids will be included in Contractual Cost borne by Contractor and will be assessed after finalization traffic management plan
			✓ Ensure safe and continuous access to all shops and residences during construction It is suggested that interventions that involves traffic management like provision of parking spaces, designated parking, prioritization of roads for	CC	-	Before / during Implementation of Project activities	PSC	Nil

Table 8.2: Environmental Mitigation and Monitoring Plan during construction phase

S#	Environmental Effect A	Potential Significance B	Mitigation Measure(s) C	Mitigation Responsibility D	Monitoring Parameters / Location E	Monitoring Frequency F	Monitoring Responsibility G	Cost and Source of Funds H
			pedestrian only should be implemented first to avoid traffic congestion while civil works on roads.					
8.	Storm water drainage	Low	✓The existing main storm drainage line passing in between the Burns Garden (outside the boundary of Burns Garden as presented in figure 6.8) and Arts council will be cleaned before the start of rehabilitation of roads. ✓The clearing of drain line will be done by removing the concrete slabs cover and cleaning via back hoe loader and transferred the garbage into the dump trucks. The dump truck will then transfer this garbage to Jam Chakro Landfill site as it contains simply the municipal waste.	CC	Cleaning of drain and transportation of garbage removed from the drain	Before rehabilitation of roads	PSC	Cost of cleaning of main drain will be included in Contractual Cost borne by Contractor and will be assessed after finalization of construction plan
			✓Awareness programs for the public will be initiated to avoid throwing of garbage in the main and proposed stormwater drains during construction and operations. ✓Sign post will also be applied over the drains to disseminate the information.	CC	Sign post placement and dissemination of knowledge	Quarterly and spot checks	PSC	Nil
			✓Strom water channels/side drains along subproject roads as included in the design should be constructed earlier to reduce flooding. ✓The main storm drainage line should be checked for any blockage and keep cleared if any blockage occurs immediately during construction activities. ✓Waste and soil pile should be barricaded and covered with tarpaulin to avoid erosion from storm water and clogging of existing drains.	CC	Check construction plans, check any obstruction in existing drains due to construction	Quarterly and spot checks	PSC	Nil
9.	Excavation at Shahrah-e-Kamal		✓ Excavation pit will be equipped with guard rails with warning signage to avoid falling of construction crew as well. ✓ The excavation pit will also be protected with	CC	Sign post placement, Checking the	Daily	PSC	Cost of guardrails, shoring protection /

Table 8.2: Environmental Mitigation and Monitoring Plan during construction phase

S#	Environmental Effect A	Potential Significance B	Mitigation Measure(s) C	Mitigation Responsibility D	Monitoring Parameters / Location E	Monitoring Frequency F	Monitoring Responsibility G	Cost and Source of Funds H
			shoring protection or if recommended by PSC structural engineer, protected by a retaining wall. The excavated soil will be temporarily stored at Muhammad Bin Qasim road away from the pit before disposal. ✓ Regarding the utility lines, all utility agencies will be taken onboard before construction to locate any existing utilities and provide suggestion for their protection. ✓ Digging will be done manually to locate the exact position of buried utilities and thereafter use of mechanical means. ✓ Suitable size of dewatering pump will be installed if groundwater found during excavation or rainwater ingression. The water will be discharge into the existing stormwater drains. ✓ Atleast 2m distance will be maintain for vehicles to operate near the excavation pit.		adequacy of guard rails, shoring protection and / or retaining wall Checking of coordination with utility agencies and presence in the meeting with the agencies before excavation Check dewatering operations and water disposal into the drains			retaining walls will be included in Contractual Cost borne by Contractor and will be assessed after finalization of construction plan
10.	Surface and Ground Water Quality deterioration due to spills from construction equipment, fuel, inadequate disposal of waste material, removal of pole mounted oil filled transformers	Low	✓Excavation material /civil works related solid waste should be disposed to KMC Jam Chakro Landfill site. ✓There will be no labor camp for residing the workers as local labor will be hired. Only Porta cabins of Resident Engineers and PSC staff will be provided that will also serves as the shelter for labor during construction and provision of water. Therefore no generation of wastewater will be envisaged.	CC	Check surface/ground water quality parameters (pH, TDS, TSS, Oil & Grease, Turbidity, Total Hardness, As, Pb, Coliform) – Grab samples will be taken and samples tested as per SEQS in EPA certified Laboratory	Quarterly	PSC	Waste disposal cost is included in Contractual Cost borne by Contractor and will be assessed after finalization of construction plan Rs.20,000 per grab sample for water quality analysis, as per

Table 8.2: Environmental Mitigation and Monitoring Plan during construction phase

S#	Environmental Effect A	Potential Significance B	Mitigation Measure(s) C	Mitigation Responsibility D	Monitoring Parameters / Location E	Monitoring Frequency F	Monitoring Responsibility G	Cost and Source of Funds H
								column F
			✓Coordination with KE should be kept during the removal of transformers and an HDPE lining sheet must be put beneath the transformer mounted poles to avoid soil contamination. ✓Use of PPE (impermeable gloves, eye protection and apron/coverall) while handling, transporting and storage of transformers will be made mandatory.	CC	Placement of HDPE lining, use of PPE and coordination with KE	At time of removal of transformers	PSC	HDPE lining cost is included in Contractual Cost borne by Contractor
			✓It will be ensured that the wastes generated from construction activities should be stored in a proper interim location onsite which should be adequately barricaded and covered to avoid ingress of storm water. The location of onsite waste storage site will be selected by PSC as per detailed construction plan.	CC	On-site waste collection facility	Weekly	PSC	Nil
11.	Waste Management during construction	Low	✓Construction sites should be equipped with temporary refuse bins.	CC	Temporary refuse bins/On-site waste collection facility	Weekly	PSC	Included in Contractual Cost borne by Contractor
			✓A waste management plan will be prepared for construction phase and implemented in letter and spirit. ✓The existing wearing and base course scrap can be reused in sub-base course of the new roads or disposed at KMC Jam Chakro Landfill site via tarpaulin covered dump trucks. ✓Empty drums of bituminous material as well as bituminous material itself will be reused as far as possible, recycled back to the asphalt mixer or ultimately disposed at KMC Jam Chakro Landfill site. ✓Also Asbestos cement pipes, if discovered from	CC	As per Waste management plan prepared by contractor and approved by PIU/PSC	Monthly	PSC	Nil

Table 8.2: Environmental Mitigation and Monitoring Plan during construction phase

S#	Environmental Effect A	Potential Significance B	Mitigation Measure(s) C	Mitigation Responsibility D	Monitoring Parameters / Location E	Monitoring Frequency F	Monitoring Responsibility G	Cost and Source of Funds H
			rehabilitation of KWSB network, will be handled and disposed via EPA certified contractor. ✓ Recycling of solid waste will be carried out as far as possible and practical like cement bags, steel scaffoldings, empty drums, wood planks, discarded bricks etc. ✓ No wastes should be dumped at any location outside the site boundary/designated disposal site.					
			✓ All hazardous waste if found shall be segregated from nonhazardous wastes at the point of generation of waste. ✓ CC will suggest/recommend recycling of the paper, glass, plastic wastes in their respective processing units.	CC	As per Waste management plan prepared by contractor and approved by PIU/PSC	Monthly	PSC	Nil
			✓ Training should be provided to working personnel for identification, segregation, and management of waste.	CC	Check training reports and records	Quarterly	PSC	Quarterly, 2-day workshop @ Rs.12,000 per workshop inc. expenses
\	Possible Noise emissions from running of construction machinery	Medium	✓ PVC Laminated Polyester Fireproof Mesh Sheet as discussed in the earlier section will be used with hard barricade to reduce the noise levels and check the noise levels outside the barricade periodically for different type of construction activity through a hand held noise meter. If the noise levels exceeds the SEQS levels, construction activity should be halted and the Polyester sheets will be replaced with noise deflectors / acoustic barriers.	CC	Check the adequacy and integrity of noise barriers and mesh sheets while monitor noise levels as per SEQS.	Daily	PSC	Cost of acoustic barriers and PVC laminated sheets will be included in Contractual Cost borne by Contractor and will be assessed after finalization sub-project plans
			✓ Machinery operation and high noise activities should be carefully planned and scheduled.	CC	Ambient Noise Monitoring	Fortnightly	PSC	Rs.10,000 for 8hr ambient

Table 8.2: Environmental Mitigation and Monitoring Plan during construction phase

S#	Environmental Effect A	Potential Significance B	Mitigation Measure(s) C	Mitigation Responsibility D	Monitoring Parameters / Location E	Monitoring Frequency F	Monitoring Responsibility G	Cost and Source of Funds H
					(dB(A)) as per SEQS near residents and businesses – Handheld noise meter will be used for measurement The location of noise monitoring is presented below location plan.			noise monitoring per location, as per column F
			✓Mufflers or silencers should be used by project-related vehicles.	CC	Noise emissions of construction vehicles as per SEQS	Fortnightly	PSC	Included in Contractual Cost borne by Contractor
			✓High noise activities should cease between 22:00 and 06:00 hrs.	CC	Check working hours	Initially daily and if found within limits than it can be reduced to monthly and even quarterly	PSC	Nil
12.	Soil Contamination due to fuel spills or ponding of water or degradation due to activities	Low	✓Fuel oils and lubricants for construction machinery will be stored in covered diked areas, underlain with HDPE membrane. ✓Washing and maintenance of vehicles will be restricted onsite and contractor is mandated to get entry of well-maintained and cleaned machinery. ✓Regular inspections will be carried out to detect leakages in construction vehicles and equipment. ✓Appropriate implements such as shovels, plastic bags and absorbent materials will be made	CC	Inspection of Fuel and lubricant storage areas, construction site and project vehicle parking areas	Daily	PSC	Inspection cost and HDPE lining cost is included in Contractual Cost borne by Contractor and will be assessed after finalization of construction

Table 8.2: Environmental Mitigation and Monitoring Plan during construction phase

S#	Environmental Effect A	Potential Significance B	Mitigation Measure(s) C	Mitigation Responsibility D	Monitoring Parameters / Location E	Monitoring Frequency F	Monitoring Responsibility G	Cost and Source of Funds H
			available near fuel and oil storage areas for removal of oil and contaminated soil.					plan
13.	Impacts on Flora / clearing of trees due to project interventions	Low	✓ Damage to trees will be avoided and trees located along roadside will be protected during construction. ✓ There are 84 mature trees located in year 1 subproject roads as mentioned in chapter 4 and these trees will be marked and cordoned off with fencing and their roots will be protected. All the works along the roads on footpaths will be done outside these tree fences. ✓ The tree plantation plan should include the plantation of native trees and *Conocarpus* specie must be avoided.	CC	Inventory for the identification of road side trees, Tree monitoring	Weekly	PSC	Nil
14.	Contamination of water supply due to damage to water mains		✓ While working near water mains, KWSB will be taken on-board and KWSB site engineers will be present at the site to locate the water mains. ✓ Water supply should be cut down while rehabilitation and connecting of new water supply lines to water mains as well as working near the water mains. ✓ If water mains get damaged, it should be repaired without delay and as per KWSB practices.	CC	Check random sampling for water quality parameters at outlets of water mains (pH, TDS, TSS, Oil & Grease, Turbidity, Total Hardness, Coliform) – Grab samples will be taken and samples tested as per SEQS in EPA certified Laboratory	While working near water mains and rehabilitation of water supply system	PSC	Rs.20,000 per grab sample for water quality analysis, as per column F
15.	Exposure to asbestos fibers during removal or fixing of sewerage and water cement pipes	High	✓ Define clear asbestos area access regulations. ✓ Only trained personal use protective clothing and appropriate respirators to handle cement pipes containing asbestos. Respirators should be approved for protection against airborne asbestos.	CC	Air surveillance/ monitoring around work areas where asbestos is being removed	Daily	PSC	Included in Contractual Cost borne by Contractor

Table 8.2: Environmental Mitigation and Monitoring Plan during construction phase

S#	Environmental Effect A	Potential Significance B	Mitigation Measure(s) C	Mitigation Responsibility D	Monitoring Parameters / Location E	Monitoring Frequency F	Monitoring Responsibility G	Cost and Source of Funds H
			✓Restrict access to areas with possibility of asbestos presence in air or ground – minimize workers' exposure to the area. ✓Measures to be taken to prevent asbestos dust/fibers from becoming airborne. Pipes to be cut and removed in large blocks. Sprinkle water to keep asbestos fibers wet before during removal operations. Hammering or breaking of sewerage pipes not to be permitted. ✓If possible, install vacuum system to filter air. ✓Decontaminate (shower) workers and remove protective clothing/change clothes when leaving regulated area. ✓ Transportation of removed cement pipes in enclosed containers to a predesignated site for safe disposal. ✓ILO Code of Practice "safety in the use of asbestos" to be followed					

Note:
ERU = Environment and Resettlement Unit, PIU
CC = Construction Contractor(s)
PSC = Project Supervision and Contractor Management Consultant
MEC = Monitoring and Evaluation Consultant

Figure 8.1: Proposed Air Quality and Noise Monitoring Locations (Yellow place mark = Noise; Green place mark = air)

8.1.1. Post Monitoring Measures

Section 11 of Sindh Environmental Protection Act, 2014 which is the prime legislation on environmental protection and enforcement of environmental measures states that: *"no person shall discharge or emit or allow the discharge or emission of any effluent, waste, pollutant, noise or any other matter that may cause or likely to cause pollution or adverse environmental effects, in an amount, concentration or level which is in excess to that specified in Sindh Environmental Quality Standards (SEQS which are presented in **Annex A** of this ESMP)".*

The SEQS are applicable for Sindh Environmental Industrial Wastewater, Effluent, Domestic Sewerage, Industrial Air Emission, Ambient Air, Noise for vehicles, Air Emissions for Vehicles and Drinking Water Quality Standards 2015 vide Notification No.EPA/TECH/739/2014 and defines threshold limits that will signal the need for corrective actions. Also the existing baseline conditions of the subproject roads as defined in this ESMP will be added in the threshold limits to compare the monitoring results with actual situation.

8.1.1.1. Proposed Corrective Measures

If the monitoring parameter results crosses the prescribed threshold limits as defined in the above section, following corrective action are proposed to be taken to ensure the environmental protection and improve the effectiveness of mitigation measures:

Table 8.2: Post Monitoring Measures

S#	Trigger of Corrective Action	Proposed Corrective Action
1.	Ambient Air Quality parameters including dust (SPM) exceeds SEQS limits	- Check water sprinkling frequency and audit the construction site for any emission sources - Check the adequacy of dust containment measures and replace the mesh sheets with jute fiber - Increase the frequency of water sprinkling - Prohibit melting of bitumen near residential areas - Use of ready mix material like crush mixed with bitumen
2.	Vehicular Emissions for Construction Vehicles exceeds SEQS limits	- Check maintenance records of construction vehicles - Prohibit vehicles which do not satisfy SEQS limits for exhaust emissions and noise
3.	Surface/ground water quality parameters exceeds SEQS limits	- Audit the construction site and check wastewater streams emerging the construction site. - Check measures for the collection and treatment measures of these streams and arrange further measures like decommissioning of soakage pit and collection of wastewater from septic tank through bowser and discharge into nearest sewerage system. Also increase the capacity of septic tank and compartments.
4.	Ambient Noise (dB(A)) exceeds SEQS limits	- Check the vehicle maintenance records and prohibit vehicles which do not satisfy SEQS limits for noise. - Apply more noise barriers while considering the access of pedestrian will not be hindered.
5.	Accidents and disease problems of labor	- Conduct accident investigation and consult for corrective actions - Apply administrative controls or if appropriate engineering controls that requires less labor.

Chapter 9 SOCIAL MANAGEMENT AND MONITORING PLAN

This Chapter presents the screening of sub-project based on Environmental and Social impacts highlighted in section 06 and Social Management and Monitoring Plan for the proposed subproject.

9.1. Positive Social Impacts of Sub-Project

Most of the Project's socioeconomic impacts will be beneficial, including for example the ease of mobility, improved sewerage and drainage system, improved road hygiene conditions and reduced air and noise emissions after construction of the roads. The beneficial impacts described briefly hereunder:

- As discussed earlier in the report that the economic activities and productivity generation of Karachi have been in decline due to various issues, mainly the poor and neglected infrastructure. Therefore, improving the infrastructure will contribute towards improved economy of the city.
- Shorter travel time on the target roads will contribute to the economic and industrial development in Karachi and surrounding area.
- Development of Pedestrian crossings on the target roads will benefit directly to women, children and elderly people.
- Employment generation for the businesses is also envisaged from the proposed project as the potential workforce may commute with ease and more frequent between their residence and business districts. The project will support, in particular, the working class of Karachi.
- By adding road safety features in the design, vulnerable road users and children will benefit and feel more secure.
- Due to the improvement in local road network, removal of mobile vendors in walkways and improved bus facilities, pedestrians including women and children have better access to crossing facilities and walkways.
- Increased mobility of traffic in Saddar Area increases the mobility of goods and consequently increases the businesses of the locals.
- The project is likely to address following sustainable development goals (SDGs) of the United Nations (UN):
    - **SDG-3 – Good Health and Well-Being**: The project would improve public urban spaces. Consequently, the transportation will be more manageable and orderly. Hence, the resulting infrastructure would promote Good Health and Well-being by improving the ambient air quality.
    - **SDG-8 – Decent Work and Economic Growth**: Infrastructure improvement will eventually lead to economic growth and enhancement of income generation activities.
    - **SDG-9 – Industry, Innovation and Infrastructure**: The goal directly coincides with the project intervention activities for resilient infrastructure development.
    - **SDG-11 – Sustainable Cities and Communities**: The project will result in Karachi being more sustainable and the communities being more inclusive, safe and livable.

The below table presents mitigation measures of each adverse socio-economic effects and monitoring parameters with responsibilities defined separately for each aspect.

Table 9.1: Social Mitigation and Monitoring Plan

S#	Socio-economic Effect A	Potential Significance B	Mitigation Measure(s) C	Mitigation Responsibility D	Monitoring Parameters E	Monitoring Frequency F	Monitoring Responsibility G	Cost and Source of Funds H
1.	Mobility of women and physically disabled persons along project roads	Low	✓Adequate crossing facilities will be developed and included in the project for pedestrians as well as walkways will be improved. ✓Adequate crossing facilities during construction will also be provided by taking care of women. ✓Due to the improvement in local road network, and improved bus facilities, pedestrians including women, children and physically disabled persons have better access to crossing facilities and walkways.	Design Consultant	Monitoring of crossing facilities and diversions	Weekly	PSC	Nil
2.	Interruption of Utilities	Medium	✓Relevant institutions such as KE and KWSB should be well-informed and taken on-board beforehand and during the commencement of any activities and their recommendations should be well-incorporated. ✓Communities near subproject area will be pre-informed and consulted if cutting down these utilities is necessary. ✓Communities and businesses near subproject area will be informed beforehand if disruption of utilities will occur. ✓A communication plan including schedule of interruption will be made by CC in association with PIU Communication specialist.	CC and Communication specialist	Coordination with utility agencies and communities and incorporation of recommendations provided by them	During rehabilitation of utilities	PSC	Nil
3.	Restriction of access and impediment of	Medium	✓It will be ensured that the construction site is appropriately cordoned off with hard barricade (as shown as an example	CC	traffic diversion sites, check access routes of pedestrians, check traffic	Weekly	PSC	Cost of hard barricade will be included in

Table 9.1: Social Mitigation and Monitoring Plan

S#	Socio-economic Effect A	Potential Significance B	Mitigation Measure(s) C	Mitigation Responsibility D	Monitoring Parameters E	Monitoring Frequency F	Monitoring Responsibility G	Cost and Source of Funds H
	locals to resources		in below figure) and also it will be ensured that safe and continuous access to all adjacent shops and residences during construction will be provided. It is estimated that to cover all the construction sites of Year 1 Subproject area, 5.6 km long barricade will be require. However, work on all areas of subproject shall not be underway at once and will be planned as per detailed construction plan. ✓ It is proposed that one track of M.R Kiyani Road at a time will be used for construction and the other for traffic diversion and pedestrian movement. In case of single track roads e.g. Dr. Ziauddin Ahmed Road, alternative diversion like Strachen Road access will be provided. However, the specific traffic management plan will be developed by CC based on the detailed construction plan. ✓ Provide alternative traffic arrangement/detours, if necessary so that traffic can be distributed and move on different roads; and, ensure that public/residents association is informed about such traffic diversions.		management plan and construction sites, check consultation records			Contractual Cost borne by Contractor and will be assessed after finalization of construction plan
			✓ Extensive consultation with stakeholders should be carried out beforehand and their feedback, concerns and input should be taken into account in the project planning and execution.	Communication specialist		Before the start of interventions and during	PSC	Nil

Table 9.1: Social Mitigation and Monitoring Plan

S#	Socio-economic Effect A	Potential Significance B	Mitigation Measure(s) C	Mitigation Responsibility D	Monitoring Parameters E	Monitoring Frequency F	Monitoring Responsibility G	Cost and Source of Funds H
			✓Provide information to the public through media – daily newspapers and local cable television (TV) services about the need and schedule of work, and alternative routes. ✓Leaflets on road diversions and traffic rerouting will be disseminated to residents, nearby shops and institutions.					
4.	Impacts on Women, Children, and Vulnerable Groups	Low	✓In awareness raising, women should be targeted. ✓Ensure participation of women in project activities through consultations, to ensure planned investments take the well-being of such groups into consideration	PSC reporting to PIU	Consultation records, awareness raising records	Monthly	PSC	Nil
5.	Project development not informed by concerns/views, participation of women and other groups.	Low	✓Identify all direct and indirect stakeholders ✓Hold meetings with all community groups, wherever possible, using women to encourage participation of women in all stages of the project. ✓Identify the communication mechanisms most commonly used by women and ensure these are used to impact and receive information throughout the project.	PSC reporting to PIU	Consultation records, awareness raising records	Monthly	PSC	Nil
6.	Labor Issues	Low	✓Preference will be given to labor from locally skilled and unskilled workers of Karachi. ✓No bonded and child labor will be allowed at site; ✓Major labor laws will be followed e.g. Minimum Wage, Hours of work,	CC	Occupational health and safety of labor including PPE, consultation records	Daily	PSC	Nil

Table 9.1: Social Mitigation and Monitoring Plan

S#	Socio-economic Effect A	Potential Significance B	Mitigation Measure(s) C	Mitigation Responsibility D	Monitoring Parameters E	Monitoring Frequency F	Monitoring Responsibility G	Cost and Source of Funds H
			Overtime Payment; harassment of women in the workplace. ✓Also laborers will be trained on appropriate interaction with local people especially women;					
			✓Prepare Labor Health and Safety Management plan defining the roles and responsibility of personnel who implement the plan	CC	Review and check the adequacy of the plan	Before the commencement of civil works	PSC	Nil
			✓Ensure that Job Hazard Analysis (JHA) is performed prior to commencing jobs and sign off by PSC	CC	Review and check JHA and sign off	Before the commencement of job	PSC	Nil
			✓Allocate ESS staff as per site-specific plans made by the CC	CC	Check CC staffing details	Before the commencement of civil works	PSC	Nil
			✓WB Group's Environment, Health and Safety (EHS) Guidelines (attached at the end of this document) will be implemented	CC	Audit WB EHS guidelines provisions	Monthly	PSC	Nil
			✓Only labor trained to use construction equipment and machinery at site should be allowed to operate	CC	Check Training Certificate	At the time of induction	PSC	
			✓The PSC will include appropriate clauses to protect environment and public health. The present ESMF will be included in the bidding document.	PSC	Appropriate clauses in the bidding documents will be checked by supervision/monitoring consultant	At the finalization of Contractor(s)	PIU ESS staff	Nil
			✓Avoid stagnation of water and initiate drainage/cleanup of stagnant water.	CC	Supervision consultant will check signs of water accumulation at construction site	Fortnightly	PSC	Nil
			✓Ensure the provision of appropriately stocked first-aid equipment at work	CC	Supervision/monitoring consultant will check First	After every accident,	PSC	Included in Contractual Cost

Table 9.1: Social Mitigation and Monitoring Plan

S#	Socio-economic Effect A	Potential Significance B	Mitigation Measure(s) C	Mitigation Responsibility D	Monitoring Parameters E	Monitoring Frequency F	Monitoring Responsibility G	Cost and Source of Funds H
			sites;		aid measures at construction site	incident or a near miss		borne by Contractor
			✓Ensure the provision of appropriate personal protective equipment (PPE) to minimize risks, such as but not limited to appropriate apron/coverall, boots and impervious gloves; eye protection and safety helmets;	CC	Supervision/monitoring Consultant will check provision of PPE for construction workers	Daily	PSC	Included in Contractual Cost borne by Contractor
			✓Provide training for workers for the use of PPE;	CC	Check training records	Monthly	PSC	Biannually, 4-day workshop @ Rs.15,000 per workshop inc. expenses
			✓Include procedures for documenting and reporting accidents, diseases, and incidents.	CC	Check procedures	Monthly	PSC	Nil
			✓Water should be sprinkled daily or whenever there is dust problem on all exposed surfaces to suppress emission of dust. Wiping and sweeping should be adopted as a continuous activity to keep the surface area of the site clean.	CC	Monitor Dust emissions (SPM) Monitoring conducted as per SEQS.	Daily, if required	PSC	Water sprinkling cost is included in Contractual Cost borne by Contractor and will be assessed after finalization sub-project plans

Note: ERU = Environment and Resettlement Unit, PIU
CC = Construction Contractor(s)
PSC = Project Supervision and Contractor Management Consultant
MEC = Monitoring and Evaluation Consultant

Chapter 10 ESMP IMPLEMENTATION BUDGET

The cost estimates to implement ESMP is provided below. This cost will be included in the overall project cost. The environmental and social safeguard staff hired by PIU is adequate and no further position is suggested in the current ESS setup and the remunerations of theses staff will be included in the project cost. Therefore, the capacity building cost is not be suggested under ESMP budget.

Table 10.1: ESMP Implementation Budget for 1 year Project (Million PKR)

Activity	*Cost Million PKR*	*Notes*
Trainings		
Refer table 6.4 (training plan)	2.08	Refer table 6.4 (training plan)
Environmental Monitoring		
Ambient Air Quality Monitoring	5.04	Fortnightly, Rs.35,000 for 8hr ambient air monitoring, assuming 06 points in subproject area for 1 year
Ambient Noise Monitoring	1.68	Fortnightly, Rs.10,000 for 8hr ambient noise monitoring, assuming 07 points in subproject area for 1 year
Vehicular Emission Monitoring	0.6	Quarterly, Rs.10,000 per vehicle for vehicular emission monitoring, assuming 15 vehicles in subproject area for 1 year
Water Quality Testing	0.32	Quarterly, Rs.20,000 per grab sample for water quality analysis, assuming 4 water samples in subproject area for 1 year
Reporting		
Waste Management Plan	0.6	15 days @ Rs.40,000/day for 1 year
Waste Tracking	0.832	104 days (02 tracking exercises per week) @ Rs.8,000/day for 1 year
Labor Health, Safety and Welfare Management plan	0.6	15 days @ Rs.40,000/day for 1 year
Protection of Trees Management Plan	0.45	15 days @ Rs.30,000/day for 1 year
Environmental and social monitoring checklists	0.09	15 days @ Rs.6,000/day for 1 year
Progress Reports	0.42	7 days per month @ Rs.5,000/day for 1 year
Training Reports	0.1	5 days per quarter @ Rs.5,000/day for 1 year
Project Completion Report	1.5	30 days @ Rs.50,000/day for 1 year
Sub-Total	**14.312**	
Contingencies (10%)	1.4312	
Total	**15.744**	

Therefore, the Budget for ESMP implementation will be **PKR 15.744 Million**.

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Annexures

Annex A: Sindh Environmental Quality Standards (SEQS)

Sindh Environmental Quality Standard for Ambient Air			
Pollutant	**Time-weighted average**	**Concentration in Ambient Air**	**Method of measurement**
Sulfur Dioxide (SO_2)	Annual Average*	80 µgm^3	Ultraviolet Fluorescence Method
	24 hours**	120 µgm^3	
Oxides of Nitrogen as (NO)	Annual Average*	40 µgm^3	Gas Phase Chemiluminescence
	24 hours**	40 µgm^3	
Oxides of Nitrogen as (NO_2)	Annual Average*	40 µgm^3	Gas Phase Chemiluminescence
	24 hours**	80 µgm^3	
O_3	1 hour	130 µgm^3	Non dispersive UV absorption method
Suspended Particulate Matter (SPM)	Annual Average*	360 µgm^3	High volume Sampling, (Average flow rate not less than 1.1m^3/minute)
	24 hours**	500 µgm^3	
Respirable Particulate Matter (PM10)	Annual Average*	120 µgm^3	B Ray absorption method
	24 hours**	150 µgm^3	
Respirable Particulate Matter (PM2.5)	24 hours**	75 µgm^3	B Ray absorption method
Lead (Pb)	Annual Average*	1 µgm^3	ASS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	1.5µgm^3	
Carbon Monoxide (CO)	8hours**	5mg/m^3	Non Dispersive Infra Red (NDIR) method
	1hours	10mg/m^3	
*Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.			
**24 hourly / 8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days.			

Sindh Environmental Quality Standard for Noise			
S. No.	**Category of Area / Zone**	**Effective from 1st January, 2015**	
		Limit it in dB(A) Leq*	
		Day Time	Night Time
1	Residential area (A)	55	45
2	Commercial area (B)	65	55
3	Industrial area (C)	75	65
4	Silence Zone (D)	50	45
Note: 1	Day time hours: 6.00 a. m to 10.00 p. m		
2	Night time hours: 10.00 p. m to 6.00p. m		
3	Silence zone; Zone which are declared as such by competent authority. An area comprising not less than 100 meters around hospitals, educational institutions and courts.		
4	Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent authority.		
***dB(A)Leq**	Time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.		

Sindh Environmental Quality Standard for Municipal & Liquid Industrial Effluents					
S. #	Parameter	Into Inland Waters	Into Sewage Treatment	Into Sea	unit
1	Temperature or Temp. increase	<3	<3	<3	°C
2	pH value (H^+)	6-9	6-9	6-9	
3	Biological Oxygen Demand $(BOD)_5$ at 20°C	80	250	80	mg/l
4	Chemical Oxygen Demand (COD)	150	400	400	mg/l
5	Total Suspended Solids (TSS)	200	400	200	mg/l

Sindh Environmental Quality Standard for Municipal & Liquid Industrial Effluents					
S. #	Parameter	Into Inland Waters	Into Sewage Treatment	Into Sea	unit
6	Total Dissolved Solids (TDS)	3500	3500	3500	mg/l
7	Oil and Grease	10	10	10	mg/l
8	Phenolic Compounds (as Phenol)	0.1	0.3	0.3	mg/l
9	Chloride (as Cl^-)	1000	1000	SC	mg/l
10	Fluoride (as F^-)	10	10	10	mg/l
11	Cyanide (as CN^-)total	1.0	1.0	1.0	mg/l
12	An-ionic detergents (as MBAS)	20	20	20	mg/l
13	Sulphate(SO_4^{2-})	600	1000	SC	mg/l
14	Sulphide (S^{2-})	1.0	1.0	1.0	mg/l
15	Ammonia (NH_3)	40	40	40	mg/l
16	Pesticides	0.15	0.15	0.15	mg/l
17	Cadmium	0.1	0.1	0.1	mg/l
18	Chromium (trivalent and hexavalent)	1.0	1.0	1.0	mg/l
19	Copper	1.0	1.0	1.0	mg/l
20	Lead	0.5	0.5	0.5	mg/l
21	Mercury	0.01	0.01	0.01	mg/l
22	Selenium	0.5	0.5	0.5	mg/l
23	Nickel	1.0	1.0	1.0	mg/l
24	Silver	1.0	1.0	1.0	mg/l
25	Total toxic metals	2.0	2.0	2.0	mg/l
26	Zinc	5.0	5.0	5.0	mg/l
27	Arsenic	1.0	1.0	1.0	mg/l
28	Barium	1.5	1.5	1.5	mg/l
29	Iron	8.0	8.0	8.0	mg/l
30	Manganese	1.5	1.5	1.5	mg/l
31	Boron	6.0	6.0	6.0	mg/l
32	Chlorine	1.0	1.0	1.0	mg/l

The Motor Vehicle Noise (SEQS)		
Parameter	Standards (maximum permissible limit)	Measuring method
Noise	85dB(A)	Sound-meter at 7.5meter from the source

Sindh Environmental Quality Standards for Drinking Waters (mg/l)					
S.#	**Properties / Parameters**	**Standard Values for Pakistan**	**S.#**	**Properties / Parameters**	**Standard Values for Pakistan**
Bacterial			Chemical		
1	All water intended for drinking (E.Coli or Thermo tolerant Coliform bacteria)	Must not be detectable in any 100 ml sample	Essential Inorganics (mg/liter)		
			3	Aluminum (Al) mg/l	≤ 0.2
			4	Antimony (Sb)	≤ 0.005
2	Treated water entering the distribution system (Ecoli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample	5	Arsenic (As)	≤ 0.05
			6	Barium (Ba)	0.7
			7	Boron (B)	0.3
3	Treated water in the distribution system (E.coli or thermo tolerant coliform and total coliform bacteria)	Must not be Detectable in any 100 ml sample. In case of large supplies, where sufficient samples are examined, must not be	8	Cadmium (Cd)	0.01
			9	Chloride (Cl-)	< 250
			10	Chromium (Cr)	≤ 0.05
			11	Copper (Cu)	2
			Organic (mg/L)		

Sindh Environmental Quality Standards for Drinking Waters (mg/l)					
S.#	**Properties / Parameters**	**Standard Values for Pakistan**	**S.#**	**Properties / Parameters**	**Standard Values for Pakistan**
Bacterial			Chemical		
		resent in 95% of the samples taken throughout any 12 month period.	12	Phenolic compounds	<0.0002
			Toxic Inorganics (mg/liter)		
			13	Cyanide (CN)-	≤ 0.05
			14	Fluoride (F)	≤ 1.5
			15	Lead (Pb)	≤ 0.05
			16	Manganese (Mn)	≤ 0.5
Physical			17	Mercury (Hg)	≤ 0.001
4	Color	< 15 TCU	18	Nickel (Ni)	≤ 0.02
5	Taste	Non objectionable/ Acceptable	19	Nitrate (NO_3)-	≤ 50
6	Odor	Non objectionable/ Acceptable	20	Nitrite (NO2)-	≤ 3
7	Turbidity	< 5 NTU	21	Selenium (Se)	≤ 0.01
8	Total Hardness as $CaCO_3$	< 500 mg/l	22	Residual Chlorine	0.2-0.5 At consumer end 0.5-1.5 at source
9	TDS	<1000			
10	pH	6.5-8.5			
Radioactive					
11	Alpha Emitters bq/L	0.1	23	Zinc (Zn)	5.0
12	Beta emitters	1			

Annex B: List of Protected Heritage Sites and Monuments of Karachi District

Buildings Declared as "Protected Heritage" by the Government of Sindh (Under the Sindh Cultural Heritage (Preservation) Act 1994 on September 7, 1995) inside the Subproject Area

1. NED City Campus (Strachan Road), Karachi
2. Victoria Museum (now Supreme Court of Pakistan Building), M.R. Kiyani Road, Karachi
3. D.J. College (Geology & Math Department) Originally Principal's Bungalow) Dr. Ziauddin Ahmed (Kutchery) Road, Karachi
4. Burns Garden, (Strachan Road), Karachi
5. D.J. College Extension, Shahrah-e-Kamal Road, Karachi

Annex C: Guidelines for Physical and Cultural Resources

As stated in the World Bank Physical and Cultural Resources (PCR) Safeguard Policy Guidebook, The PCR policy applies to projects having any one or more of the following three features: (i) Subprojects involving significant excavations, demolition, movement of earth, flooding or other major environmental changes; (ii) Subprojects located within or in the vicinity of a recognized PCR conservation area or heritage site; and (iii) Subprojects designed to support the management or conservation of PCR.

The subprojects under the proposed project will involve excavation works, movement of earth and will located in the vicinity of PCRs. An impact assessment of Physical Cultural Resources is outlined below.

Identification of PCRs

Annex B provides list of designated and protected PCR and its road locations.

Assessment of probable impacts due to construction activities

Below is a list of project activities or features under the context of the proposed project, which may commonly give rise to negative impacts on PCR, during construction phase and operational phase.

Construction phase:

1. Establishment of work camps:

- Vandalism, theft and illegal export of movable PCR, and of pieces of monumental PCR accessible directly or indirectly to migrant laborer
- Desecration of sacred sites.

2. Excavation, construction and soil compaction:

- Direct physical damage to natural, manmade and buried PCR on site
- Construction traffic
- Vibration, soil, air and water pollution causing damage to natural or manmade PCR on site.
- Noise pollution can interfere with the use and enjoyment of PCR such as tourist destinations, historic buildings, religious establishments and cemeteries.

3. Mobilization of heavy construction equipment:

- Damage to natural or manmade PCR on site
- Soil compaction, damaging pipelines and drains serving built PCR in the vicinity.

4. Flooding and Inundation:

- Submergence or destruction of human-made, natural or buried PCR.
- Barrier to access of all types of PCR.
- Raised water table can lead to damage to all types of PCR.
- Damage to aesthetics of scenic landscapes.

Above measures will be mitigated through following tools:

- An experience structural engineer as independent consultant will be hired by PIU during the course of construction who will assess the stability of the buildings and nature of interventions near them and decide what intervention can be done near sensitive PCRs.

Chance Find Procedures

"Chance find" procedures apply when subprojects are identified as potentially impacting Physical or Cultural Resources either during the screening phase or during the actual construction period.

In the event of finding of properties of cultural value during construction, the following procedures for identification, protection from theft, and treatment of discovered sites or artifacts should be followed and included in Contractor(s) bidding document.

a) Stop the construction activities in the area of the chance find;
b) Delineate the discovered site or area;
c) Secure the site to prevent any damage or loss of removable objects.
d) Notify the ESS staff/ Supervisory Engineer who in turn will notify the Antiquities Department;
e) Antiquities Department would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures.
f) Decisions on how to handle the finding shall be taken by the PIU and the Antiquities Department. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeological importance), conservation, restoration and salvage.
g) Implementation of the authority decision concerning the management of the finding shall be communicated in writing by the relevant Ministry.
h) Construction work could resume only after permission is given from the Antiquities Department concerning safeguard of the heritage.

These procedures must be referred to as standard provisions in construction contracts. During project supervision, the ESS staff shall monitor the above regulations relating to the treatment of any chance find encountered. Relevant findings will be recorded in Progress Reports.

Completion Reports will assess the overall effectiveness of the project's cultural property mitigation, management, and activities, as appropriate.

Annex D: A3 Maps of Subproject Layout Plans

Annex E: Population Characteristics of Karachi's Districts and Towns (2015)

Districts	Towns	Area (Km^2)	Estimated Population (2015)	Male	Female	Estimated Population Density (per sq. Km)	Sex Ratio
Central	Gulberg	14.03	759,087	400,061	359,026	54,104.60	**111**
Central	Liquatabad	7.67	1,086,498	572,616	513,882	141,655.50	**111**
Central	N.Nazimabad	16.99	830,568	437,734	392,834	48,885.70	**111**
Central	New Karachi	19.66	1,145,239	603,574	541,665	58,252.20	**111**
	Total	**58.35**	**3821392**	**2013985**	**1807407**	**65,479.70**	**111**
East	Gulshan e Iqbal	54.63	964,345	514,254	450,091	17,652.30	**114**
East	Jamshed	24.69	786,238	425,039	361,199	31,844.40	**118**
	Total	**79.32**	**1750583**	**939293**	**811290**	**20,315.20**	**114**
Malir	Bin Qasim	552.11	630,035	352,213	277,822	1,141.10	**127**
Malir	Gadap	2,173.03	576,080	322,050	254,030	265.1	**127**
Malir	Malir	15.32	792,386	442,973	349,413	51,722.30	**127**
	Total	**2,740.46**	**1,998,501**	**1,117,236**	**881,265**	**790.7**	**127**
South	**Saddar**	**29.24**	**660,164**	**356,884**	**303,280**	**22,577.4**	**118**
West	Baldia	25.73	965,830	527,052	438,778	37,537.10	**120**
West	Kimari	391.75	914,021	498,780	415,241	2,333.20	**120**
West	Orangi	23.82	1,720,890	939,088	781,802	72,245.60	**120**
West	Layari	11.36	651,421	352,157	299,264	57,343.40	**118**
West	SITE	25.28	1,111,821	606,720	505,101	43,980.30	**120**
	Total	**477.94**	**5,363,983**	**2,923,797**	**2,440,186**	**10,099.5**	**120**
Korangi	Korangi	39.47	705,321	376,125	329,196	17,869.80	**114**
Korangi	Shah Faisal	12.7	1,147,809	612,089	535,720	90,378.70	**114**
Korangi	Landhi	41.1	1,400,355	746,764	653,591	34,071.90	**114**
	Total	**93.27**	**3253485**	**1734978**	**1518507**	**34,882.4**	**114**
Cantonment	Shah Faisal	35.3	849,806	453,174	396,632	24,073.80	**114**
Cantonment	Korangi Creek	22.22	121,821	68,102	53,719	5,482.50	**127**
Cantonment	Malir	73.05	121,821	68,102	53,719	1,667.60	**127**
Cantonment	Clifton	43.41	267,858	144,804	123,054	6,170.40	**118**
Cantonment	Karachi	5	65,606	35,467	30,139	13,121.20	**118**
Cantonment	Manora	14.44	145,606	79,457	66,149	10,083.50	**120**
	Total	**193.42**	**1572518**	**849106**	**723412**	**10,099.5**	**120**
	Grand Total	**3,671**	**18,420,626**	**-**	**-**	**5,017.9**	**-**

Source: Pakistan Emergency Situation Analysis, District Karachi, 2015 (Est. using 3.75% Growth Rate) – Alhasan Systems Private Limited April 2015

Annex H: World Bank Group's Environment, Health, and Safety Guidelines

Environmental, Health, and Safety General Guidelines

Introduction

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP)[1]. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These **General EHS Guidelines** are designed to be used together with the relevant **Industry Sector EHS Guidelines** which provide guidance to users on EHS issues in specific industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary. A complete list of industry-sector guidelines can be found at: www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment[2] in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

The **General EHS Guidelines** are organized as follows:

1. Environmental	**3**
1.1 Air Emissions and Ambient Air Quality	3
1.2 Energy Conservation	17
1.3 Wastewater and Ambient Water Quality	24
1.4 Water Conservation	32
1.5 Hazardous Materials Management	35
1.6 Waste Management	45
1.7 Noise	51
1.8 Contaminated Land	53
2. Occupational Health and Safety	**59**
2.1 General Facility Design and Operation	60
2.2 Communication and Training	62
2.3 Physical Hazards	64
2.4 Chemical Hazards	68
2.5 Biological Hazards	70
2.6 Radiological Hazards	72
2.7 Personal Protective Equipment (PPE)	72
2.8 Special Hazard Environments	73
2.9 Monitoring	74
3. Community Health and Safety	**77**
3.1 Water Quality and Availability	77
3.2 Structural Safety of Project Infrastructure	78
3.3 Life and Fire Safety (L&FS)	79
3.4 Traffic Safety	82
3.5 Transport of Hazardous Materials	82
3.6 Disease Prevention	85
3.7 Emergency Preparedness and Response	86
4. Construction and Decommissioning	**89**
4.1 Environment	89
4.2 Occupational Health & Safety	92
4.3 Community Health & Safety	94
References and Additional Sources*	**96**

[1] Defined as the exercise of professional skill, diligence, prudence and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of pollution prevention and control techniques available to a project may include, but are not limited to, varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of financial and technical feasibility.

[2] For IFC, such assessment is carried out consistent with Performance Standard 1, and for the World Bank, with Operational Policy 4.01.

General Approach to the Management of EHS Issues at the Facility or Project Level

Effective management of environmental, health, and safety (EHS) issues entails the inclusion of EHS considerations into corporate- and facility-level business processes in an organized, hierarchical approach that includes the following steps:

- Identifying EHS project hazards[3] and associated risks[4] as early as possible in the facility development or project cycle, including the incorporation of EHS considerations into the site selection process, product design process, engineering planning process for capital requests, engineering work orders, facility modification authorizations, or layout and process change plans.
- Involving EHS professionals, who have the experience, competence, and training necessary to assess and manage EHS impacts and risks, and carry out specialized environmental management functions including the preparation of project or activity-specific plans and procedures that incorporate the technical recommendations presented in this document that are relevant to the project.
- Understanding the likelihood and magnitude of EHS risks, based on:
    - The nature of the project activities, such as whether the project will generate significant quantities of emissions or effluents, or involve hazardous materials or processes;
    - The potential consequences to workers, communities, or the environment if hazards are not adequately managed, which may depend on the proximity of project activities to people or to the environmental resources on which they depend.
- Prioritizing risk management strategies with the objective of achieving an overall reduction of risk to human health and the environment, focusing on the prevention of irreversible and / or significant impacts.
- Favoring strategies that eliminate the cause of the hazard at its source, for example, by selecting less hazardous materials or processes that avoid the need for EHS controls.
- When impact avoidance is not feasible, incorporating engineering and management controls to reduce or minimize the possibility and magnitude of undesired consequences, for example, with the application of pollution controls to reduce the levels of emitted contaminants to workers or environments.
- Preparing workers and nearby communities to respond to accidents, including providing technical and financial resources to effectively and safely control such events, and restoring workplace and community environments to a safe and healthy condition.
- Improving EHS performance through a combination of ongoing monitoring of facility performance and effective accountability.

[3] Defined as "threats to humans and what they value" (Kates, et al., 1985).

[4] Defined as "quantitative measures of hazard consequences, usually expressed as conditional probabilities of experiencing harm" (Kates, et. al., 1985)

1.0 Environmental

1.1 Air Emissions and Ambient Air Quality

Applicability and Approach 3
Ambient Air Quality 4
General Approach 4
Projects Located in Degraded Airsheds or Ecologically Sensitive Areas 5
Point Sources 5
Stack Height 5
Small Combustion Facilities Emissions Guidelines 6
Fugitive Sources 8
Volatile Organic Compounds (VOCs) 8
Particulate Matter (PM) 8
Ozone Depleting Substances (ODS) 9
Mobile Sources – Land-based 9
Greenhouse Gases (GHGs) 9
Monitoring 10
Monitoring of Small Combustion Plants Emissions 11

Applicability and Approach

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

Emissions of air pollutants can occur from a wide variety of activities during the construction, operation, and decommissioning phases of a project. These activities can be categorized based on the spatial characteristic of the source including point sources, fugitive sources, and mobile sources and, further, by process, such as combustion, materials storage, or other industry sector-specific processes.

Where possible, facilities and projects should avoid, minimize, and control adverse impacts to human health, safety, and the environment from emissions to air. Where this is not possible, the generation and release of emissions of any type should be managed through a combination of:

- Energy use efficiency
- Process modification
- Selection of fuels or other materials, the processing of which may result in less polluting emissions
- Application of emissions control techniques

The selected prevention and control techniques may include one or more methods of treatment depending on:

- Regulatory requirements
- Significance of the source
- Location of the emitting facility relative to other sources
- Location of sensitive receptors
- Existing ambient air quality, and potential for degradation of the airshed from a proposed project
- Technical feasibility and cost effectiveness of the available options for prevention, control, and release of emissions

Ambient Air Quality

General Approach

Projects with significant[5,6] sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that:

- Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards[9] by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines[10] (see Table 1.1.1), or other internationally recognized sources[11];
- Emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed.[12]

At facility level, impacts should be estimated through qualitative or quantitative assessments by the use of baseline air quality assessments and atmospheric dispersion models to assess potential ground level concentrations. Local atmospheric, climatic, and air quality data should be applied when modeling dispersion, protection against atmospheric downwash, wakes, or eddy effects of the source, nearby[13] structures, and terrain features. The dispersion model applied should be internationally recognized, or comparable. Examples of acceptable emission estimation and dispersion modeling approaches for point and fugitive sources are

Table 1.1.1: WHO Ambient Air Quality Guidelines[7,8]

	Averaging Period	Guideline value in $\mu g/m^3$
Sulfur dioxide (SO_2)	24-hour	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)
	10 minute	500 (guideline)
Nitrogen dioxide (NO_2)	1-year	40 (guideline)
	1-hour	200 (guideline)
Particulate Matter PM_{10}	1-year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)
	24-hour	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter $PM_{2.5}$	1-year	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)
	24-hour	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)

[5] Significant sources of point and fugitive emissions are considered to be general sources which, for example, can contribute a net emissions increase of one or more of the following pollutants within a given airshed: PM10: 50 tons per year (tpy); NOx: 500 tpy; SO2: 500 tpy; or as established through national legislation; and combustion sources with an equivalent heat input of 50 MWth or greater. The significance of emissions of inorganic and organic pollutants should be established on a project-specific basis taking into account toxic and other properties of the pollutant.

[6] United States Environmental Protection Agency, Prevention of Significant Deterioration of Air Quality, 40 CFR Ch. 1 Part 52.21. Other references for establishing significant emissions include the European Commission. 2000. "Guidance Document for EPER implementation." http://ec.europa.eu/environment/ippc/eper/index.htm ; and Australian Government. 2004. "National Pollutant Inventory Guide." http://www.npi.gov.au/handbooks/pubs/npiguide.pdf

[7] World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile.

[8] Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.

[9] Ambient air quality standards are ambient air quality levels established and published through national legislative and regulatory processes, and ambient quality guidelines refer to ambient quality levels primarily developed through clinical, toxicological, and epidemiological evidence (such as those published by the World Health Organization).

[10] Available at World Health Organization (WHO). http://www.who.int/en

[11] For example the United States National Ambient Air Quality Standards (NAAQS) (http://www.epa.gov/air/criteria.html) and the relevant European Council Directives (Council Directive 1999/30/EC of 22 April 1999 / Council Directive 2002/3/EC of February 12 2002).

[12] US EPA Prevention of Significant Deterioration Increments Limits applicable to non-degraded airsheds.

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

Projects Located in Degraded Airsheds or Ecologically Sensitive Areas

Facilities or projects located within poor quality airsheds[14], and within or next to areas established as ecologically sensitive (e.g. national parks), should ensure that any increase in pollution levels is as small as feasible, and amounts to a fraction of the applicable short-term and annual average air quality guidelines or standards as established in the project-specific environmental assessment. Suitable mitigation measures may also include the relocation of significant sources of emissions outside the airshed in question, use of cleaner fuels or technologies, application of comprehensive pollution control measures, offset activities at installations controlled by the project sponsor or other facilities within the same airshed, and buy-down of emissions within the same airshed.

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

Point Sources

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

Point sources are characterized by the release of air pollutants typically associated with the combustion of fossil fuels, such as nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), and particulate matter (PM), as well as other air pollutants including certain volatile organic compounds (VOCs) and metals that may also be associated with a wide range of industrial activities.

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

Stack Height

The stack height for all point sources of emissions, whether 'significant' or not, should be designed according to GIIP (see Annex 1.1.3) to avoid excessive ground level concentrations due to downwash, wakes, and eddy effects, and to ensure reasonable diffusion to minimize impacts. For projects where there are multiple sources of emissions, stack heights should be established with due consideration to emissions from all other project sources, both point and fugitive. Non-significant sources of emissions,

[13] "Nearby" generally considers an area within a radius of up to 20 times the stack height.

[14] An airshed should be considered as having poor air quality if nationally legislated air quality standards or WHO Air Quality Guidelines are exceeded significantly.

[15] Emission points refer to a specific stack, vent, or other discrete point of pollution release. This term should not be confused with point source, which is a regulatory distinction from area and mobile sources. The characterization of point sources into multiple emissions points is useful for allowing more detailed reporting of emissions information.

including small combustion sources,[16] should also use GIIP in stack design.

Small Combustion Facilities Emissions Guidelines

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

The emissions guidelines in Table 1.1.2 are applicable to small combustion process installations operating more than 500 hours per year, and those with an annual capacity utilization of more than 30 percent. Plants firing a mixture of fuels should compare emissions performance with these guidelines based on the sum of the relative contribution of each applied fuel[17]. Lower emission values may apply if the proposed facility is located in an ecologically sensitive airshed, or airshed with poor air quality, in order to address potential cumulative impacts from the installation of more than one small combustion plant as part of a distributed generation project.

[16] Small combustion sources are those with a total rated heat input capacity of 50MWth or less.

[17] The contribution of a fuel is the percentage of heat input (LHV) provided by this fuel multiplied by its limit value.

Table 1.1.2 - Small Combustion Facilities Emissions Guidelines (3MWth – 50MWth) – (in mg/Nm^3 or as indicated)

Combustion Technology / Fuel	Particulate Matter (PM)	Sulfur Dioxide (SO_2)	Nitrogen Oxides (NOx)	Dry Gas, Excess O_2 Content (%)
Engine				
Gas	N/A	N/A	200 (Spark Ignition) 400 (Dual Fuel) 1,600 (Compression Ignition)	15
Liquid	50 or up to 100 if justified by project specific considerations (e.g. Economic feasibility of using lower ash content fuel, or adding secondary treatment to meet 50, and available environmental capacity of the site)	1.5 percent Sulfur or up to 3.0 percent Sulfur if justified by project specific considerations (e.g. Economic feasibility of using lower S content fuel, or adding secondary treatment to meet levels of using 1.5 percent Sulfur, and available environmental capacity of the site)	If bore size diameter [mm] < 400: 1460 (or up to 1,600 if justified to maintain high energy efficiency.) If bore size diameter [mm] > or = 400: 1,850	15
Turbine				
Natural Gas =3MWth to < 15MWth	N/A	N/A	42 ppm (Electric generation) 100 ppm (Mechanical drive)	15
Natural Gas =15MWth to < 50MWth	N/A	N/A	25 ppm	15
Fuels other than Natural Gas =3MWth to < 15MWth	N/A	0.5 percent Sulfur or lower percent Sulfur (e.g. 0.2 percent Sulfur) if commercially available without significant excess fuel cost	96 ppm (Electric generation) 150 ppm (Mechanical drive)	15
Fuels other than Natural Gas =15MWth to < 50MWth	N/A	0.5% S or lower % S (0.2%S) if commercially available without significant excess fuel cost	74 ppm	15
Boiler				
Gas	N/A	N/A	320	3
Liquid	50 or up to 150 if justified by environmental assessment	2000	460	3
Solid	50 or up to 150 if justified by environmental assessment	2000	650	6

Notes: -N/A/ - no emissions guideline; Higher performance levels than these in the Table should be applicable to facilities located in urban / industrial areas with degraded airsheds or close to ecologically sensitive areas where more stringent emissions controls may be needed.; MWth is heat input on HHV basis; Solid fuels include biomass; Nm^3 is at one atmosphere pressure, 0° C.; MWth category is to apply to the entire facility consisting of multiple units that are reasonably considered to be emitted from a common stack except for NOx and PM limits for turbines and boilers. Guidelines values apply to facilities operating more than 500 hours per year with an annual capacity utilization factor of more than 30 percent.

Fugitive Sources

Fugitive source air emissions refer to emissions that are distributed spatially over a wide area and not confined to a specific discharge point. They originate in operations where exhausts are not captured and passed through a stack. Fugitive emissions have the potential for much greater ground-level impacts per unit than stationary source emissions, since they are discharged and dispersed close to the ground. The two main types of fugitive emissions are Volatile Organic Compounds (VOCs) and particulate matter (PM). Other contaminants (NO_x, SO_2 and CO) are mainly associated with combustion processes, as described above. Projects with potentially significant fugitive sources of emissions should establish the need for ambient quality assessment and monitoring practices.

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

Volatile Organic Compounds (VOCs)

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

- Equipment modifications, examples of which are presented in Annex 1.1.4;
- Implementing a leak detection and repair (LDAR) program that controls fugitive emissions by regularly monitoring to detect leaks, and implementing repairs within a predefined time period.[18]

For VOC emissions associated with handling of chemicals in open vats and mixing processes, the recommended prevention and control techniques include:

- Substitution of less volatile substances, such as aqueous solvents;
- Collection of vapors through air extractors and subsequent treatment of gas stream by removing VOCs with control devices such as condensers or activated carbon absorption;
- Collection of vapors through air extractors and subsequent treatment with destructive control devices such as:
  - Catalytic Incinerators: Used to reduce VOCs from process exhaust gases exiting paint spray booths, ovens, and other process operations
  - Thermal Incinerators: Used to control VOC levels in a gas stream by passing the stream through a combustion chamber where the VOCs are burned in air at temperatures between 700º C to 1,300º C
  - Enclosed Oxidizing Flares: Used to convert VOCs into CO_2 and H_2O by way of direct combustion
- Use of floating roofs on storage tanks to reduce the opportunity for volatilization by eliminating the headspace present in conventional storage tanks.

Particulate Matter (PM)

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

[18] For more information, see Leak Detection and Repair Program (LDAR), at: http://www.ldar.net

Recommended prevention and control of these emissions sources include:

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

Ozone Depleting Substances (ODS)

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

Mobile Sources – Land-based

Similar to other combustion processes, emissions from vehicles include CO, NO_x, SO_2, PM and VOCs. Emissions from on-road and off-road vehicles should comply with national or regional programs. In the absence of these, the following approach should be considered:

- Regardless of the size or type of vehicle, fleet owners / operators should implement the manufacturer recommended engine maintenance programs;
- Drivers should be instructed on the benefits of driving practices that reduce both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits;
- Operators with fleets of 120 or more units of heavy duty vehicles (buses and trucks), or 540 or more light duty vehicles[21] (cars and light trucks) within an airshed should consider additional ways to reduce potential impacts including:
  - Replacing older vehicles with newer, more fuel efficient alternatives
  - Converting high-use vehicles to cleaner fuels, where feasible
  - Installing and maintaining emissions control devices, such as catalytic converters
  - Implementing a regular vehicle maintenance and repair program

Greenhouse Gases (GHGs)

Sectors that may have potentially significant emissions of greenhouse gases (GHGs)[22] include energy, transport, heavy industry (e.g. cement production, iron / steel manufacturing, aluminum smelting, petrochemical industries, petroleum refining, fertilizer manufacturing), agriculture, forestry and waste management. GHGs may be generated from direct emissions

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

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

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

[22] The six greenhouse gases that form part of the Kyoto Protocol to the United Nations Framework Convention on Climate Change include carbon dioxide ($C0_2$); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulfur hexafluoride (SF_6).

from facilities within the physical project boundary and indirect emissions associated with the off-site production of power used by the project.

Recommendations for reduction and control of greenhouse gases include:

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

Monitoring

Emissions and air quality monitoring programs provide information that can be used to assess the effectiveness of emissions management strategies. A systematic planning process is recommended to ensure that the data collected are adequate for their intended purposes (and to avoid collecting unnecessary data). This process, sometimes referred to as a data quality objectives process, defines the purpose of collecting the data, the decisions to be made based on the data and the consequences of making an incorrect decision, the time and geographic boundaries, and the quality of data needed to make a correct decision.[25] The air quality monitoring program should consider the following elements:

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

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

[24] Carbon dioxide capture and storage (CCS) is a process consisting of the separation of CO_2 from industrial and energy-related sources; transport to a storage location; and long-term isolation from the atmosphere, for example in geological formations, in the ocean, or in mineral carbonates (reaction of CO_2 with metal oxides in silicate minerals to produce stable carbonates). It is the object of intensive research worldwide (Intergovernmental Panel on Climate Change (IPCC), Special Report, Carbon Dioxide Capture and Storage (2006).

[25] See, for example, United States Environmental Protection Agency, Guidance on Systematic Planning Using the Data Quality Objectives Process EPA QA/G-4, EPA/240/B-06/001 February 2006.

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

- *Sampling and analysis methods*: Monitoring programs should apply national or international methods for sample collection and analysis, such as those published by the International Organization for Standardization,[26] the European Committee for Standardization,[27] or the U.S. Environmental Protection Agency.[28] Sampling should be conducted by, or under, the supervision of trained individuals. Analysis should be conducted by entities permitted or certified for this purpose. Sampling and analysis Quality Assurance / Quality Control (QA/QC) plans should be applied and documented to ensure that data quality is adequate for the intended data use (e.g., method detection limits are below levels of concern). Monitoring reports should include QA/QC documentation.

Monitoring of Small Combustion Plants Emissions

- Additional recommended monitoring approaches for **boilers**:

  Boilers with capacities between =3 MWth and < 20 MWth:

  - Annual Stack Emission Testing: SO_2, NO_x and PM. For gaseous fuel-fired boilers, only NO_x. SO_2 can be calculated based on fuel quality certification if no SO_2 control equipment is used.
  - If Annual Stack Emission Testing demonstrates results consistently and significantly better than the required levels, frequency of Annual Stack Emission Testing can be reduced from annual to every two or three years.
  - Emission Monitoring: None

  Boilers with capacities between =20 MWth and < 50 MWth

  - Annual Stack Emission Testing: SO_2, NO_x and PM. For gaseous fuel-fired boilers, only NO_x. SO_2 can be calculated based on fuel quality certification (if no SO_2 control equipment is used)
  - Emission Monitoring: SO_2. Plants with SO_2 control equipment: Continuous. NO_x: Continuous monitoring of either NO_x emissions or indicative NO_x emissions using combustion parameters. PM: Continuous monitoring of either PM emissions, opacity, or indicative PM emissions using combustion parameters / visual monitoring.

- Additional recommended monitoring approaches for **turbines**:
  - Annual Stack Emission Testing: NO_x and SO_2 (NO_x only for gaseous fuel-fired turbines).
  - If Annual Stack Emission Testing results show constantly (3 consecutive years) and significantly (e.g. less than 75 percent) better than the required levels, frequency of Annual Stack Emission Testing can be reduced from annual to every two or three years.
  - Emission Monitoring: NO_x: Continuous monitoring of either NO_x emissions or indicative NO_x emissions using combustion parameters.SO_2: Continuous monitoring if SO_2 control equipment is used.

- Additional recommended monitoring approaches for **engines**:
  - Annual Stack Emission Testing: NO_x ,SO_2 and PM (NO_x only for gaseous fuel-fired diesel engines).

[26] An on-line catalogue of ISO standards relating to the environment, health protection, and safety is available at: http://www.iso.org/iso/en/CatalogueListPage.CatalogueList?ICS1=13&ICS2=&ICS3=&scopelist=

[27] An on-line catalogue of European Standards is available at: http://www.cen.eu/catweb/cwen.htm .

[28] The National Environmental Methods Index provides a searchable clearinghouse of U.S. methods and procedures for both regulatory and non-regulatory monitoring purposes for water, sediment, air and tissues, and is available at http://www.nemi.gov/.

- If Annual Stack Emission Testing results show constantly (3 consecutive years) and significantly (e.g. less than 75 percent) better than the required levels, frequency of Annual Stack Emission Testing can be reduced from annual to every two or three years.
- Emission Monitoring: NO_x: Continuous monitoring of either NO_x emissions or indicative NO_x emissions using combustion parameters. SO_2: Continuous monitoring if SO_2 control equipment is used. PM: Continuous monitoring of either PM emissions or indicative PM emissions using operating parameters.

Annex 1.1.1 – Air Emissions Estimation and Dispersion Modeling Methods

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

Australian Emission Estimation Technique Manuals
http://www.npi.gov.au/handbooks/

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

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

Guidelines on Air Quality Models (Revised), US Environmental Protection Agency (EPA), 2005
http://www.epa.gov/scram001/guidance/guide/appw_05.pdf

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

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

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

Principal Sources and Issues	General Prevention / Process Modification Approach	Control Options	Reduction Efficiency (%)	Gas Condition	Comments
Particulate Matter (PM)					
Main sources are the combustion of fossil fuels and numerous manufacturing processes that collect PM through air extraction and ventilation systems. Volcanoes, ocean spray, forest fires and blowing dust (most prevalent in dry and semiarid climates) contribute to background levels.	Fuel switching (e.g. selection of lower sulfur fuels) or reducing the amount of fine particulates added to a process.	Fabric Filters	99 - 99.7%	Dry gas, temp <400F	Applicability depends on flue gas properties including temperature, chemical properties, abrasion and load. Typical air to cloth ratio range of 2.0 to 3.5 cfm/ft^2 Achievable outlet concentrations of 23 mg/Nm^3
		Electrostatic Precipitator (ESP)	97 – 99%	Varies depending of particle type	Precondition gas to remove large particles. Efficiency dependent on resistivity of particle. Achievable outlet concentration of 23 mg/Nm^3
		Cyclone	74 – 95%	None	Most efficient for large particles. Achievable outlet concentrations of 30 - 40 mg/Nm^3
		Wet Scrubber	93 – 95%	None	Wet sludge may be a disposal problem depending on local infrastructure. Achievable outlet concentrations of 30 - 40 mg/Nm3
Sulfur Dioxide (SO_2)					
Mainly produced by the combustion of fuels such as oil and coal and as a by-product from some chemical production or wastewater treatment processes.	Control system selection is heavily dependent on the inlet concentration. For SO2 concentrations in excess of 10%, the stream is passed through an acid plant not only to lower the SO2 emissions but also to generate high grade sulfur for sale. Levels below 10% are not rich enough for this process and should therefore utilize absorption or 'scrubbing,' where SO2 molecules are captured into a liquid phase or adsorption, where SO2 molecules are captured on the surface of a solid adsorbent.	Fuel Switching	>90%		Alternate fuels may include low sulfur coal, light diesel or natural gas with consequent reduction in particulate emissions related to sulfur in the fuel. Fuel cleaning or beneficiation of fuels prior to combustion is another viable option but may have economic consequences.
		Sorbent Injection	30% - 70%		Calcium or lime is injected into the flue gas and the SO_2 is adsorbed onto the sorbent
		Dry Flue Gas Desulfurization	70%-90%		Can be regenerable or throwaway.
		Wet Flue Gas Desulfurization	>90%		Produces gypsum as a by-product

Annex 1.1.2: Illustrative Point Source Air Emissions Prevention and Control Technologies (continued)

Oxides of Nitrogen (NOx)		Percent Reduction by Fuel Type			Comments
Associated with combustion of fuel. May occur in several forms of nitrogen oxide; namely nitric oxide (NO), nitrogen dioxide (NO_2) and nitrous oxide (N_2O), which is also a greenhouse gas. The term NOx serves as a composite between NO and NO_2 and emissions are usually reported as NOx. Here the NO is multiplied by the ratio of molecular weights of NO_2 to NO and added to the NO_2 emissions. Means of reducing NOx emissions are based on the modification of operating conditions such as minimizing the resident time at peak temperatures, reducing the peak temperatures by increasing heat transfer rates or minimizing the availability of oxygen.	**Combustion modification** (Illustrative of boilers)	**Coal**	**Oil**	**Gas**	These modifications are capable of reducing NOx emissions by 50 to 95%. The method of combustion control used depends on the type of boiler and the method of firing fuel.
	Low-excess-air firing	10–30	10–30	10–30	
	Staged Combustion	20–50	20–50	20–50	
	Flue Gas Recirculation	N/A	20–50	20–50	
	Water/Steam Injection	N/A	10–50	N/A.	
	Low-NOx Burners	30–40	30–40	30–40	
	Flue Gas Treatment	**Coal**	**Oil**	**Gas**	Flue gas treatment is more effective in reducing NOx emissions than are combustion controls. Techniques can be classified as SCR, SNCR, and adsorption. SCR involves the injection of ammonia as a reducing agent to convert NOx to nitrogen in the presence of a catalyst in a converter upstream of the air heater. Generally, some ammonia slips through and is part of the emissions. SNCR also involves the injection of ammonia or urea based products without the presence of a catalyst.
	Selective Catalytic Reduction (SCR)	60–90	60–90	60–90	
	Selective Non-Catalytic Reduction (SNCR)	N/A	30–70	30–70	

Note: Compiled by IFC based on inputs from technical experts.

Annex 1.1.3 - Good International Industry Practice (GIIP) Stack Height

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

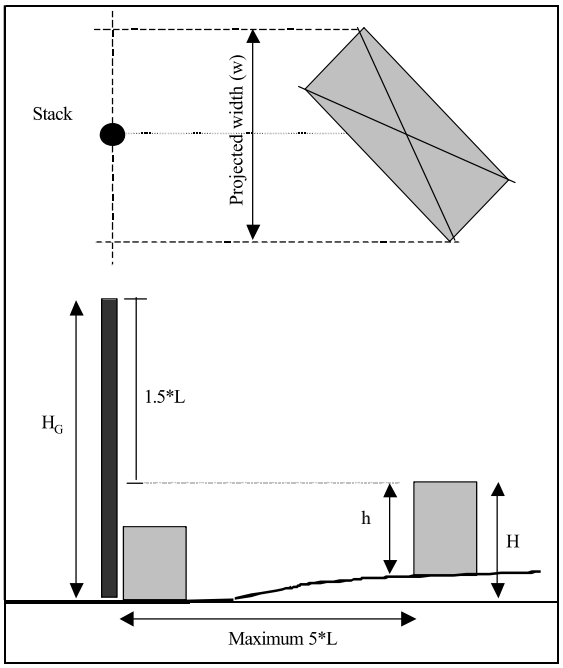
$H_G = H + 1.5L$; where

H_G = GEP stack height measured from the ground level elevation at the base of the stack

H = Height of nearby structure(s) above the base of the stack.

L = Lesser dimension, height (h) or width (w), of nearby structures

"Nearby structures" = Structures within/touching a radius of 5L but less than 800 m.



Annex 1.1.4 - Examples of VOC Emissions Controls

Equipment Type	Modification	Approximate Control Efficiency (%)
Pumps	Seal-less design	100[29]
	Closed-vent system	90[30]
	Dual mechanical seal with barrier fluid maintained at a higher pressure than the pumped fluid	100
Compressors	Closed-vent system	90
	Dual mechanical seal with barrier fluid maintained at a higher pressure than the compressed gas	100
Pressure Relief Devices	Closed-vent system	Variable[31]
	Rupture disk assembly	100
Valves	Seal-less design	100
Connectors	Weld together	100
Open-ended Lines	Blind, cap, plug, or second valve	100
Sampling Connections	Closed-loop sampling	100
Note: Examples of technologies are provided for illustrative purposes. The availability and applicability of any particular technology will vary depending on manufacturer specifications.		

29 Seal-less equipment can be a large source of emissions in the event of equipment failure.
30 Actual efficiency of a closed-vent system depends on percentage of vapors collected and efficiency of control device to which the vapors are routed.
31 Control efficiency of closed vent-systems installed on a pressure relief device may be lower than other closed-vent systems.

Annex 1.1.5 - Fugitive PM Emissions Controls

Control Type	Control Efficiency
Chemical Stabilization	0% - 98%
Hygroscopic salts Bitumens/adhesives	60% - 96%
Surfactants	0% - 68%
Wet Suppression – Watering	12% - 98%
Speed Reduction	0% - 80%
Traffic Reduction	Not quantified
Paving (Asphalt / Concrete)	85% - 99%
Covering with Gravel, Slag, or "Road Carpet"	30% - 50%
Vacuum Sweeping	0% - 58%
Water Flushing/Broom Sweeping	0% - 96%

1.2 Energy Conservation

Applicability and Approach 18
Energy Management Programs....18
Energy Efficiency....18
Process Heating....19
Heating Load Reduction 19
Heat Distribution Systems....19
Energy Conversion System Efficiency Improvements20
Process Cooling....20
Load Reduction....21
Energy Conversion....21
Refrigerant Compression Efficiency 23
Refrigeration System Auxiliaries....23
Compressed Air Systems....24
Load reduction 24
Distribution....24

Applicability and Approach

This guideline applies to facilities or projects that consume energy in process heating and cooling; process and auxiliary systems, such as motors, pumps, and fans; compressed air systems and heating, ventilation and air conditioning systems (HVAC); and lighting systems. It complements the industry-specific emissions guidance presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines by providing information about common techniques for energy conservation that may be applied to a range of industry sectors.

Energy management at the facility level should be viewed in the context of overall consumption patterns, including those associated with production processes and supporting utilities, as well as overall impacts associated with emissions from power sources. The following section provides guidance on energy management with a focus on common utility systems often representing technical and financially feasible opportunities for improvement in energy conservation. However, operations should also evaluate energy conservation opportunities arising from manufacturing process modifications.

Energy Management Programs

Energy management programs should include the following elements:

- Identification, and regular measurement and reporting of principal energy flows within a facility at unit process level
- Preparation of mass and energy balance;
- Definition and regular review of energy performance targets, which are adjusted to account for changes in major influencing factors on energy use
- Regular comparison and monitoring of energy flows with performance targets to identify where action should be taken to reduce energy use
- Regular review of targets, which may include comparison with benchmark data, to confirm that targets are set at appropriate levels

Energy Efficiency

For any energy-using system, a systematic analysis of energy efficiency improvements and cost reduction opportunities should include a hierarchical examination of opportunities to:

- Demand/Load Side Management by reducing loads on the energy system
- Supply Side Management by:
  - Reduce losses in energy distribution
  - Improve energy conversion efficiency
  - Exploit energy purchasing opportunities
  - Use lower-carbon fuels

Common opportunities in each of these areas are summarized below.[32]

Process Heating

Process heating is vital to many manufacturing processes, including heating for fluids, calcining, drying, heat treating, metal heating, melting, melting agglomeration, curing, and forming[33].

In process heating systems, a system heat and mass balance will show how much of the system's energy input provides true process heating, and quantify fuel used to satisfy energy losses caused by excessive parasitic loads, distribution, or conversion losses. Examination of savings opportunities should be directed by the results of the heat and mass balance, though the following techniques are often valuable and cost-effective.

Heating Load Reduction

- Ensure adequate insulation to reduce heat losses through furnace/oven etc. structure
- Recover heat from hot process or exhaust streams to reduce system loads
- In intermittently-heated systems, consider use of low thermal mass insulation to reduce energy required to heat the system structure to operating temperature
- Control process temperature and other parameters accurately to avoid, for example, overheating or overdrying
- Examine opportunities to use low weight and/or low thermal mass product carriers, such as heated shapers, kiln cars etc.
- Review opportunities to schedule work flow to limit the need for process reheating between stages
- Operate furnaces/ovens at slight positive pressure, and maintain air seals to reduce air in-leakage into the heated system, thereby reducing the energy required to heat unnecessary air to system operating temperature
- Reduce radiant heat losses by sealing structural openings and keep viewing ports closed when not in use
- Where possible, use the system for long runs close to or at operating capacity
- Consider use of high emissivity coatings of high temperature insulation, and consequent reduction in process temperature
- Near net weight and shape heat designs
- Robust Quality assurance on input material
- Robust Scheduled maintenance programs

Heat Distribution Systems

Heat distribution in process heating applications typically takes place through steam, hot water, or thermal fluid systems. Losses can be reduced through the following actions:

- Promptly repair distribution system leaks
- Avoid steam leaks despite a perceived need to get steam through the turbine. Electricity purchase is usually cheaper overall, especially when the cost to treat turbine-quality boiler feed water is included. If the heat-power ratio of the distribution process is less than that of power systems, opportunities should be considered to increase the ratio; for example, by using low-pressure steam to drive absorption cooling systems rather than using electrically-driven vapor-compression systems.
- Regularly verify correct operation of steam traps in steam systems, and ensure that traps are not bypassed. Since

[32] Additional guidance on energy efficiency is available from sources such as Natural Resources Canada (NRCAN http://oee.nrcan.gc.ca/commercial/financial-assistance/new-buildings/mnecb.cfm?attr=20); the European Union (EUROPA. http://europa.eu.int/scadplus/leg/en/s15004.htm), and United States Department of Energy (US DOE, http://www.eere.energy.gov/consumer/industry/process.html).

[33] US DOE. http://www.eere.energy.gov/consumer/industry/process.html

steam traps typically last approximately 5 years, 20% should be replaced or repaired annually
- Insulate distribution system vessels, such as hot wells and de-aerators, in steam systems and thermal fluid or hot water storage tanks
- Insulate all steam, condensate, hot water and thermal fluid distribution pipework, down to and including 1" (25 mm) diameter pipe, in addition to insulating all hot valves and flanges
- In steam systems, return condensate to the boiler house for re-use, since condensate is expensive boiler-quality water and valuable beyond its heat content alone
- Use flash steam recovery systems to reduce losses due to evaporation of high-pressure condensate
- Consider steam expansion through a back-pressure turbine rather than reducing valve stations
- Eliminate distribution system losses by adopting point-of-use heating systems

Energy Conversion System Efficiency Improvements

The following efficiency opportunities should be examined for process furnaces or ovens, and utility systems, such as boilers and fluid heaters:

- Regularly monitor CO, oxygen or CO2 content of flue gases to verify that combustion systems are using the minimum practical excess air volumes
- Consider combustion automation using oxygen-trim controls
- Minimize the number of boilers or heaters used to meet loads. It is typically more efficient to run one boiler at 90% of capacity than two at 45%. Minimize the number of boilers kept at hot–standby
- Use flue dampers to eliminate ventilation losses from hot boilers held at standby
- Maintain clean heat transfer surfaces; in steam boilers, flue gases should be no more than 20 K above steam temperature)
- In steam boiler systems, use economizers to recover heat from flue gases to pre-heat boiler feed water or combustion air
- Consider reverse osmosis or electrodialysis feed water treatment to minimize the requirement for boiler blowdown
- Adopt automatic (continuous) boiler blowdown
- Recover heat from blowdown systems through flash steam recovery or feed-water preheat
- Do not supply excessive quantities of steam to the de-aerator
- With fired heaters, consider opportunities to recover heat to combustion air through the use of recuperative or regenerative burner systems
- For systems operating for extended periods (> 6000 hours/year), cogeneration of electrical power, heat and /or cooling can be cost effective
- Oxy Fuel burners
- Oxygen enrichment/injection
- Use of turbolators in boilers
- Sizing design and use of multiple boilers for different load configurations
- Fuel quality control/fuel blending

Process Cooling

The general methodology outlined above should be applied to process cooling systems. Commonly used and cost-effective measures to improve process cooling efficiency are described below.

Load Reduction

- Ensure adequate insulation to reduce heat gains through cooling system structure and to below-ambient temperature refrigerant pipes and vessels
- Control process temperature accurately to avoid overcooling
- Operate cooling tunnels at slight positive pressure and maintain air seals to reduce air in-leakage into the cooled system, thus reducing the energy required to cool this unnecessary air to system operating temperature
- Examine opportunities to pre-cool using heat recovery to a process stream requiring heating, or by using a higher temperature cooling utility
- In cold and chill stores, minimize heat gains to the cooled space by use of air curtains, entrance vestibules, or rapidly opening/closing doors. Where conveyors carry products into chilled areas, minimize the area of transfer openings, for example, by using strip curtains
- Quantify and minimize "incidental" cooling loads, for example, those due to evaporator fans, other machinery, defrost systems and lighting in cooled spaces, circulation fans in cooling tunnels, or secondary refrigerant pumps (e.g. chilled water, brines, glycols)
- Do not use refrigeration for auxiliary cooling duties, such as compressor cylinder head or oil cooling
- While not a thermal load, ensure there is no gas bypass of the expansion valve since this imposes compressor load while providing little effective cooling
- In the case of air conditioning applications, energy efficiency techniques include:
  - Placing air intakes and air-conditioning units in cool, shaded locations
  - Improving building insulation including seals, vents, windows, and doors
  - Planting trees as thermal shields around buildings
  - Installing timers and/or thermostats and/or enthalpy-based control systems
  - Installing ventilation heat recovery systems[34]

Energy Conversion

The efficiency of refrigeration service provision is normally discussed in terms of Coefficient of Performance ("COP"), which is the ratio of cooling duty divided by input power. COP is maximized by effective refrigeration system design and increased refrigerant compression efficiency, as well as minimization of the temperature difference through which the system works and of auxiliary loads (i.e. those in addition to compressor power demand) used to operate the refrigeration system.

System Design

- If process temperatures are above ambient for all, or part, of the year, use of ambient cooling systems, such as provided by cooling towers or dry air coolers, may be appropriate, perhaps supplemented by refrigeration in summer conditions.
- Most refrigeration systems are electric-motor driven vapor compression systems using positive displacement or centrifugal compressors. The remainder of this guideline relates primarily to vapor-compression systems. However, when a cheap or free heat source is available (e.g. waste heat from an engine-driven generator—low-pressure steam

[34] More information on HVAC energy efficiency can be found at the British Columbia Building Corporation (Woolliams, 2002. http://www.greenbuildingsbc.com/new_buildings/pdf_files/greenbuild_strategies_guide.pdf), NRCAN's EnerGuide (http://oee.nrcan.gc.ca/equipment/english/index.cfm?PrintView=N&Text=N) and NRCAN's Energy Star Programs (http://oee.nrcan.gc.ca/energystar/english/consumers/heating.cfm?text=N&printview=N#AC), and the US Energy Star Program (http://www.energystar.gov/index.cfm?c=guidelines.download_guidelines).

that has passed through a back-pressure turbine), absorption refrigeration may be appropriate.

- Exploit high cooling temperature range: precooling by ambient and/or 'high temperature' refrigeration before final cooling can reduce refrigeration capital and running costs. High cooling temperature range also provides an opportunity for countercurrent (cascade) cooling, which reduces refrigerant flow needs.
- Keep 'hot' and 'cold' fluids separate, for example, do not mix water leaving the chiller with water returning from cooling circuits.
- In low-temperature systems where high temperature differences are inevitable, consider two-stage or compound compression, or economized screw compressors, rather than single-stage compression.

Minimizing Temperature Differences

A vapor-compression refrigeration system raises the temperature of the refrigerant from somewhat below the lowest process temperature (the evaporating temperature) to provide process cooling, to a higher temperature (the condensing temperature), somewhat above ambient, to facilitate heat rejection to the air or cooling water systems. Increasing evaporating temperature typically increases compressor cooling capacity without greatly affecting power consumption. Reducing condensing temperature increases evaporator cooling capacity and substantially reduces compressor power consumption.

Elevating Evaporating Temperature

- Select a large evaporator to permit relatively low temperature differences between process and evaporating temperatures. Ensure that energy use of auxiliaries (e.g. evaporator fans) does not outweigh compression savings. In air-cooling applications, a design temperature difference of 6-10 K between leaving air temperature and evaporating temperature is indicative of an appropriately sized evaporator. When cooling liquids, 2K between leaving liquid and evaporating temperatures can be achieved, though a 4K difference is generally indicative of a generously-sized evaporator.
- Keep the evaporator clean. When cooling air, ensure correct defrost operation. In liquid cooling, monitor refrigerant/process temperature differences and compare with design expectations to be alert to heat exchanger contamination by scale or oil.
- Ensure oil is regularly removed from the evaporator, and that oil additions and removals balance.
- Avoid the use of back-pressure valves.
- Adjust expansion valves to minimize suction superheat consistent with avoidance of liquid carry-over to compressors.
- Ensure that an appropriate refrigerant charge volume is present.

Reducing Condensing Temperature

- Consider whether to use air-cooled or evaporation-based cooling (e.g. evaporative or water cooled condensers and cooling towers). Air-cooled evaporators usually have higher condensing temperatures, hence higher compressor energy use, and auxiliary power consumption, especially in low humidity climates. If a wet system is used, ensure adequate treatment to prevent growth of *legionella* bacteria.
- Whichever basic system is chosen, select a relatively large condenser to minimize differences between condensing and the heat sink temperatures. Condensing temperatures with air cooled or evaporative condensers should not be more than 10K above design ambient condition, and a 4K approach in a liquid-cooled condenser is possible.

- Avoid accumulation of non-condensable gases in the condenser system. Consider the installation of refrigerated non-condensable purgers, particularly for systems operating below atmospheric pressure.
- Keep condensers clean and free from scale. Monitor refrigerant/ambient temperature differences and compare with design expectations to be alert to heat exchanger contamination.
- Avoid liquid backup, which restricts heat transfer area in condensers. This can be caused by installation errors such as concentric reducers in horizontal liquid refrigerant pipes, or "up and over" liquid lines leading from condensers.
- In multiple condenser applications, refrigerant liquid lines should be connected via drop-leg traps to the main liquid refrigerant line to ensure that hot gases flow to all condensers.
- Avoid head pressure control to the extent possible. Head pressure control maintains condensing temperature at, or near, design levels. It therefore prevents reduction in compressor power consumption, which accompanies reduced condensing temperature, by restricting condenser capacity (usually by switching off the condenser, or cooling tower fans, or restricting cooling water flow) under conditions of less severe than design load or ambient temperature conditions. Head pressure is often kept higher than necessary to facilitate hot gas defrost or adequate liquid refrigerant circulation. Use of electronic rather than thermostatic expansion valves, and liquid refrigerant pumps can permit effective refrigerant circulation at much reduced condensing temperatures.
- Site condensers and cooling towers with adequate spacing so as to prevent recirculation of hot air into the tower.

Refrigerant Compression Efficiency

- Some refrigerant compressors and chillers are more efficient than others offered for the same duty. Before purchase, identify the operating conditions under which the compressor or chiller is likely to operate for substantial parts of its annual cycle. Check operating efficiency under these conditions, and ask for estimates of annual running cost. Note that refrigeration and HVAC systems rarely run for extended periods at design conditions, which are deliberately extreme. Operational efficiency under the most commonly occurring off-design conditions is likely to be most important.
- Compressors lose efficiency when unloaded. Avoid operation of multiple compressors at part-load conditions. Note that package chillers can gain coefficient of performance (COP) when slightly unloaded, as loss of compressor efficiency can be outweighed by the benefits of reduced condensing and elevated evaporating temperature. However, it is unlikely to be energy efficient to operate a single compressor-chiller at less than 50% of capacity.
- Consider turndown efficiency when specifying chillers. Variable speed control or multiple compressor chillers can be highly efficient at part loads.
- Use of thermal storage systems (e.g., ice storage) can avoid the need for close load-tracking and, hence, can avoid part-loaded compressor operation.

Refrigeration System Auxiliaries

Many refrigeration system auxiliaries (e.g. evaporator fans and chilled water pumps) contribute to refrigeration system load, so reductions in their energy use have a double benefit. General energy saving techniques for pumps and fans, listed in the next section of these guidelines, should be applied to refrigeration auxiliaries.

Additionally, auxiliary use can be reduced by avoidance of part-load operation and in plant selection (e.g. axial fan evaporative condensers generally use less energy than equivalent centrifugal fan towers).

Under extreme off-design conditions, reduction in duty of cooling system fans and pumps can be worthwhile, usually when the lowest possible condensing pressure has been achieved.

Compressed Air Systems

Compressed air is the most commonly found utility service in industry, yet in many compressed air systems, the energy contained in compressed air delivered to the user is often 10% or less of energy used in air compression. Savings are often possible through the following techniques:

Load reduction

- Examine each true user of compressed air to identify the air volume needed and the pressure at which this should be delivered.
- Do not mix high volume low pressure and low volume high pressure loads. Decentralize low volume high-pressure applications or provide dedicated low-pressure utilities, for example, by using fans rather than compressed air.
- Review air use reduction opportunities, for example:
    - Use air amplifier nozzles rather than simple open-pipe compressed air jets
    - Consider whether compressed air is needed at all
    - Where air jets are required intermittently (e.g. to propel product), consider operating the jet via a process-related solenoid valve, which opens only when air is required
    - Use manual or automatically operated valves to isolate air supply to individual machines or zones that are not in continuous use
    - Implement systems for systematic identification and repair of leaks
    - All condensate drain points should be trapped. Do not leave drain valves continuously 'cracked open'
    - Train workers never to direct compressed air against their bodies or clothing to dust or cool themselves down.

Distribution

- Monitor pressure losses in filters and replace as appropriate
- Use adequately sized distribution pipework designed to minimize pressure losses

1.3 Wastewater and Ambient Water Quality

Applicability and Approach....25
General Liquid Effluent Quality....26
Discharge to Surface Water....26
Discharge to Sanitary Sewer Systems....26
Land Application of Treated Effluent....27
Septic Systems....27
Wastewater Management....27
Industrial Wastewater....27
Sanitary Wastewater....29
Emissions from Wastewater Treatment Operations.30
Residuals from Wastewater Treatment Operations..30
Occupational Health and Safety Issues in Wastewater Treatment Operations....30
Monitoring....30

Applicability and Approach

This guideline applies to projects that have either direct or indirect discharge of process wastewater, wastewater from utility operations or stormwater to the environment. These guidelines are also applicable to industrial discharges to sanitary sewers that discharge to the environment without any treatment. Process wastewater may include contaminated wastewater from utility operations, stormwater, and sanitary sewage. It provides information on common techniques for wastewater management, water conservation, and reuse that can be applied to a wide range of industry sectors. This guideline is meant to be complemented by the industry-specific effluent guidelines presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines. Projects with the potential to generate process wastewater, sanitary (domestic) sewage, or stormwater should incorporate the necessary precautions to avoid, minimize, and control adverse impacts to human health, safety, or the environment.

In the context of their overall ESHS management system, facilities should:

- Understand the quality, quantity, frequency and sources of liquid effluents in its installations. This includes knowledge about the locations, routes and integrity of internal drainage systems and discharge points
- Plan and implement the segregation of liquid effluents principally along industrial, utility, sanitary, and stormwater categories, in order to limit the volume of water requiring specialized treatment. Characteristics of individual streams may also be used for source segregation.
- Identify opportunities to prevent or reduce wastewater pollution through such measures as recycle/reuse within their facility, input substitution, or process modification (e.g. change of technology or operating conditions/modes).
- Assess compliance of their wastewater discharges with the applicable: (i) discharge standard (if the wastewater is discharged to a surface water or sewer), and (ii) water quality standard for a specific reuse (e.g. if the wastewater is reused for irrigation).

Additionally, the generation and discharge of wastewater of any type should be managed through a combination of:

- Water use efficiency to reduce the amount of wastewater generation
- Process modification, including waste minimization, and reducing the use of hazardous materials to reduce the load of pollutants requiring treatment
- If needed, application of wastewater treatment techniques to further reduce the load of contaminants prior to discharge, taking into consideration potential impacts of cross-media transfer of contaminants during treatment (e.g., from water to air or land)

When wastewater treatment is required prior to discharge, the level of treatment should be based on:

- Whether wastewater is being discharged to a sanitary sewer system, or to surface waters
- National and local standards as reflected in permit requirements and sewer system capacity to convey and treat wastewater if discharge is to sanitary sewer
- Assimilative capacity of the receiving water for the load of contaminant being discharged wastewater if discharge is to surface water
- Intended use of the receiving water body (e.g. as a source of drinking water, recreation, irrigation, navigation, or other)
- Presence of sensitive receptors (e.g., endangered species) or habitats
- Good International Industry Practice (GIIP) for the relevant industry sector

General Liquid Effluent Quality

Discharge to Surface Water

Discharges of process wastewater, sanitary wastewater, wastewater from utility operations or stormwater to surface water should not result in contaminant concentrations in excess of local ambient water quality criteria or, in the absence of local criteria, other sources of ambient water quality.[35] Receiving water use[36] and assimilative capacity[37], taking other sources of discharges to the receiving water into consideration, should also influence the acceptable pollution loadings and effluent discharge quality. Additional considerations that should be included in the setting of project-specific performance levels for wastewater effluents include:

- Process wastewater treatment standards consistent with applicable Industry Sector EHS Guidelines. Projects for which there are no industry-specific guidelines should reference the effluent quality guidelines of an industry sector with suitably analogous processes and effluents;
- Compliance with national or local standards for sanitary wastewater discharges or, in their absence, the indicative guideline values applicable to sanitary wastewater discharges shown in Table 1.3.1 below;
- Temperature of wastewater prior to discharge does not result in an increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use and assimilative capacity among other considerations.

Discharge to Sanitary Sewer Systems

Discharges of industrial wastewater, sanitary wastewater, wastewater from utility operations or stormwater into public or private wastewater treatment systems should:

- Meet the pretreatment and monitoring requirements of the sewer treatment system into which it discharges.
- Not interfere, directly or indirectly, with the operation and maintenance of the collection and treatment systems, or pose a risk to worker health and safety, or adversely impact

[35] An example is the US EPA National Recommended Water Quality Criteria http://www.epa.gov/waterscience/criteria/wqcriteria.html

[36] Examples of receiving water uses as may be designated by local authorities include: drinking water (with some level of treatment), recreation, aquaculture, irrigation, general aquatic life, ornamental, and navigation. Examples of health-based guideline values for receiving waters include World Health Organization (WHO) guidelines for recreational use (http://www.who.int/water_sanitation_health/dwq/guidelines/en/index.html)

[37] The assimilative capacity of the receiving water body depends on numerous factors including, but not limited to, the total volume of water, flow rate, flushing rate of the water body and the loading of pollutants from other effluent sources in the area or region. A seasonally representative baseline assessment of ambient water quality may be required for use with established scientific methods and mathematical models to estimate potential impact to the receiving water from an effluent source.

characteristics of residuals from wastewater treatment operations.

- Be discharged into municipal or centralized wastewater treatment systems that have adequate capacity to meet local regulatory requirements for treatment of wastewater generated from the project. Pretreatment of wastewater to meet regulatory requirements before discharge from the project site is required if the municipal or centralized wastewater treatment system receiving wastewater from the project does not have adequate capacity to maintain regulatory compliance.

Land Application of Treated Effluent

The quality of treated process wastewater, wastewater from utility operations or stormwater discharged on land, including wetlands, should be established based on local regulatory requirements. . Where land is used as part of the treatment system and the ultimate receptor is surface water, water quality guidelines for surface water discharges specific to the industry sector process should apply.[38] Potential impact on soil, groundwater, and surface water, in the context of protection, conservation and long term sustainability of water and land resources should be assessed when land is used as part of any wastewater treatment system.

Septic Systems

Septic systems are commonly used for treatment and disposal of domestic sanitary sewage in areas with no sewerage collection networks, Septic systems should only be used for treatment of sanitary sewage, and unsuitable for industrial wastewater treatment. When septic systems are the selected form of wastewater disposal and treatment, they should be:

- Properly designed and installed in accordance with local regulations and guidance to prevent any hazard to public health or contamination of land, surface or groundwater.
- Well maintained to allow effective operation.
- Installed in areas with sufficient soil percolation for the design wastewater loading rate.
- Installed in areas of stable soils that are nearly level, well drained, and permeable, with enough separation between the drain field and the groundwater table or other receiving waters.

Wastewater Management

Wastewater management includes water conservation, wastewater treatment, stormwater management, and wastewater and water quality monitoring.

Industrial Wastewater

Industrial wastewater generated from industrial operations includes process wastewater, wastewater from utility operations,, runoff from process and materials staging areas, and miscellaneous activities including wastewater from laboratories, equipment maintenance shops, etc.. The pollutants in an industrial wastewater may include acids or bases (exhibited as low or high pH), soluble organic chemicals causing depletion of dissolved oxygen, suspended solids, nutrients (phosphorus, nitrogen), heavy metals (e.g. cadmium, chromium, copper, lead, mercury, nickel, zinc), cyanide, toxic organic chemicals, oily materials, and volatile materials. , as well as from thermal characteristics of the discharge (e.g., elevated temperature). Transfer of pollutants to another phase, such as air, soil, or the sub-surface, should be minimized through process and engineering controls.

Process Wastewater – – Examples of treatment approaches typically used in the treatment of industrial wastewater are summarized in Annex 1.3.1. While the choice of treatment

[38] Additional guidance on water quality considerations for land application is available in the WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater. Volume 2: Wastewater Use in Agriculture http://www.who.int/water_sanitation_health/wastewater/gsuweg2/en/index.html

technology is driven by wastewater characteristics, the actual performance of this technology depends largely on the adequacy of its design, equipment selection, as well as operation and maintenance of its installed facilities. Adequate resources are required for proper operation and maintenance of a treatment facility, and performance is strongly dependent on the technical ability and training of its operational staff. One or more treatment technologies may be used to achieve the desired discharge quality and to maintain consistent compliance with regulatory requirements. The design and operation of the selected wastewater treatment technologies should avoid uncontrolled air emissions of volatile chemicals from wastewaters. Residuals from industrial wastewater treatment operations should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.

Wastewater from Utilities Operations - Utility operations such as cooling towers and demineralization systems may result in high rates of water consumption, as well as the potential release of high temperature water containing high dissolved solids, residues of biocides, residues of other cooling system anti-fouling agents, etc. Recommended water management strategies for utility operations include:

- Adoption of water conservation opportunities for facility cooling systems as provided in the Water Conservation section below;
- Use of heat recovery methods (also energy efficiency improvements) or other cooling methods to reduce the temperature of heated water prior to discharge to ensure the discharge water temperature does not result in an increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity among other considerations;
- Minimizing use of antifouling and corrosion inhibiting chemicals by ensuring appropriate depth of water intake and use of screens. Least hazardous alternatives should be used with regards to toxicity, biodegradability, bioavailability, and bioaccumulation potential. Dose applied should accord with local regulatory requirements and manufacturer recommendations;
- Testing for residual biocides and other pollutants of concern should be conducted to determine the need for dose adjustments or treatment of cooling water prior to discharge.

Stormwater Management - Stormwater includes any surface runoff and flows resulting from precipitation, drainage or other sources. Typically stormwater runoff contains suspended sediments, metals, petroleum hydrocarbons, Polycyclic Aromatic Hydrocarbons (PAHs), coliform, etc. Rapid runoff, even of uncontaminated stormwater, also degrades the quality of the receiving water by eroding stream beds and banks. In order to reduce the need for stormwater treatment, the following principles should be applied:

- Stormwater should be separated from process and sanitary wastewater streams in order to reduce the volume of wastewater to be treated prior to discharge
- Surface runoff from process areas or potential sources of contamination should be prevented
- Where this approach is not practical, runoff from process and storage areas should be segregated from potentially less contaminated runoff
- Runoff from areas without potential sources of contamination should be minimized (e.g. by minimizing the area of impermeable surfaces) and the peak discharge rate should

be reduced (e.g. by using vegetated swales and retention ponds);

- Where stormwater treatment is deemed necessary to protect the quality of receiving water bodies, priority should be given to managing and treating the first flush of stormwater runoff where the majority of potential contaminants tend to be present;
- When water quality criteria allow, stormwater should be managed as a resource, either for groundwater recharge or for meeting water needs at the facility;
- Oil water separators and grease traps should be installed and maintained as appropriate at refueling facilities, workshops, parking areas, fuel storage and containment areas.
- Sludge from stormwater catchments or collection and treatment systems may contain elevated levels of pollutants and should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.

Sanitary Wastewater

Sanitary wastewater from industrial facilities may include effluents from domestic sewage, food service, and laundry facilities serving site employees. Miscellaneous wastewater from laboratories, medical infirmaries, water softening etc. may also be discharged to the sanitary wastewater treatment system. Recommended sanitary wastewater management strategies include:

- Segregation of wastewater streams to ensure compatibility with selected treatment option (e.g. septic system which can only accept domestic sewage);
- Segregation and pretreatment of oil and grease containing effluents (e.g. use of a grease trap) prior to discharge into sewer systems;
- If sewage from the industrial facility is to be discharged to surface water, treatment to meet national or local standards for sanitary wastewater discharges or, in their absence, the indicative guideline values applicable to sanitary wastewater discharges shown in Table 1.3.1;
- If sewage from the industrial facility is to be discharged to either a septic system, or where land is used as part of the treatment system, treatment to meet applicable national or local standards for sanitary wastewater discharges is required.
- Sludge from sanitary wastewater treatment systems should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.

Table 1.3.1 Indicative Values for Treated Sanitary Sewage Discharges[a]

Pollutants	Units	Guideline Value
pH	pH	6 – 9
BOD	mg/l	30
COD	mg/l	125
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50
Total coliform bacteria	MPN[b] / 100 ml	400[a]

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

Emissions from Wastewater Treatment Operations

Air emissions from wastewater treatment operations may include hydrogen sulfide, methane, ozone (in the case of ozone disinfection), volatile organic compounds (e.g., chloroform generated from chlorination activities and other volatile organic compounds (VOCs) from industrial wastewater), gaseous or volatile chemicals used for disinfection processes (e.g., chlorine and ammonia), and bioaerosols. Odors from treatment facilities can also be a nuisance to workers and the surrounding community. Recommendations for the management of emissions are presented in the Air Emissions and Ambient Air Quality section of this document and in the EHS Guidelines for Water and Sanitation.

Residuals from Wastewater Treatment Operations

Sludge from a waste treatment plant needs to be evaluated on a case-by-case basis to establish whether it constitutes a hazardous or a non-hazardous waste and managed accordingly as described in the Waste Management section of this document.

Occupational Health and Safety Issues in Wastewater Treatment Operations

Wastewater treatment facility operators may be exposed to physical, chemical, and biological hazards depending on the design of the facilities and the types of wastewater effluents managed. Examples of these hazards include the potential for trips and falls into tanks, confined space entries for maintenance operations, and inhalation of VOCs, bioaerosols, and methane, contact with pathogens and vectors, and use of potentially hazardous chemicals, including chlorine, sodium and calcium hypochlorite, and ammonia. Detailed recommendations for the management of occupational health and safety issues are presented in the relevant section of this document. Additional guidance specifically applicable to wastewater treatment systems is provided in the EHS Guidelines for Water and Sanitation.

Monitoring

A wastewater and water quality monitoring program with adequate resources and management oversight should be developed and implemented to meet the objective(s) of the monitoring program. The wastewater and water quality monitoring program should consider the following elements:

- *Monitoring parameters*: The parameters selected for monitoring should be indicative of the pollutants of concern from the process, and should include parameters that are regulated under compliance requirements;

- *Monitoring type and frequency*: Wastewater monitoring should take into consideration the discharge characteristics from the process over time. Monitoring of discharges from processes with batch manufacturing or seasonal process variations should take into consideration of time-dependent

variations in discharges and, therefore, is more complex than monitoring of continuous discharges. Effluents from highly variable processes may need to be sampled more frequently or through composite methods. Grab samples or, if automated equipment permits, composite samples may offer more insight on average concentrations of pollutants over a 24-hour period. Composite samplers may not be appropriate where analytes of concern are short-lived (e.g., quickly degraded or volatile).

- *Monitoring locations*: The monitoring location should be selected with the objective of providing representative monitoring data. Effluent sampling stations may be located at the final discharge, as well as at strategic upstream points prior to merging of different discharges. Process discharges should not be diluted prior or after treatment with the objective of meeting the discharge or ambient water quality standards.

- *Data quality*: Monitoring programs should apply internationally approved methods for sample collection, preservation and analysis. Sampling should be conducted by or under the supervision of trained individuals. Analysis should be conducted by entities permitted or certified for this purpose. Sampling and Analysis Quality Assurance/Quality Control (QA/QC) plans should be prepared and, implemented. QA/QC documentation should be included in monitoring reports.

Annex 1.3.1 - Examples of Industrial Wastewater Treatment Approaches

Pollutant/Parameter	Control Options / Principle	Common End of Pipe Control Technology
pH	Chemical, Equalization	Acid/Base addition, Flow equalization
Oil and Grease / TPH	Phase separation	Dissolved Air Floatation, oil water separator, grease trap
TSS - Settleable	Settling, Size Exclusion	Sedimentation basin, clarifier, centrifuge, screens
TSS - Non-Settleable	Floatation, Filtration - traditional and tangential	Dissolved air floatation, Multimedia filter, sand filter, fabric filter, ultrafiltration, microfiltration
Hi - BOD (> 2 Kg/m^3)	Biological - Anaerobic	Suspended growth, attached growth, hybrid
Lo - BOD (< 2 Kg/m^3)	Biological - Aerobic, Facultative	Suspended growth, attached growth, hybrid
COD - Non-Biodegradable	Oxidation, Adsorption, Size Exclusion	Chemical oxidation, Thermal oxidation, Activated Carbon, Membranes
Metals - Particulate and Soluble	Coagulation, flocculation, precipitation, size exclusion	Flash mix with settling, filtration - traditional and tangential
Inorganics / Non-metals	Coagulation, flocculation, precipitation, size exclusion, Oxidation, Adsorption	Flash mix with settling, filtration - traditional and tangential, Chemical oxidation, Thermal oxidation, Activated Carbon, Reverse Osmosis, Evaporation
Organics - VOCs and SVOCs	Biological - Aerobic, Anaerobic, Facultative; Adsorption, Oxidation	Biological : Suspended growth, attached growth, hybrid; Chemical oxidation, Thermal oxidation, Activated Carbon
Emissions – Odors and VOCs	Capture – Active or Passive; Biological; Adsorption, Oxidation	Biological : Attached growth; Chemical oxidation, Thermal oxidation, Activated Carbon
Nutrients	Biological Nutrient Removal, Chemical, Physical, Adsorption	Aerobic/Anoxic biological treatment, chemical hydrolysis and air stripping, chlorination, ion exchange
Color	Biological - Aerobic, Anaerobic, Facultative; Adsorption, Oxidation	Biological Aerobic, Chemical oxidation, Activated Carbon
Temperature	Evaporative Cooling	Surface Aerators, Flow Equalization
TDS	Concentration, Size Exclusion	Evaporation, crystallization, Reverse Osmosis
Active Ingredients/Emerging Contaminants	Adsorption, Oxidation, Size Exclusion, Concentration	Chemical oxidation, Thermal oxidation, Activated Carbon, Ion Exchange, Reverse Osmosis, Evaporation, Crystallization
Radionuclides	Adsorption,Size Exclusion, Concentration	Ion Exchange, Reverse Osmosis, Evaporation, Crystallization
Pathogens	Disinfection, Sterilization	Chlorine, Ozone, Peroxide, UV, Thermal
Toxicity	Adsorption, Oxidation, Size Exclusion, Concentration	Chemical oxidation, Thermal oxidation, Activated Carbon, Evaporation, crystallization, Reverse Osmosis

1.4 Water Conservation

Applicability and Approach 33
Water Monitoring and Management.....33
Process Water Reuse and Recycling.....33
Building Facility Operations 34
Cooling Systems.....34
Heating Systems.....34

Applicability and Approach

Water conservation programs should be implemented commensurate with the magnitude and cost of water use. These programs should promote the continuous reduction in water consumption and achieve savings in the water pumping, treatment and disposal costs. Water conservation measures may include water monitoring/management techniques; process and cooling/heating water recycling, reuse, and other techniques; and sanitary water conservation techniques.

General recommendations include:

- Storm/Rainwater harvesting and use
- Zero discharge design/Use of treated waste water to be included in project design processes
- Use of localized recirculation systems in plant/facility/shops (as opposed to centralized recirculation system), with provision only for makeup water
- Use of dry process technologies e.g. dry quenching
- Process water system pressure management
- Project design to have measures for adequate water collection, spill control and leakage control system

Water Monitoring and Management

The essential elements of a water management program involve:

- Identification, regular measurement, and recording of principal flows within a facility;
- Definition and regular review of performance targets, which are adjusted to account for changes in major factors affecting water use (e.g. industrial production rate);
- Regular comparison of water flows with performance targets to identify where action should be taken to reduce water use.

Water measurement (metering) should emphasize areas of greatest water use. Based on review of metering data, 'unaccounted' use–indicating major leaks at industrial facilities–could be identified.

Process Water Reuse and Recycling

Opportunities for water savings in industrial processes are highly industry-specific. However, the following techniques have all been used successfully, and should be considered in conjunction with the development of the metering system described above.

- *Washing Machines:* Many washing machines use large quantities of hot water. Use can increase as nozzles become enlarged due to repeated cleaning and /or wear. Monitor machine water use, compare with specification, and replace nozzles when water and heat use reaches levels warranting such work.
- *Water reuse:* Common water reuse applications include countercurrent rinsing, for example in multi-stage washing

and rinsing processes, or reusing waste water from one process for another with less exacting water requirements. For example, using bleaching rinse water for textile washing, or bottle-washer rinse water for bottle crate washing, or even washing the floor. More sophisticated reuse projects requiring treatment of water before reuse are also sometimes practical.

- *Water jets/sprays:* If processes use water jets or sprays (e.g. to keep conveyors clean or to cool product) review the accuracy of the spray pattern to prevent unnecessary water loss.
- *Flow control optimization:* Industrial processes sometimes require the use of tanks, which are refilled to control losses. It is often possible to reduce the rate of water supply to such tanks, and sometimes to reduce tank levels to reduce spillage. If the process uses water cooling sprays, it may be possible to reduce flow while maintaining cooling performance. Testing can determine the optimum balance.
    - If hoses are used in cleaning, use flow controls to restrict wasteful water flow
    - Consider the use of high pressure, low volume cleaning systems rather than using large volumes of water sprayed from hosepipes
    - Using flow timers and limit switches to control water use
    - Using 'clean-up' practices rather than hosing down

Building Facility Operations

Consumption of building and sanitary water is typically less than that used in industrial processes. However, savings can readily be identified, as outlined below:

- Compare daily water use per employee to existing benchmarks taking into consideration the primary use at the facility, whether sanitary or including other activities such as showering or catering
- Regularly maintain plumbing, and identify and repair leaks
- Shut off water to unused areas
- Install self-closing taps, automatic shut-off valves, spray nozzles, pressure reducing valves, and water conserving fixtures (e.g. low flow shower heads, faucets, toilets, urinals; and spring loaded or sensored faucets)
- Operate dishwashers and laundries on full loads, and only when needed
- Install water-saving equipment in lavatories, such as low-flow toilets

Cooling Systems

Water conservation opportunities in cooling systems include:

- Use of closed circuit cooling systems with cooling towers rather than once-through cooling systems
- Limiting condenser or cooling tower blowdown to the minimum required to prevent unacceptable accumulation of dissolved solids
- Use of air cooling rather than evaporative cooling, although this may increase electricity use in the cooling system
- Use of treated waste water for cooling towers
- Reusing/recycling cooling tower blowdown

Heating Systems

Heating systems based on the circulation of low or medium pressure hot water (which do not consume water) should be closed. If they do consume water, regular maintenance should be conducted to check for leaks. However, large quantities of water may be used by steam systems, and this can be reduced by the following measures:

- Repair of steam and condensate leaks, and repair of all failed steam traps
- Return of condensate to the boilerhouse, and use of heat exchangers (with condensate return) rather than direct steam injection where process permits
- Flash steam recovery
- Minimizing boiler blowdown consistent with maintaining acceptably low dissolved solids in boiler water. Use of reverse osmosis boiler feed water treatment substantially reduces the need for boiler blowdown
- Minimizing deaerator heating

1.5 Hazardous Materials Management

Applicability and Approach 36
General Hazardous Materials Management 37
Hazard Assessment 37
Management Actions 37
Release Prevention and Control Planning 38
Occupational Health and Safety 38
Process Knowledge and Documentation 39
Preventive Measures 39
Hazardous Materials Transfer 39
Overfill Protection 39
Reaction, Fire, and Explosion Prevention 40
Control Measures 40
Secondary Containment (Liquids) 40
Storage Tank and Piping Leak Detection 41
Underground Storage Tanks (USTs) 41
Management of Major Hazards 42
Management Actions 42
Preventive Measures 43
Emergency Preparedness and Response 44
Community Involvement and Awareness 44

Applicability and Approach

These guidelines apply to projects that use, store, or handle any quantity of hazardous materials (Hazmats), defined as materials that represent a risk to human health, property, or the environment due to their physical or chemical characteristics. Hazmats can be classified according to the hazard as explosives; compressed gases, including toxic or flammable gases; flammable liquids; flammable solids; oxidizing substances; toxic materials; radioactive material; and corrosive substances. Guidance on the transport of hazardous materials is covered in Section 3 of this document.

When a hazardous material is no longer usable for its original purpose and is intended for disposal, but still has hazardous properties, it is considered a *hazardous waste* (see Section 1.4).

This guidance is intended to be applied in conjunction with traditional occupational health and safety and emergency preparedness programs which are included in Section 2.0 on Occupational Health and Safety Management, and Section 3.7 on Emergency Preparedness and Response. Guidance on the Transport of Hazardous Materials is provided in Section 3.5.

This section is divided into two main subsections:

General Hazardous Materials Management: Guidance applicable to all projects or facilities that handle or store any quantity of hazardous materials.

Management of Major Hazards: Additional guidance for projects or facilities that store or handle hazardous materials at, or above, threshold quantities[39], and thus require special treatment to prevent accidents such as fire, explosions, leaks or spills, and to prepare and respond to emergencies.

The overall objective of hazardous materials management is to avoid or, when avoidance is not feasible, minimize uncontrolled releases of hazardous materials or accidents (including explosion and fire) during their production, handling, storage and use. This objective can be achieved by:

[39] For examples, threshold quantities should be those established for emergency planning purposes such as provided in the US Environmental Protection Agency. *Protection of Environment* (Title Threshold quantities are provided in the US Environmental Protection Agency. *Protection of Environment* (Title 40 CFR Parts 68, 112, and 355).

- Establishing hazardous materials management priorities based on hazard analysis of risky operations identified through Social and Environmental Assessment;
- Where practicable, avoiding or minimizing the use of hazardous materials. For example, non-hazardous materials have been found to substitute asbestos in building materials, PCBs in electrical equipment, persistent organic pollutants (POPs) in pesticides formulations, and ozone depleting substances in refrigeration systems;
- Preventing uncontrolled releases of hazardous materials to the environment or uncontrolled reactions that might result in fire or explosion;
- Using engineering controls (containment, automatic alarms, and shut-off systems) commensurate with the nature of hazard;
- Implementing management controls (procedures, inspections, communications, training, and drills) to address residual risks that have not been prevented or controlled through engineering measures.

General Hazardous Materials Management

Projects which manufacture, handle, use, or store hazardous materials should establish management programs that are commensurate with the potential risks present. The main objectives of projects involving hazardous materials should be the protection of the workforce and the prevention and control of releases and accidents. These objectives should be addressed by integrating prevention and control measures, management actions, and procedures into day-to-day business activities. Potentially applicable elements of a management program include the following:

Hazard Assessment

The level of risk should be established through an on-going assessment process based on:

- The types and amounts of hazardous materials present in the project. This information should be recorded and should include a summary table with the following information:
  - Name and description (e.g. composition of a mixture) of the Hazmat
  - Classification (e.g. code, class or division) of the Hazmat
  - Internationally accepted regulatory reporting threshold quantity or national equivalent[40] of the Hazmat
  - Quantity of Hazmat used per month
  - Characteristic(s) that make(s) the Hazmat hazardous (e.g. flammability, toxicity)
- Analysis of potential spill and release scenarios using available industry statistics on spills and accidents where available
- Analysis of the potential for uncontrolled reactions such as fire and explosions
- Analysis of potential consequences based on the physical-geographical characteristics of the project site, including aspects such as its distance to settlements, water resources, and other environmentally sensitive areas

Hazard assessment should be performed by specialized professionals using internationally-accepted methodologies such as Hazardous Operations Analysis (HAZOP), Failure Mode and Effects Analysis (FMEA), and Hazard Identification (HAZID).

Management Actions

The management actions to be included in a Hazardous Materials Management Plan should be commensurate with the level of

[40] Threshold quantities are provided in the US Environmental Protection Agency. *Protection of Environment* (Title 40 CFR Parts 68, 112, and 355).

potential risks associated with the production, handling, storage, and use of hazardous materials.

Release Prevention and Control Planning

Where there is risk of a spill of uncontrolled hazardous materials, facilities should prepare a spill control, prevention, and countermeasure plan as a specific component of their Emergency Preparedness and Response Plan (described in more detail in Section 3.7). The plan should be tailored to the hazards associated with the project, and include:

- Training of operators on release prevention, including drills specific to hazardous materials as part of emergency preparedness response training
- Implementation of inspection programs to maintain the mechanical integrity and operability of pressure vessels, tanks, piping systems, relief and vent valve systems, containment infrastructure, emergency shutdown systems, controls and pumps, and associated process equipment
- Preparation of written Standard Operating Procedures (SOPs) for filling USTs, ASTs or other containers or equipment as well as for transfer operations by personnel trained in the safe transfer and filling of the hazardous material, and in spill prevention and response
- SOPs for the management of secondary containment structures, specifically the removal of any accumulated fluid, such as rainfall, to ensure that the intent of the system is not accidentally or willfully defeated
- Identification of locations of hazardous materials and associated activities on an emergency plan site map
- Documentation of availability of specific personal protective equipment and training needed to respond to an emergency
- Documentation of availability of spill response equipment sufficient to handle at least initial stages of a spill and a list of external resources for equipment and personnel, if necessary, to supplement internal resources
- Description of response activities in the event of a spill, release, or other chemical emergency including:
  - Internal and external notification procedures
  - Specific responsibilities of individuals or groups
  - Decision process for assessing severity of the release, and determining appropriate actions
  - Facility evacuation routes
  - Post-event activities such as clean-up and disposal, incident investigation, employee re-entry, and restoration of spill response equipment.

Occupational Health and Safety

The Hazardous Materials Management Plan should address applicable, essential elements of occupational health and safety management as described in Section 2.0 on Occupational Health and Safety, including:

- Job safety analysis to identify specific potential occupational hazards and industrial hygiene surveys, as appropriate, to monitor and verify chemical exposure levels, and compare with applicable occupational exposure standards[41]
- Hazard communication and training programs to prepare workers to recognize and respond to workplace chemical hazards. Programs should include aspects of hazard identification, safe operating and materials handling procedures, safe work practices, basic emergency procedures, and special hazards unique to their jobs.

[41] Including: Threshold Limit Value (TLV®) occupational exposure guidelines and Biological Exposure Indices (BEIs®), American Conference of Governmental Industrial Hygienists (ACGIH), http://www.acgih.org/TLV/; U.S. National Institute for Occupational Health and Safety (NIOSH), http://www.cdc.gov/niosh/npg/; Permissible Exposure Limits (PELs), U.S. Occupational Safety and Health Administration (OSHA), http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992; Indicative Occupational Exposure Limit Values, European Union, http://europe.osha.eu.int/good_practice/risks/ds/oel/; and other similar sources.

Training should incorporate information from Material Safety Data Sheets[42] (MSDSs) for hazardous materials being handled. MSDSs should be readily accessible to employees in their local language.

- Definition and implementation of permitted maintenance activities, such as hot work or confined space entries
- Provision of suitable personal protection equipment (PPE) (footwear, masks, protective clothing and goggles in appropriate areas), emergency eyewash and shower stations, ventilation systems, and sanitary facilities
- Monitoring and record-keeping activities, including audit procedures designed to verify and record the effectiveness of prevention and control of exposure to occupational hazards, and maintaining accident and incident investigation reports on file for a period of at least five years

Process Knowledge and Documentation

The Hazardous Materials Management Plan should be incorporated into, and consistent with, the other elements of the facility ES/OHS MS and include:

- Written process safety parameters (i.e., hazards of the chemical substances, safety equipment specifications, safe operation ranges for temperature, pressure, and other applicable parameters, evaluation of the consequences of deviations, etc.)
- Written operating procedures
- Compliance audit procedures

[42] MSDSs are produced by the manufacturer, but might not be prepared for chemical intermediates that are not distributed in commerce. In these cases, employers still need to provide workers with equivalent information.

Preventive Measures

Hazardous Materials Transfer

Uncontrolled releases of hazardous materials may result from small cumulative events, or from more significant equipment failure associated with events such as manual or mechanical transfer between storage systems or process equipment. Recommended practices to prevent hazardous material releases from processes include:

- Use of dedicated fittings, pipes, and hoses specific to materials in tanks (e.g., all acids use one type of connection, all caustics use another), and maintaining procedures to prevent addition of hazardous materials to incorrect tanks
- Use of transfer equipment that is compatible and suitable for the characteristics of the materials transferred and designed to ensure safe transfer
- Regular inspection, maintenance and repair of fittings, pipes and hoses
- Provision of secondary containment, drip trays or other overflow and drip containment measures, for hazardous materials containers at connection points or other possible overflow points.

Overfill Protection

Overfills of vessels and tanks should be prevented as they are among the most common causes of spills resulting in soil and water contamination, and among the easiest to prevent. Recommended overfill protection measures include:

- Prepare written procedures for transfer operations that includes a checklist of measures to follow during filling operations and the use of filling operators trained in these procedures
- Installation of gauges on tanks to measure volume inside
- Use of dripless hose connections for vehicle tank and fixed connections with storage tanks

- Provision of automatic fill shutoff valves on storage tanks to prevent overfilling
- Use of a catch basin around the fill pipe to collect spills
- Use of piping connections with automatic overfill protection (float valve)
- Pumping less volume than available capacity into the tank or vessel by ordering less material than its available capacity
- Provision of overfill or over pressure vents that allow controlled release to a capture point

Reaction, Fire, and Explosion Prevention

Reactive, flammable, and explosive materials should also be managed to avoid uncontrolled reactions or conditions resulting in fire or explosion. Recommended prevention practices include:

- Storage of incompatible materials (acids, bases, flammables, oxidizers, reactive chemicals) in separate areas, and with containment facilities separating material storage areas
- Provision of material-specific storage for extremely hazardous or reactive materials
- Use of flame arresting devices on vents from flammable storage containers
- Provision of grounding and lightning protection for tank farms, transfer stations, and other equipment that handles flammable materials
- Selection of materials of construction compatible with products stored for all parts of storage and delivery systems, and avoiding reuse of tanks for different products without checking material compatibility
- Storage of hazardous materials in an area of the facility separated from the main production works. Where proximity is unavoidable, physical separation should be provided using structures designed to prevent fire, explosion, spill, and other emergency situations from affecting facility operations
- Prohibition of all sources of ignition from areas near flammable storage tanks

Control Measures

Secondary Containment (Liquids)

A critical aspect for controlling accidental releases of liquid hazardous materials during storage and transfer is the provision of secondary containment. It is not necessary for secondary containment methods to meet long term material compatibility as with primary storage and piping, but their design and construction should hold released materials effectively until they can be detected and safely recovered. Appropriate secondary containment structures consist of berms, dikes, or walls capable of containing the larger of 110 percent of the largest tank or 25% percent of the combined tank volumes in areas with above-ground tanks with a total storage volume equal or greater than 1,000 liters and will be made of impervious, chemically resistant material. Secondary containment design should also consider means to prevent contact between incompatible materials in the event of a release.

Other secondary containment measures that should be applied depending on site-specific conditions include:

- Transfer of hazardous materials from vehicle tanks to storage in areas with surfaces sufficiently impervious to avoid loss to the environment and sloped to a collection or a containment structure not connected to municipal wastewater/stormwater collection system
- Where it is not practical to provide permanent, dedicated containment structures for transfer operations, one or more alternative forms of spill containment should be provided, such as portable drain covers (which can be deployed for the duration of the operations), automatic shut-off valves on storm water basins, or shut off valves in drainage or sewer facilities, combined with oil-water separators

- Storage of drummed hazardous materials with a total volume equal or greater than 1,000 liters in areas with impervious surfaces that are sloped or bermed to contain a minimum of 25 percent of the total storage volume
- Provision of secondary containment for components (tanks, pipes) of the hazardous material storage system, to the extent feasible
- Conducting periodic (e.g. daily or weekly) reconciliation of tank contents, and inspection of visible portions of tanks and piping for leaks;
- Use of double-walled, composite, or specially coated storage and piping systems particularly in the use of underground storage tanks (USTs) and underground piping. If double-walled systems are used, they should provide a means of detecting leaks between the two walls.

Storage Tank and Piping Leak Detection

Leak detection may be used in conjunction with secondary containment, particularly in high-risk locations[43]. Leak detection is especially important in situations where secondary containment is not feasible or practicable, such as in long pipe runs. Acceptable leak detection methods include:

- Use of automatic pressure loss detectors on pressurized or long distance piping
- Use of approved or certified integrity testing methods on piping or tank systems, at regular intervals
- Considering the use of SCADA[44] if financially feasible

[43] High-risk locations are places where the release of product from the storage system could result in the contamination of drinking water source or those located in water resource protection areas as designated by local authorities.

[44] Supervisory Control and Data Acquisition

Underground Storage Tanks (USTs)[45]

Although there are many environmental and safety advantages of underground storage of hazardous materials, including reduced risk of fire or explosion, and lower vapor losses into the atmosphere, leaks of hazardous materials can go undetected for long periods of time with potential for soil and groundwater contamination. Examples of techniques to manage these risks include:

- Avoiding use of USTs for storage of highly soluble organic materials
- Assessing local soil corrosion potential, and installing and maintaining cathodic protection (or equivalent rust protection) for steel tanks
- For new installations, installing impermeable liners or structures (e.g., concrete vaults) under and around tanks and lines that direct any leaked product to monitoring ports at the lowest point of the liner or structure
- Monitoring the surface above any tank for indications of soil movement
- Reconciling tank contents by measuring the volume in store with the expected volume, given the stored quantity at last stocking, and deliveries to and withdrawals from the store
- Testing integrity by volumetric, vacuum, acoustic, tracers, or other means on all tanks at regular intervals
- Considering the monitoring groundwater of quality down gradient of locations where multiple USTs are in use
- Evaluating the risk of existing UST in newly acquired facilities to determine if upgrades are required for USTs that will be continued to be used, including replacement with new systems or permanent closure of abandoned USTs. Ensuring that new USTs are sited away from wells,

[45] Additional details on the management of USTs is provided in the EHS Guidelines for Retail Petroleum Stations.

reservoirs and other source water protection areas and floodplains, and maintained so as to prevent corrosion.

Management of Major Hazards

In addition to the application of the above-referenced guidance on prevention and control of releases of hazardous materials, projects involving production, handling, and storage of hazardous materials *at or above threshold limits*[46] should prepare a Hazardous Materials Risk Management Plan, in the context of its overall ES/OHS MS, containing all of the elements presented below.[47] The objective of this guidance is the prevention and control of catastrophic releases of toxic, reactive, flammable, or explosive chemicals that may result in toxic, fire, or explosion hazards.[48]

Management Actions

- *Management of Change:* These procedures should address:
  - The technical basis for changes in processes and operations
  - The impact of changes on health and safety
  - Modification to operating procedures
  - Authorization requirements
  - Employees affected
  - Training needs
- *Compliance Audit*: A compliance audit is a way to evaluate compliance with the prevention program requirements for each process. A compliance audit covering each element of the prevention measures (see below) should be conducted at least every three years and should include:
  - Preparation of a report of the findings
  - Determination and documentation of the appropriate response to each finding
  - Documentation that any deficiency has been corrected
- *Incident Investigation:* Incidents can provide valuable information about site hazards and the steps needed to prevent accidental releases. An incident investigation mechanism should include procedures for:
  - Initiation of the investigation promptly
  - Summarizing the investigation in a report
  - Addressing the report findings and recommendations
  - A review of the report with staff and contractors
- *Employee Participation:* A written plan of action should describe an active employee participation program for the prevention of accidents.
- *Contractors:* There should be a mechanism for contractor control which should include a requirement for them to develop hazard materials management procedures that meet the requirements of the hazardous materials management plan. Their procedures should be consistent with those of the contracting company and the contractor workforce should undergo the same training. Additionally, procedures should require that contractors are:
  - Provided with safety performance procedures and safety and hazard information
  - Observe safety practices
  - Act responsibly
  - Have access to appropriate training for their employees
  - Ensure that their employees know process hazards and applicable emergency actions

[46] Threshold quantities should be those established for emergency planning purposes such as provided in the US Environmental Protection Agency. *Protection of Environment* (Title 40 CFR Parts 300-399 and 700 to 789).

[47] For further information and guidance, please refer to International Finance Corporation (IFC) Hazardous Materials Risk Management Manual. Washington, D.C. December 2000.

[48] The approach to the management of major hazards is largely based on an approach to Process Safety Management developed by the American Institute of Chemical Engineers.

- Prepare and submit training records for their employees to the contracting company
- Inform their employees about the hazards presented by their work
- Assess trends of repeated similar incidents
- Develop and implement procedures to manage repeated similar incidents

- *Training*: Project employees should be provided training on Hazmat management. The training program should include:
  - A list of employees to be trained
  - Specific training objectives
  - Mechanisms to achieve the objectives (i.e., hands-on workshops, videos, etc.)
  - The means to determine whether the training program is effective
  - Training procedures for new hires and refresher courses for existing employees

Preventive Measures

The purpose of preventive measures is to ensure that safety-related aspects of the process and equipment are considered, limits to be placed on the operations are well known, and accepted standards and codes are adopted, where they apply.

- *Process Safety Information:* Procedures should be prepared for each hazardous materials and include:
  - Compilation of Material Safety Data Sheets (MSDS)
  - Identification of maximum intended inventories and safe upper/lower parameters
  - Documentation of equipment specifications and of codes and standards used to design, build and operate the process
- *Operating Procedures:* SOPs should be prepared for each step of all processes or operations within the project (e.g. initial startup, normal operations, temporary operations, emergency shutdown, emergency operations, normal shutdown, and start-up following a normal or emergency shutdown or major change). These SOPs should include special considerations for Mazmats used in the process or operations (e.g. temperature control to prevent emissions of a volatile hazardous chemical; diversion of gaseous discharges of hazardous pollutants from the process to a temporary storage tank in case of emergency).

Other procedures to be developed include impacts of deviations, steps to avoid deviations, prevention of chemical exposure, exposure control measures, and equipment inspections.

Mechanical Integrity of process equipment, piping and instrumentation: Inspection and maintenance procedures should be developed and documented to ensure mechanical integrity of equipment, piping, and instrumentation and prevent uncontrolled releases of hazardous materials from the project. These procedures should be included as part of the project SOPs. The specific process components of major interest include pressure vessels and storage tanks, piping systems, relief and vent systems and devices, emergency shutdown systems, controls, and pumps. Recommended aspects of the inspection and maintenance program include:

- Developing inspection and maintenance procedures
- Establishing a quality assurance plan for equipment, maintenance materials, and spare parts
- Conducting employee training on the inspection and maintenance procedures
- Conducting equipment, piping, and instrumentation inspections and maintenance
- Identifying and correcting identified deficiencies

- Evaluating the inspection and maintenance results and, if necessary, updating the inspection and maintenance procedures
- Reporting the results to management.

- *Hot Work Permit:* Hot work operations – such as brazing, torch-cutting, grinding, soldering, and welding – are associated with potential health, safety, and property hazards resulting from the fumes, gases, sparks, and hot metal and radiant energy produced during hot work. Hot work permit is required for any operation involving open flames or producing heat and/or sparks. The section of SOPs on hot work should include the responsibility for hot work permitting, personal protection equipment (PPE), hot work procedures, personnel training, and recordkeeping.
- *Pre-Start Review:* Procedures should be prepared to carry out pre-start reviews when a modification is significant enough to require a change in safety information under the management of change procedure. The procedures should:
  - Confirm that the new or modified construction and/or equipment meet design specifications
  - Ensure that procedures for safety, operation, maintenance, and emergency are adequate
  - Include a process hazard assessment, and resolve or implement recommendations for new process
  - Ensure that training for all affected employees is being conducted

Emergency Preparedness and Response

When handling hazardous materials, procedures and practices should be developed allowing for quick and efficient responses to accidents that could result in human injury or damage to the environment. An Emergency Preparedness and Response Plan, incorporated into and consistent with, the facility's overall ES/OHS MS, should be prepared to cover the following:[49]

- *Planning Coordination:* Procedures should be prepared for:
  - Informing the public and emergency response agencies
  - Documenting first aid and emergency medical treatment
  - Taking emergency response actions
  - Reviewing and updating the emergency response plan to reflect changes, and ensuring that employees are informed of such changes
- *Emergency Equipment:* Procedures should be prepared for using, inspecting, testing, and maintaining the emergency response equipment.
- *Training:* Employees and contractors should be trained on emergency response procedures.

Community Involvement and Awareness

When hazardous materials are in use above threshold quantities, the management plan should include a system for community awareness, notification and involvement that should be commensurate with the potential risks identified for the project during the hazard assessment studies. This should include mechanisms for sharing the results of hazard and risk assessment studies in a timely, understandable and culturally sensitive manner with potentially affected communities that provides a means for public feedback. Community involvement activities should include:

- Availability of general information to the potentially affected community on the nature and extent of project operations, and the prevention and control measures in place to ensure no effects to human health

[49] For a comprehensive treatment of the development of emergency response plans in conjunction with communities refer to the Awareness and Preparedness for Emergencies at Local Level (APELL) Guidelines available at: http://www.uneptie.org/pc/apell/publications/handbooks.html

- The potential for off-site effects to human health or the environment following an accident at planned or existing hazardous installations
- Specific and timely information on appropriate behavior and safety measures to be adopted in the event of an accident including practice drills in locations with higher risks
- Access to information necessary to understand the nature of the possible effect of an accident and an opportunity to contribute effectively, as appropriate, to decisions concerning hazardous installations and the development of community emergency preparedness plans.

1.6 Waste Management

Applicability and Approach 46
General Waste Management.....47
Waste Management Planning 47
Waste Prevention.....47
Recycling and Reuse.....48
Treatment and Disposal.....48
Hazardous Waste Management.....48
Waste Storage 48
Transportation.....49
Treatment and Disposal.....49
Commercial or Government Waste Contractors....49
Small Quantities of Hazardous Waste 50
Monitoring.....50

Applicability and Approach

These guidelines apply to projects that generate, store, or handle any quantity of waste across a range of industry sectors. It is not intended to apply to projects or facilities where the primary business is the collection, transportation, treatment, or disposal of wastes. Specific guidance for these types of facilities is presented in the Environmental Health and Safety (EHS) Guidelines for Waste Management Facilities.

A *waste* is any solid, liquid, or contained gaseous material that is being discarded by disposal, recycling, burning or incineration. It can be byproduct of a manufacturing process or an obsolete commercial product that can no longer be used for intended purpose and requires disposal.

Solid (non-hazardous) wastes generally include any garbage, refuse. Examples of such waste include domestic trash and garbage; inert construction / demolition materials; refuse, such as metal scrap and empty containers (except those previously used to contain hazardous materials which should, in principle, be managed as a hazardous waste); and residual waste from industrial operations, such as boiler slag, clinker, and fly ash.

Hazardous waste shares the properties of a hazardous material (e.g. ignitability, corrosivity, reactivity, or toxicity), or other physical, chemical, or biological characteristics that may pose a potential risk to human health or the environment if improperly managed. Wastes may also be defined as "hazardous" by local regulations or international conventions, based on the origin of the waste and its inclusion on hazardous waste lists, or based on its characteristics.

Sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial operations needs to be evaluated on a case-by-case basis to establish whether it constitutes a hazardous or a non-hazardous waste.

Facilities that generate and store wastes should practice the following:

- Establishing waste management priorities at the outset of activities based on an understanding of potential Environmental, Health, and Safety (EHS) risks and impacts and considering waste generation and its consequences
- Establishing a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes.
- Avoiding or minimizing the generation waste materials, as far as practicable
- Where waste generation cannot be avoided but has been minimized, recovering and reusing waste

- Where waste can not be recovered or reused, treating, destroying, and disposing of it in an environmentally sound manner

General Waste Management

The following guidance applies to the management of non-hazardous and hazardous waste. Additional guidance specifically applicable to hazardous wastes is presented below. Waste management should be addressed through a Waste management system that addresses issues linked to waste minimization, generation, transport, disposal, and monitoring.

Waste Management Planning

Facilities that generate waste should characterize their waste according to composition, source, types of wastes produced, generation rates, or according to local regulatory requirements. Effective planning and implementation of waste management strategies should include:

- Review of new waste sources during planning, siting, and design activities, including during equipment modifications and process alterations, to identify expected waste generation, pollution prevention opportunities, and necessary treatment, storage, and disposal infrastructure
- Collection of data and information about the process and waste streams in existing facilities, including characterization of waste streams by type, quantities, and potential use/disposition
- Establishment of priorities based on a risk analysis that takes into account the potential EHS risks during the waste cycle and the availability of infrastructure to manage the waste in an environmentally sound manner
- Definition of opportunities for source reduction, as well as reuse and recycling
- Definition of procedures and operational controls for on-site storage
- Definition of options / procedures / operational controls for treatment and final disposal

Waste Prevention

Processes should be designed and operated to prevent, or minimize, the quantities of wastes generated and hazards associated with the wastes generated in accordance with the following strategy:

- Substituting raw materials or inputs with less hazardous or toxic materials, or with those where processing generates lower waste volumes
- Applying manufacturing process that convert materials efficiently, providing higher product output yields, including modification of design of the production process, operating conditions, and process controls[50]
- Instituting good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off-specification, contaminated, damaged, or excess to plant needs
- Instituting procurement measures that recognize opportunities to return usable materials such as containers and which prevents the over ordering of materials
- Minimizing hazardous waste generation by implementing stringent waste segregation to prevent the commingling of non-hazardous and hazardous waste to be managed

[50] Examples of waste prevention strategies include the concept of Lean Manufacturing found at http://www.epa.gov/epaoswer/hazwaste/minimize/lean.htm

Recycling and Reuse

In addition to the implementation of waste prevention strategies, the total amount of waste may be significantly reduced through the implementation of recycling plans, which should consider the following elements:

- Evaluation of waste production processes and identification of potentially recyclable materials
- Identification and recycling of products that can be reintroduced into the manufacturing process or industry activity at the site
- Investigation of external markets for recycling by other industrial processing operations located in the neighborhood or region of the facility (e.g., waste exchange)
- Establishing recycling objectives and formal tracking of waste generation and recycling rates
- Providing training and incentives to employees in order to meet objectives

Treatment and Disposal

If waste materials are still generated after the implementation of feasible waste prevention, reduction, reuse, recovery and recycling measures, waste materials should be treated and disposed of and all measures should be taken to avoid potential impacts to human health and the environment. Selected management approaches should be consistent with the characteristics of the waste and local regulations, and may include one or more of the following:

- On-site or off-site biological, chemical, or physical treatment of the waste material to render it non-hazardous prior to final disposal
- Treatment or disposal at permitted facilities specially designed to receive the waste. Examples include: composting operations for organic non-hazardous wastes; properly designed, permitted and operated landfills or incinerators designed for the respective type of waste; or other methods known to be effective in the safe, final disposal of waste materials such as bioremediation.

Hazardous Waste Management

Hazardous wastes should always be segregated from non-hazardous wastes. If generation of hazardous waste can not be prevented through the implementation of the above general waste management practices, its management should focus on the prevention of harm to health, safety, and the environment, according to the following additional principles:

- Understanding potential impacts and risks associated with the management of any generated hazardous waste during its complete life cycle
- Ensuring that contractors handling, treating, and disposing of hazardous waste are reputable and legitimate enterprises, licensed by the relevant regulatory agencies and following good international industry practice for the waste being handled
- Ensuring compliance with applicable local and international regulations[51]

Waste Storage

Hazardous waste should be stored so as to prevent or control accidental releases to air, soil, and water resources in area location where:

[51] International requirements may include host-country commitments under the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their disposal (http://www.basel.int/) and Rotterdam Convention on the prior Inform Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (http://www.pic.int/)

- Waste is stored in a manner that prevents the commingling or contact between incompatible wastes, and allows for inspection between containers to monitor leaks or spills. Examples include sufficient space between incompatibles or physical separation such as walls or containment curbs
- Store in closed containers away from direct sunlight, wind and rain
- Secondary containment systems should be constructed with materials appropriate for the wastes being contained and adequate to prevent loss to the environment
- Secondary containment is included wherever liquid wastes are stored in volumes greater than 220 liters. The available volume of secondary containment should be at least 110 percent of the largest storage container, or 25 percent of the total storage capacity (whichever is greater), in that specific location
- Provide adequate ventilation where volatile wastes are stored.

Hazardous waste storage activities should also be subject to special management actions, conducted by employees who have received specific training in handling and storage of hazardous wastes:

- Provision of readily available information on chemical compatibility to employees, including labeling each container to identify its contents
- Limiting access to hazardous waste storage areas to employees who have received proper training
- Clearly identifying (label) and demarcating the area, including documentation of its location on a facility map or site plan
- Conducting periodic inspections of waste storage areas and documenting the findings
- Preparing and implementing spill response and emergency plans to address their accidental release (additional information on Emergency Plans in provided in Section 3 of this document)
- Avoiding underground storage tanks and underground piping of hazardous waste

Transportation

On-site and Off-site transportation of waste should be conducted so as to prevent or minimize spills, releases, and exposures to employees and the public. All waste containers designated for off-site shipment should be secured and labeled with the contents and associated hazards, be properly loaded on the transport vehicles before leaving the site, and be accompanied by a shipping paper (i.e., manifest) that describes the load and its associated hazards, consistent with the guidance provided in Section 3.4 on the Transport of Hazardous Materials.

Treatment and Disposal

In addition to the recommendations for treatment and disposal applicable to general wastes, the following issues specific to hazardous wastes should be considered:

Commercial or Government Waste Contractors

In the absence of qualified commercial or government-owned waste vendors (taking into consideration proximity and transportation requirements), facilities generating waste should consider using:

- Have the technical capability to manage the waste in a manner that reduces immediate and future impact to the environment
- Have all required permits, certifications, and approvals, of applicable government authorities

- Have been secured through the use of formal procurement agreements

In the absence of qualified commercial or government-owned waste disposal operators (taking into consideration proximity and transportation requirements), project sponsors should consider using:

- Installing on-site waste treatment or recycling processes
- As a final option, constructing facilities that will provide for the environmental sound long-term storage of wastes on-site (as described elsewhere in the General EHS Guidelines) or at an alternative appropriate location up until external commercial options become available

Small Quantities of Hazardous Waste

Hazardous waste materials are frequently generated in small quantities by many projects through a variety of activities such as equipment and building maintenance activities. Examples of these types of wastes include: spent solvents and oily rags, empty paint cans, chemical containers; used lubricating oil; used batteries (such as nickel-cadmium or lead acid); and lighting equipment, such as lamps or lamp ballasts. These wastes should be managed following the guidance provided in the above sections.

Monitoring

Monitoring activities associated with the management of hazardous and non-hazardous waste should include:

- Regular visual inspection of all waste storage collection and storage areas for evidence of accidental releases and to verify that wastes are properly labeled and stored. When significant quantities of hazardous wastes are generated and stored on site, monitoring activities should include:
  - Inspection of vessels for leaks, drips or other indications of loss
  - Identification of cracks, corrosion, or damage to tanks, protective equipment, or floors
  - Verification of locks, emergency valves, and other safety devices for easy operation (lubricating if required and employing the practice of keeping locks and safety equipment in standby position when the area is not occupied)
  - Checking the operability of emergency systems
  - Documenting results of testing for integrity, emissions, or monitoring stations (air, soil vapor, or groundwater)
  - Documenting any changes to the storage facility, and any significant changes in the quantity of materials in storage
- Regular audits of waste segregation and collection practices
- Tracking of waste generation trends by type and amount of waste generated, preferably by facility departments
- Characterizing waste at the beginning of generation of a new waste stream, and periodically documenting the characteristics and proper management of the waste, especially hazardous wastes
- Keeping manifests or other records that document the amount of waste generated and its destination
- Periodic auditing of third party treatment, and disposal services including re-use and recycling facilities when significant quantities of hazardous wastes are managed by third parties. Whenever possible, audits should include site visits to the treatment storage and disposal location

- Regular monitoring of groundwater quality in cases of Hazardous Waste on site storage and/or pretreatment and disposal
- Monitoring records for hazardous waste collected, stored, or shipped should include:
  - Name and identification number of the material(s) composing the hazardous waste
  - Physical state (i.e., solid, liquid, gaseous or a combination of one, or more, of these)
  - Quantity (e.g., kilograms or liters, number of containers)
  - Waste shipment tracking documentation to include, quantity and type, date dispatched, date transported and date received, record of the originator, the receiver and the transporter
  - Method and date of storing, repacking, treating, or disposing at the facility, cross-referenced to specific manifest document numbers applicable to the hazardous waste
  - Location of each hazardous waste within the facility, and the quantity at each location

1.7 Noise

Applicability

This section addresses impacts of noise beyond the property boundary of the facilities. Worker exposure to noise is covered in Section 2.0 on Occupational Health and Safety.

Prevention and Control

Noise prevention and mitigation measures should be applied where predicted or measured noise impacts from a project facility or operations exceed the applicable noise level guideline at the most sensitive point of reception.[52] The preferred method for controlling noise from stationary sources is to implement noise control measures at source.[53] Methods for prevention and control of sources of noise emissions depend on the source and proximity of receptors. Noise reduction options that should be considered include:

- Selecting equipment with lower sound power levels
- Installing silencers for fans
- Installing suitable mufflers on engine exhausts and compressor components
- Installing acoustic enclosures for equipment casing radiating noise
- Improving the acoustic performance of constructed buildings, apply sound insulation
- Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the barrier. Barriers should be located as close to the source or to the receptor location to be effective
- Installing vibration isolation for mechanical equipment
- Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas
- Re-locating noise sources to less sensitive areas to take advantage of distance and shielding
- Siting permanent facilities away from community areas if possible
- Taking advantage of the natural topography as a noise buffer during facility design
- Reducing project traffic routing through community areas wherever possible
- Planning flight routes, timing and altitude for aircraft (airplane and helicopter) flying over community areas
- Developing a mechanism to record and respond to complaints

Noise Level Guidelines

Noise impacts should not exceed the levels presented in Table 1.7.1, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

[52] A point of reception or receptor may be defined as any point on the premises occupied by persons where extraneous noise and/or vibration are received. Examples of receptor locations may include: permanent or seasonal residences; hotels / motels; schools and daycares; hospitals and nursing homes; places of worship; and parks and campgrounds.

[53] At the design stage of a project, equipment manufacturers should provide design or construction specifications in the form of *"Insertion Loss Performance"* for silencers and mufflers, and *"Transmission Loss Performance"* for acoustic enclosures and upgraded building construction.

Table 1.7.1- Noise Level Guidelines[54]		
	One Hour L_{Aeq} (dBA)	
Receptor	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational[55]	55	45
Industrial; commercial	70	70

Highly intrusive noises, such as noise from aircraft flyovers and passing trains, should not be included when establishing background noise levels.

Monitoring

Noise monitoring[56] may be carried out for the purposes of establishing the existing ambient noise levels in the area of the proposed or existing facility, or for verifying operational phase noise levels.

Noise monitoring programs should be designed and conducted by trained specialists. Typical monitoring periods should be sufficient for statistical analysis and may last 48 hours with the use of noise monitors that should be capable of logging data continuously over this time period, or hourly, or more frequently, as appropriate (or else cover differing time periods within several days, including weekday and weekend workdays). The type of acoustic indices recorded depends on the type of noise being monitored, as established by a noise expert. Monitors should be located approximately 1.5 m above the ground and no closer than 3 m to any reflecting surface (e.g., wall). In general, the noise level limit is represented by the background or ambient noise levels that would be present in the absence of the facility or noise source(s) under investigation.

[54] Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.

[55] For acceptable indoor noise levels for residential, institutional, and educational settings refer to WHO (1999).

[56] Noise monitoring should be carried out using a Type 1 or 2 sound level meter meeting all appropriate IEC standards.

1.8 Contaminated Land

Applicability and Approach 54
Risk Screening 55
Interim Risk Management 56
Detailed Risk Assessment....56
Permanent Risk Reduction Measures....57
Occupational Health and Safety Considerations....59

Applicability and Approach

This section provides a summary of management approaches for land contamination due to anthropogenic releases of hazardous materials, wastes, or oil, including naturally occurring substances. Releases of these materials may be the result of historic or current site activities, including, but not limited to, accidents during their handling and storage, or due to their poor management or disposal.

Land is considered contaminated when it contains hazardous materials or oil concentrations above background or naturally occurring levels.

Contaminated lands may involve surficial soils or subsurface soils that, through leaching and transport, may affect groundwater, surface water, and adjacent sites. Where subsurface contaminant sources include volatile substances, soil vapor may also become a transport and exposure medium, and create potential for contaminant infiltration of indoor air spaces of buildings.

Contaminated land is a concern because of:

- The potential risks to human health and ecology (e.g. risk of cancer or other human health effects, loss of ecology);
- The liability that it may pose to the polluter/business owners (e.g., cost of remediation, damage of business reputation and/or business-community relations) or affected parties (e.g. workers at the site, nearby property owners).

Contamination of land should be avoided by preventing or controlling the release of hazardous materials, hazardous wastes, or oil to the environment. When contamination of land is suspected or confirmed during any project phase, the cause of the uncontrolled release should be identified and corrected to avoid further releases and associated adverse impacts.

Contaminated lands should be managed to avoid the risk to human health and ecological receptors. The preferred strategy for land decontamination is to reduce the level of contamination at the site while preventing the human exposure to contamination.

To determine whether risk management actions are warranted, the following assessment approach should be applied to establish whether the three risk factors of 'Contaminants', 'Receptors', and 'Exposure Pathways' co-exist, or are likely to co-exist, at the project site under current or possible future land use:

- *Contaminant(s)*: Presence of hazardous materials, waste, or oil in any environmental media at potentially hazardous concentrations
- *Receptor(s)*: Actual or likely contact of humans, wildlife, plants, and other living organisms with the contaminants of concern
- *Exposure pathway(s)*: A combination of the route of migration of the contaminant from its point of release (e.g., leaching into potable groundwater) and exposure routes

(e.g., ingestion, transdermal absorption), which would allow receptor(s) to come into actual contact with contaminants

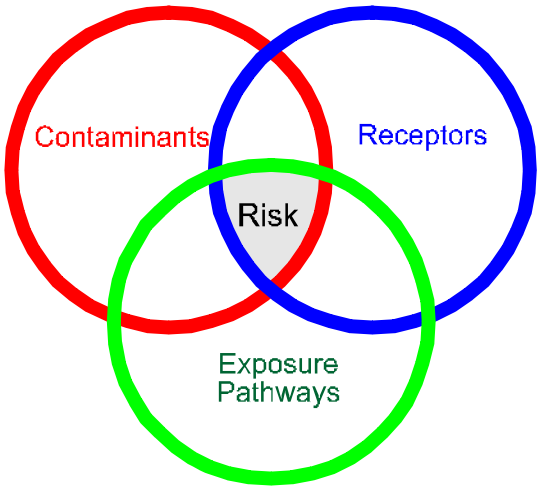


FIGURE 1.8.1: Inter-Relationship of Contaminant Risk Factors

When the three risk factors are considered to be present (in spite of limited data) under current or foreseeable future conditions, the following steps should be followed (as described in the remaining parts of this section):

1) Risk screening;
2) Interim risk management;
3) Detailed quantitative risk assessment; and
4) Permanent risk reduction measures.

Risk Screening

This step is also known as "problem formulation" for environmental risk assessment. Where there is potential evidence of contamination at a site, the following steps are recommended:

- Identification of the location of suspected highest level of contamination through a combination of visual and historical operational information;
- Sampling and testing of the contaminated media (soils or water) according to established technical methods applicable to suspected type of contaminant[57,58];
- Evaluation of the analytical results against the local and national contaminated sites regulations. In the absence of such regulations or environmental standards, other sources of risk-based standards or guidelines should be consulted to obtain comprehensive criteria for screening soil concentrations of pollutants.[59]
- Verification of the potential human and/or ecological receptors and exposure pathways relevant to the site in question

The outcome of risk-screening may reveal that there is no overlap between the three risk-factors as the contaminant levels identified are below those considered to pose a risk to human health or the environment. Alternatively, interim or permanent

[57] BC MOE. http://www.env.gov.bc.ca/epd/epdpa/contam_sites/guidance

[58] Massachusetts Department of Environment. http://www.mass.gov/dep/cleanup

[59] These may include the USEPA Region 3 Risk-Based Concentrations (RBCs). http://www.epa.gov/reg3hwmd/risk/human/index.htm. These RBCs are considered acceptable for specific land use and contaminant exposure scenarios as they have been developed by governments using risk assessment techniques for use as general targets in the site remediation. Separate PRGs have been developed or adopted for soil, sediment or groundwater, and often a distinction is made between land uses (as noted earlier) because of the need for more stringent guidelines for residential and agricultural versus commercial/industrial landuse. The RBC Tables contains Reference Doses (RfDs) and Cancer Slope Factors (CSFs) for about 400 chemicals. These toxicity factors have been combined with "standard" exposure scenarios to calculate RBCs--chemical concentrations corresponding to fixed levels of risk (i.e., a Hazard Quotient (HQ) of 1, or lifetime cancer risk of 1E-6, whichever occurs at a lower concentration) in water, air, fish tissue, and soil for individual chemical substances. The primary use of RBCs is for chemical screening during baseline risk assessment (see EPA Regional Guidance EPA/903/R-93-001, "Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening"). Additional useful soil quality guidelines can also be obtained from Lijzen et al. 2001.

risk reduction measures may need to be taken with, or without, more detailed risk assessment activities, as described below.

Interim Risk Management

Interim risk management actions should be implemented at any phase of the project life cycle if the presence of land contamination poses an "imminent hazard", i.e., representing an immediate risk to human health and the environment if contamination were allowed to continue, even a short period of time. Examples of situations considered to involve imminent hazards include, but are not restricted to:

- Presence of an explosive atmosphere caused by contaminated land
- Accessible and excessive contamination for which short-term exposure and potency of contaminants could result in acute toxicity, irreversible long term effects, sensitization, or accumulation of persistent biocumulative and toxic substances
- Concentrations of pollutants at concentrations above the Risk Based Concentrations (RBCs[60]) or drinking water standards in potable water at the point of abstraction

Appropriate risk reduction should be implemented as soon as practicable to remove the condition posing the imminent hazard.

Detailed Risk Assessment

As an alternative to complying with numerical standards or preliminary remediation goals, and depending on local regulatory requirements, a detailed site-specific, environmental risk assessment may be used to develop strategies that yield acceptable health risks, while achieving low level contamination on-site. An assessment of contaminant risks needs to be considered in the context of current and future land use, and development scenarios (e.g., residential, commercial, industrial, and urban parkland or wilderness use).

A detailed quantitative risk assessment builds on risk screening (problem formulation). It involves first, a detailed site investigation to identify the scope of contamination.[61] Site investigation programs should apply quality assurance/quality control (QA/QC) measures to ensure that data quality is adequate for the intended data use (e.g., method detection limits are below levels of concern). The site investigation in turn should be used to develop a *conceptual site model* of how and where contaminants exist, how they are transported, and where routes of exposure occur to organisms and humans. The risk factors and conceptual site model provide a framework for assessing contaminant risks.

Human or ecological risk assessments facilitate risk management decisions at contaminated sites. Specific risk assessment objectives include:

- Identifying relevant human and ecological receptors (e.g., children, adults, fish, wildlife)
- Determining if contaminants are present at levels that pose potential human health and/or ecological concerns (e.g., levels above applicable regulatory criteria based on health or environmental risk considerations)
- Determining how human or ecological receptors are exposed to the contaminants (e.g., ingestions of soil, dermal contact, inhalation of dust)

[60] For example, USEPA Region 3 Risk-Based Concentrations (RBCs). http://www.epa.gov/reg3hwmd/risk/human/index.htm.

[61] Examples include processes defined by the American Society of Testing and Materials (ASTM) Phase II ESA Process; the British Columbia Ministry of Environment Canada (BC MOE) http://www.env.gov.bc.ca/epd/epdpa/contam_sites/guidance); and the Massachusetts Department of Environment http://www.mass.gov/dep/cleanup.

- Identifying the types of adverse effects that might result from exposure to the contaminants (e.g., effect on target organ, cancer, impaired growth or reproduction) in the absence of regulatory standards
- Quantifying the magnitude of health risks to human and ecological receptors based on a quantitative analysis of contaminant exposure and toxicity (e.g. calculate lifetime cancer risk or ratios of estimated exposure rates compared to safe exposure rates)
- Determining how current and proposed future land use influence the predicted risks (e.g. change of land use from industrial to residential with more sensitive receptors such as children)
- Quantifying the potential environmental and/or human health risks from off-site contaminant migration (e.g., consider if leaching and groundwater transport, or surface water transport results in exposure at adjacent lands/receptors)
- Determining if the risk is likely to remain stable, increase, or decrease with time in the absence of any remediation (e.g., consider if the contaminant is reasonably degradable and likely to remain in place, or be transported to other media)[62]

Addressing these objectives provides a basis to develop and implement risk reduction measures (e.g., clean-up, on-site controls) at the site. If such a need exists, the following additional objectives become relevant:

- Determining where, and in what conceptual manner, risk reduction measures should be implemented
- Identifying the preferred technologies (including engineering controls) needed to implement the conceptual risk reduction measures
- Developing a monitoring plan to ascertain whether risk reduction measures are effective
- Considering the need and appropriateness for institutional controls (e.g. deed restriction, land use restrictions) as part of a comprehensive approach

Permanent Risk Reduction Measures

The *risk factors* and *conceptual site model* within the contaminant risk approach described also provide a basis to manage and mitigate environmental contaminant health risks. The underlying principle is to reduce, eliminate, or control any or all of the three risk factors illustrated in Figure 1.8.1. A short list of examples of risk mitigation strategies is provided below, although actual strategies should be developed based on site-specific conditions, and the practicality of prevailing factors and site constraints. Regardless of the management options selected, the action plan should include, whenever possible, *contaminant source reduction* (i.e., net improvement of the site) as part of the overall strategy towards managing health risks at contaminated sites, as this alone provides for improved environmental quality.

Figure 1.8.2 presents a schematic of the inter-relationship of risk factors and example strategies to mitigate contaminant health risk by modifying the conditions of one or more risk factors to ultimately reduce contaminant exposure to the receptor. The selected approach should take into consideration the technical and financial feasibility (e.g. operability of a selected technology given the local availability of technical expertise and equipment and its associated costs).

Example risk mitigation strategies for contaminant source and exposure concentrations include:

[62] An example of a simplified quantitative risk assessment method is the ASTM E1739-95(2002) Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites and the ASTM E2081-00(2004)e1 Standard Guide for Risk-Based Corrective Action (at chemical release sites).

- Soil, sediment, and sludge:
  - In situ biological treatment (aerobic or anaerobic)
  - In situ physical/chemical treatment (e.g., soil vapor extraction with off-gas treatment, chemical oxidation)
  - In situ thermal treatment (e.g., steam injection, 6-phase heating)
  - Ex situ biological treatment (e.g., excavation and composting)
  - Ex situ physical/chemical treatment (e.g., excavation and stabilization)
  - Ex situ thermal treatment (e.g., excavation and thermal desorption or incineration)
  - Containment (e.g. landfill)
  - Natural attenuation
  - Other treatment processes
- Groundwater, surface water, and leachate:
  - In situ biological treatment (aerobic and/or aerobic)
  - In situ physical/chemical treatment (e.g., air sparging, zero-valent iron permeable reactive barrier)
  - Ex situ biological, physical, and or chemical treatment (i.e., groundwater extraction and treatment)
  - Containment (e.g., slurry wall or sheet pile barrier)
  - Natural attenuation
  - Other treatment processes
- Soil vapor intrusion:
  - Soil vapor extraction to reduce VOC contaminant source in soil
  - Installation of a sub-slab depressurization system to prevent migration of soil vapor into the building
  - Creating a positive pressure condition in buildings
  - Installation (during building construction) of an impermeable barrier below the building and/or an alternative flow pathway for soil vapor beneath building foundations (e.g., porous media and ventilation to shunt vapors away from building)

Example risk mitigation strategies for receptors include:

- Limiting or preventing access to contaminant by receptors (actions targeted at the receptor may include signage with instructions, fencing, or site security)
- Imposing health advisory or prohibiting certain practices leading to exposure such as fishing, crab trapping, shellfish collection
- Educating receptors (people) to modify behavior in order to reduce exposure (e.g., improved work practices, and use of protective clothing and equipment)

Example risk mitigation strategies for exposure pathways include:

- Providing an alternative water supply to replace, for example, a contaminated groundwater supply well
- Capping contaminated soil with at least 1m of clean soil to prevent human contact, as well as plant root or small mammal penetration into contaminated soils
- Paving over contaminated soil as an interim measure to negate the pathway of direct contact or dust generation and inhalation
- Using an interception trench and pump, and treat technologies to prevent contaminated groundwater from discharging into fish streams

The above-reference containment measures should also be considered for immediate implementation in situations where source reduction measures are expected to take time.

Occupational Health and Safety Considerations

Investigation and remediation of contaminated lands requires that workers be mindful of the occupational exposures that could arise from working in close contact with contaminated soil or other environmental media (e.g., groundwater, wastewater, sediments, and soil vapor). Occupational health and safety precautions should be exercised to minimize exposure, as described in Section 2 on Occupational Health and Safety. In addition, workers on contaminated sites should receive special health and safety training specific to contaminated site investigation and remediation activities.[63]

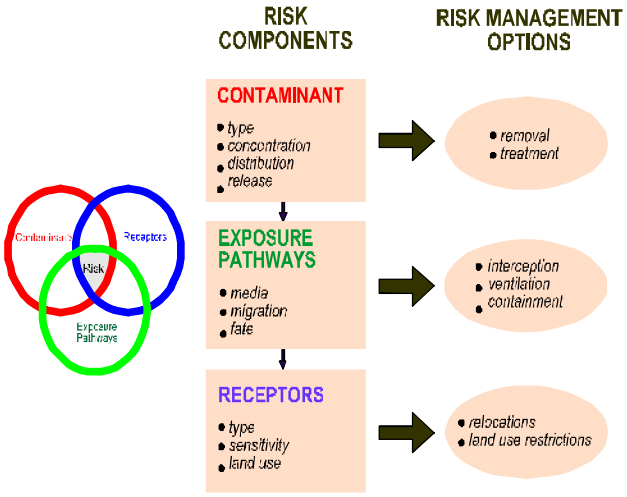


FIGURE 1.8.2: Inter-Relationship of Risk Factors and Management Options

[63] For example, US Occupational Safety and Health Agency (OSHA) regulations found at 40 CFR 1910.120. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9765

2.0 Occupational Health and Safety

Applicability and Approach....60
2.1 General Facility Design and Operation....61
Integrity of Workplace Structures....61
Severe Weather and Facility Shutdown....61
Workspace and Exit....61
Fire Precautions....62
Lavatories and Showers....62
Potable Water Supply....62
Clean Eating Area....62
Lighting....62
Safe Access....62
First Aid....63
Air Supply....63
Work Environment Temperature....63
2.2 Communication and Training....63
OHS Training....63
Visitor Orientation....63
New Task Employee and Contractor Training....63
Basic OHS Training....64
Area Signage....64
Labeling of Equipment....64
Communicate Hazard Codes....64
2.3 Physical Hazards....64
Rotating and Moving Equipment....65
Noise....65
Vibration....65
Electrical....66
Eye Hazards....67
Welding / Hot Work....67
Industrial Vehicle Driving and Site Traffic....67
Working Environment Temperature....68
Ergonomics, Repetitive Motion, Manual Handling....68
Working at Heights....68
Illumination....69
2.4 Chemical Hazards....69
Air Quality....70
Fire and Explosions....70
Corrosive, oxidizing, and reactive chemicals....71
Asbestos Containing Materials (ACM)....71
2.5 Biological Hazards....71
2.6 Radiological Hazards....73
2.7 Personal Protective Equipment (PPE)....73
2.8 Special Hazard Environments....74
Confined Space....74
Lone and Isolated Workers....75
2.9 Monitoring....75
Accidents and Diseases monitoring....76

Applicability and Approach

Employers and supervisors are obliged to implement all reasonable precautions to protect the health and safety of workers. This section provides guidance and examples of reasonable precautions to implement in managing principal risks to occupational health and safety. Although the focus is placed on the operational phase of projects, much of the guidance also applies to construction and decommissioning activities. Companies should hire contractors that have the technical capability to manage the occupational health and safety issues of their employees, extending the application of the hazard management activities through formal procurement agreements.

Preventive and protective measures should be introduced according to the following order of priority:

- *Eliminating the hazard* by removing the activity from the work process. Examples include substitution with less hazardous chemicals, using different manufacturing processes, etc;
- *Controlling the hazard* at its source through use of engineering controls. Examples include local exhaust ventilation, isolation rooms, machine guarding, acoustic insulating, etc;
- *Minimizing the hazard* through design of safe work systems and administrative or institutional control measures. Examples include job rotation, training safe work procedures, lock-out and tag-out, workplace monitoring, limiting exposure or work duration, etc.
- *Providing appropriate personal protective equipment (PPE)* in conjunction with training, use, and maintenance of the PPE.

The application of prevention and control measures to occupational hazards should be based on comprehensive job

safety or job hazard analyses. The results of these analyses should be prioritized as part of an action plan based on the likelihood and severity of the consequence of exposure to the identified hazards. An example of a qualitative risk ranking or analysis matrix to help identify priorities is described in Table 2.1.1.

Table 2.1.1. Risk Ranking Table to Classify Worker Scenarios Based on Likelihood and Consequence

Likelihood	Consequences				
	Insignificant 1	Minor 2	Moderate 3	Major 4	Catas-trophic 5
A. Almost certain	L	M	E	E	E
B. Likely	L	M	H	E	E
C. Moderate	L	M	H	E	E
D. Unlikely	L	L	M	H	E
E. Rare	L	L	M	H	H

Legend
E: extreme risk; immediate action required
H: high risk; senior management attention needed
M: moderate risk; management responsibility should be specified
L: low risk; manage by routine procedures

2.1 General Facility Design and Operation

Integrity of Workplace Structures

Permanent and recurrent places of work should be designed and equipped to protect OHS:

- Surfaces, structures and installations should be easy to clean and maintain, and not allow for accumulation of hazardous compounds.
- Buildings should be structurally safe, provide appropriate protection against the climate, and have acceptable light and noise conditions.
- Fire resistant, noise-absorbing materials should, to the extent feasible, be used for cladding on ceilings and walls.
- Floors should be level, even, and non-skid.
- Heavy oscillating, rotating or alternating equipment should be located in dedicated buildings or structurally isolated sections.

Severe Weather and Facility Shutdown

- Work place structures should be designed and constructed to withstand the expected elements for the region and have an area designated for safe refuge, if appropriate.
- Standard Operating Procedures (SOPs) should be developed for project or process shut-down, including an evacuation plan. Drills to practice the procedure and plan should also be undertaken annually.

Workspace and Exit

- The space provided for each worker, and in total, should be adequate for safe execution of all activities, including transport and interim storage of materials and products.
- Passages to emergency exits should be unobstructed at all times. Exits should be clearly marked to be visible in total darkness. The number and capacity of emergency exits should be sufficient for safe and orderly evacuation of the greatest number of people present at any time, and there should be a minimum two exits from any work area.

- Facilities also should be designed and built taking into account the needs of disabled persons.

Fire Precautions

The workplace should be designed to prevent the start of fires through the implementation of fire codes applicable to industrial settings. Other essential measures include:

- Equipping facilities with fire detectors, alarm systems, and fire-fighting equipment. The equipment should be maintained in good working order and be readily accessible. It should be adequate for the dimensions and use of the premises, equipment installed, physical and chemical properties of substances present, and the maximum number of people present.
- Provision of manual firefighting equipment that is easily accessible and simple to use
- Fire and emergency alarm systems that are both audible and visible

The IFC Life and Fire Safety Guideline should apply to buildings accessible to the public (See Section 3.3).

Lavatories and Showers

- Adequate lavatory facilities (toilets and washing areas) should be provided for the number of people expected to work in the facility and allowances made for segregated facilities, or for indicating whether the toilet facility is "In Use" or "Vacant". Toilet facilities should also be provided with adequate supplies of hot and cold running water, soap, and hand drying devices.
- Where workers may be exposed to substances poisonous by ingestion and skin contamination may occur, facilities for showering and changing into and out of street and work clothes should be provided.

Potable Water Supply

- Adequate supplies of potable drinking water should be provided from a fountain with an upward jet or with a sanitary means of collecting the water for the purposes of drinking
- Water supplied to areas of food preparation or for the purpose of personal hygiene (washing or bathing) should meet drinking water quality standards

Clean Eating Area

- Where there is potential for exposure to substances poisonous by ingestion, suitable arrangements are to be made for provision of clean eating areas where workers are not exposed to the hazardous or noxious substances

Lighting

- Workplaces should, to the degree feasible, receive natural light and be supplemented with sufficient artificial illumination to promote workers' safety and health, and enable safe equipment operation. Supplemental 'task lighting' may be required where specific visual acuity requirements should be met.
- Emergency lighting of adequate intensity should be installed and automatically activated upon failure of the principal artificial light source to ensure safe shut-down, evacuation, etc.

Safe Access

- Passageways for pedestrians and vehicles within and outside buildings should be segregated and provide for easy, safe, and appropriate access
- Equipment and installations requiring servicing, inspection, and/or cleaning should have unobstructed, unrestricted, and ready access
- Hand, knee and foot railings should be installed on stairs, fixed ladders, platforms, permanent and interim floor openings, loading bays, ramps, etc.

- Openings should be sealed by gates or removable chains
- Covers should, if feasible, be installed to protect against falling items
- Measures to prevent unauthorized access to dangerous areas should be in place

First Aid

- The employer should ensure that qualified first-aid can be provided at all times. Appropriately equipped first-aid stations should be easily accessible throughout the place of work
- Eye-wash stations and/or emergency showers should be provided close to all workstations where immediate flushing with water is the recommended first-aid response
- Where the scale of work or the type of activity being carried out so requires, dedicated and appropriately equipped first-aid room(s) should be provided. First aid stations and rooms should be equipped with gloves, gowns, and masks for protection against direct contact with blood and other body fluids
- Remote sites should have written emergency procedures in place for dealing with cases of trauma or serious illness up to the point at which patient care can be transferred to an appropriate medical facility.

Air Supply

- Sufficient fresh air should be supplied for indoor and confined work spaces. Factors to be considered in ventilation design include physical activity, substances in use, and process-related emissions. Air distribution systems should be designed so as not to expose workers to draughts
- Mechanical ventilation systems should be maintained in good working order. Point-source exhaust systems required for maintaining a safe ambient environment should have local indicators of correct functioning.
- Re-circulation of contaminated air is not acceptable. Air inlet filters should be kept clean and free of dust and microorganisms. Heating, ventilation and air conditioning (HVAC) and industrial evaporative cooling systems should be equipped, maintained and operated so as to prevent growth and spreading of disease agents (e.g. *Legionnella pneumophilia*) or breeding of vectors (e.g. mosquitoes and flies) of public health concern.

Work Environment Temperature

- The temperature in work, rest room and other welfare facilities should, during service hours, be maintained at a level appropriate for the purpose of the facility.

2.2 Communication and Training

OHS Training

- Provisions should be made to provide OHS orientation training to all new employees to ensure they are apprised of the basic site rules of work at / on the site and of personal protection and preventing injury to fellow employees.
- Training should consist of basic hazard awareness, site-specific hazards, safe work practices, and emergency procedures for fire, evacuation, and natural disaster, as appropriate. Any site-specific hazard or color coding in use should be thoroughly reviewed as part of orientation training.

Visitor Orientation

- If visitors to the site can gain access to areas where hazardous conditions or substances may be present, a visitor orientation and control program should be established to ensure visitors do not enter hazard areas unescorted.

New Task Employee and Contractor Training

- The employer should ensure that workers and contractors, prior to commencement of new assignments, have received adequate training and information enabling them to

understand work hazards and to protect their health from hazardous ambient factors that may be present.

The training should adequately cover:

- Knowledge of materials, equipment, and tools
- Known hazards in the operations and how they are controlled
- Potential risks to health
- Precautions to prevent exposure
- Hygiene requirements
- Wearing and use of protective equipment and clothing
- Appropriate response to operation extremes, incidents and accidents

Basic OHS Training

- A basic occupational training program and specialty courses should be provided, as needed, to ensure that workers are oriented to the specific hazards of individual work assignments. Training should generally be provided to management, supervisors, workers, and occasional visitors to areas of risks and hazards.
- Workers with rescue and first-aid duties should receive dedicated training so as not to inadvertently aggravate exposures and health hazards to themselves or their co-workers. Training would include the risks of becoming infected with blood–borne pathogens through contact with bodily fluids and tissue.
- Through appropriate contract specifications and monitoring, the employer should ensure that service providers, as well as contracted and subcontracted labor, are trained adequately before assignments begin.

Area Signage

- Hazardous areas (electrical rooms, compressor rooms, etc), installations, materials, safety measures, and emergency exits, etc. should be marked appropriately.
- Signage should be in accordance with international standards and be well known to, and easily understood by workers, visitors and the general public as appropriate.

Labeling of Equipment

- All vessels that may contain substances that are hazardous as a result of chemical or toxicological properties, or temperature or pressure, should be labeled as to the contents and hazard, or appropriately color coded.
- Similarly, piping systems that contain hazardous substances should be labeled with the direction of flow and contents of the pipe, or color coded whenever the pipe passing through a wall or floor is interrupted by a valve or junction device.

Communicate Hazard Codes

- Copies of the hazard coding system should be posted outside the facility at emergency entrance doors and fire emergency connection systems where they are likely to come to the attention of emergency services personnel.
- Information regarding the types of hazardous materials stored, handled or used at the facility, including typical maximum inventories and storage locations, should be shared proactively with emergency services and security personnel to expedite emergency response when needed.
- Representatives of local emergency and security services should be invited to participate in periodic (annual) orientation tours and site inspections to ensure familiarity with potential hazards present.

2.3 Physical Hazards

Physical hazards represent potential for accident or injury or illness due to repetitive exposure to mechanical action or work activity. Single exposure to physical hazards may result in a wide range of injuries, from minor and medical aid only, to disabling, catastrophic, and/or fatal. Multiple exposures over prolonged

periods can result in disabling injuries of comparable significance and consequence.

Rotating and Moving Equipment

Injury or death can occur from being trapped, entangled, or struck by machinery parts due to unexpected starting of equipment or unobvious movement during operations. Recommended protective measures include:

- Designing machines to eliminate trap hazards and ensuring that extremities are kept out of harm's way under normal operating conditions. Examples of proper design considerations include two-hand operated machines to prevent amputations or the availability of emergency stops dedicated to the machine and placed in strategic locations. Where a machine or equipment has an exposed moving part or exposed pinch point that may endanger the safety of any worker, the machine or equipment should be equipped with, and protected by, a guard or other device that prevents access to the moving part or pinch point. Guards should be designed and installed in conformance with appropriate machine safety standards.[64]
- Turning off, disconnecting, isolating, and de-energizing (Locked Out and Tagged Out) machinery with exposed or guarded moving parts, or in which energy can be stored (e.g. compressed air, electrical components) during servicing or maintenance, in conformance with a standard such as CSA Z460 Lockout or equivalent ISO or ANSI standard
- Designing and installing equipment, where feasible, to enable routine service, such as lubrication, without removal of the guarding devices or mechanisms

[64] For example: CSA Z432.04 Safe Guarding of Machinery, CSA Z434 Robot Safety, ISO 11161 Safety of Machinery – Integrated Manufacturing Systems or ISO 14121 Safety of Machinery – Principals of Risk Management or equivalent ANSI standard.

Noise

Noise limits for different working environments are provided in Table 2.3.1.

- No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C).
- The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reach 140 dB(C), or the average maximum sound level reaches 110dB(A). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85 dB(A).
- Although hearing protection is preferred for any period of noise exposure in excess of 85 dB(A), an equivalent level of protection can be obtained, but less easily managed, by limiting the duration of noise exposure. For every 3 dB(A) increase in sound levels, the 'allowed' exposure period or duration should be reduced by 50 percent.[65]
- Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls should be investigated and implemented, where feasible
- Periodic medical hearing checks should be performed on workers exposed to high noise levels

Vibration

Exposure to hand-arm vibration from equipment such as hand and power tools, or whole-body vibrations from surfaces on which the worker stands or sits, should be controlled through choice of equipment, installation of vibration dampening pads or devices, and limiting the duration of exposure. Limits for vibration and

[65] The American Conference of Governmental Industrial Hygienists (ACGIH), 2006

action values, (i.e. the level of exposure at which remediation should be initiated) are provided by the ACGIH[66]. Exposure levels should be checked on the basis of daily exposure time and data provided by equipment manufacturers.

Electrical

Exposed or faulty electrical devices, such as circuit breakers, panels, cables, cords and hand tools, can pose a serious risk to workers. Overhead wires can be struck by metal devices, such as poles or ladders, and by vehicles with metal booms. Vehicles or grounded metal objects brought into close proximity with overhead wires can result in arcing between the wires and the object, without actual contact. Recommended actions include:

Table 2.3.1. Noise Limits for Various Working Environments

Location /activity	Equivalent level $LA_{eq,8h}$	Maximum $LA_{max,fast}$
Heavy Industry (no demand for oral communication)	85 dB(A)	110 dB(A)
Light industry (decreasing demand for oral communication)	50-65 dB(A)	110 dB(A)
Open offices, control rooms, service counters or similar	45-50 dB(A)	-
Individual offices (no disturbing noise)	40-45 dB(A)	-
Classrooms, lecture halls	35-40 dB(A)	-
Hospitals	30-35 dB(A)	40 dB(A)

- Marking all energized electrical devices and lines with warning signs
- Locking out (de-charging and leaving open with a controlled locking device) and tagging-out (warning sign placed on the lock) devices during service or maintenance
- Checking all electrical cords, cables, and hand power tools for frayed or exposed cords and following manufacturer recommendations for maximum permitted operating voltage of the portable hand tools
- Double insulating / grounding all electrical equipment used in environments that are, or may become, wet; using equipment with ground fault interrupter (GFI) protected circuits
- Protecting power cords and extension cords against damage from traffic by shielding or suspending above traffic areas
- Appropriate labeling of service rooms housing high voltage equipment ('electrical hazard') and where entry is controlled or prohibited (see also Section 3 on Planning, Siting, and Design);
- Establishing "No Approach" zones around or under high voltage power lines in conformance with Table 2.3.2
- Rubber tired construction or other vehicles that come into direct contact with, or arcing between, high voltage wires may need to be taken out of service for periods of 48 hours and have the tires replaced to prevent catastrophic tire and wheel assembly failure, potentially causing serious injury or death;
- Conducting detailed identification and marking of all buried electrical wiring prior to any excavation work

[66] ACGIH, 2005

Table 2.3.2. No Approach Zones for High Voltage Power Lines	
Nominal phase-to-phase voltage rating	Minimum distance
750 or more volts, but no more than 150,000 volts	3 meters
More than 150,000 volts, but no more than 250,000 volts	4.5 meters
More than 250,000 volts	6 meters

Eye Hazards

Solid particles from a wide variety of industrial operations, and / or a liquid chemical spray may strike a worker in the eye causing an eye injury or permanent blindness. Recommended measures include:

- Use of machine guards or splash shields and/or face and eye protection devices, such as safety glasses with side shields, goggles, and/or a full face shield. Specific Safe Operating Procedures (SOPs) may be required for use of sanding and grinding tools and/or when working around liquid chemicals. Frequent checks of these types of equipment prior to use to ensure mechanical integrity is also good practice. Machine and equipment guarding should conform to standards published by organizations such as CSA, ANSI and ISO (see also Section 2.3 on Rotating and Moving Equipment and 2.7 on Personal Protective Equipment).
- Moving areas where the discharge of solid fragments, liquid, or gaseous emissions can reasonably be predicted (e.g. discharge of sparks from a metal cutting station, pressure relief valve discharge) away from places expected to be occupied or transited by workers or visitors. Where machine or work fragments could present a hazard to transient workers or passers-by, extra area guarding or proximity restricting systems should be implemented, or PPE required for transients and visitors.
- Provisions should be made for persons who have to wear prescription glasses either through the use overglasses or prescription hardened glasses.

Welding / Hot Work

Welding creates an extremely bright and intense light that may seriously injur a worker's eyesight. In extreme cases, blindness may result. Additionally, welding may produce noxious fumes to which prolonged exposure can cause serious chronic diseases. Recommended measures include:

- Provision of proper eye protection such as welder goggles and/or a full-face eye shield for all personnel involved in, or assisting, welding operations. Additional methods may include the use of welding barrier screens around the specific work station (a solid piece of light metal, canvas, or plywood designed to block welding light from others). Devices to extract and remove noxious fumes at the source may also be required.
- Special hot work and fire prevention precautions and Standard Operating Procedures (SOPs) should be implemented if welding or hot cutting is undertaken outside established welding work stations, including 'Hot Work Permits, stand-by fire extinguishers, stand-by fire watch, and maintaining the fire watch for up to one hour after welding or hot cutting has terminated. Special procedures are required for hotwork on tanks or vessels that have contained flammable materials.

Industrial Vehicle Driving and Site Traffic

Poorly trained or inexperienced industrial vehicle drivers have increased risk of accident with other vehicles, pedestrians, and equipment. Industrial vehicles and delivery vehicles, as well as private vehicles on-site, also represent potential collision scenarios. Industrial vehicle driving and site traffic safety practices include:

- Training and licensing industrial vehicle operators in the safe operation of specialized vehicles such as forklifts, including safe loading/unloading, load limits
- Ensuring drivers undergo medical surveillance
- Ensuring moving equipment with restricted rear visibility is outfitted with audible back-up alarms
- Establishing rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures (e.g. prohibiting operation of forklifts with forks in down position), and control of traffic patterns or direction
- Restricting the circulation of delivery and private vehicles to defined routes and areas, giving preference to 'one-way' circulation, where appropriate

Working Environment Temperature

Exposure to hot or cold working conditions in indoor or outdoor environments can result temperature stress-related injury or death. Use of personal protective equipment (PPE) to protect against other occupational hazards can accentuate and aggravate heat-related illnesses. Extreme temperatures in permanent work environments should be avoided through implementation of engineering controls and ventilation. Where this is not possible, such as during short-term outdoor work, temperature-related stress management procedures should be implemented which include:

- Monitoring weather forecasts for outdoor work to provide advance warning of extreme weather and scheduling work accordingly
- Adjustment of work and rest periods according to temperature stress management procedures provided by ACGIH[67], depending on the temperature and workloads
- Providing temporary shelters to protect against the elements during working activities or for use as rest areas
- Use of protective clothing
- Providing easy access to adequate hydration such as drinking water or electrolyte drinks, and avoiding consumption of alcoholic beverages

Ergonomics, Repetitive Motion, Manual Handling

Injuries due to ergonomic factors, such as repetitive motion, over-exertion, and manual handling, take prolonged and repeated exposures to develop, and typically require periods of weeks to months for recovery. These OHS problems should be minimized or eliminated to maintain a productive workplace. Controls may include:

- Facility and workstation design with 5th to 95th percentile operational and maintenance workers in mind
- Use of mechanical assists to eliminate or reduce exertions required to lift materials, hold tools and work objects, and requiring multi-person lifts if weights exceed thresholds
- Selecting and designing tools that reduce force requirements and holding times, and improve postures
- Providing user adjustable work stations
- Incorporating rest and stretch breaks into work processes, and conducting job rotation
- Implementing quality control and maintenance programs that reduce unnecessary forces and exertions
- Taking into consideration additional special conditions such as left handed persons

Working at Heights

Fall prevention and protection measures should be implemented whenever a worker is exposed to the hazard of falling more than two meters; into operating machinery; into water or other liquid; into hazardous substances; or through an opening in a work surface. Fall prevention / protection measures may also be warranted on a case-specific basis when there are risks of falling from lesser heights. Fall prevention may include:

[67] ACGIH, 2005

- Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area
- Proper use of ladders and scaffolds by trained employees
- Use of fall prevention devices, including safety belt and lanyard travel limiting devices to prevent access to fall hazard area, or fall protection devices such as full body harnesses used in conjunction with shock absorbing lanyards or self-retracting inertial fall arrest devices attached to fixed anchor point or horizontal life-lines
- Appropriate training in use, serviceability, and integrity of the necessary PPE
- Inclusion of rescue and/or recovery plans, and equipment to respond to workers after an arrested fall

Illumination

Work area light intensity should be adequate for the general purpose of the location and type of activity, and should be supplemented with dedicated work station illumination, as needed. The minimum limits for illumination intensity for a range of locations/activities appear in Table 2.3.3.

Table 2.3.3. Minimum Limits For Workplace Illumination Intensity

Location / Activity	Light Intensity
Emergency light	10 lux
Outdoor non working areas	20 lux
Simple orientation and temporary visits (machine storage, garage, warehouse)	50 lux
Workspace with occasional visual tasks only (corridors, stairways, lobby, elevator, auditorium, etc.)	100 lux
Medium precision work (simple assembly, rough machine works, welding, packing, etc.)	200 lux
Precision work (reading, moderately difficult assembly, sorting, checking, medium bench and machine works, etc.), offices.	500 lux
High precision work (difficult assembly, sewing, color inspection, fine sorting etc.)	1,000 – 3,000 lux

Controls should include:

- Use of energy efficient light sources with minimum heat emission
- Undertaking measures to eliminate glare / reflections and flickering of lights
- Taking precautions to minimize and control optical radiation including direct sunlight. Exposure to high intensity UV and IR radiation and high intensity visible light should also be controlled
- Controlling laser hazards in accordance with equipment specifications, certifications, and recognized safety standards. The lowest feasible class Laser should be applied to minimize risks.

2.4 Chemical Hazards

Chemical hazards represent potential for illness or injury due to single acute exposure or chronic repetitive exposure to toxic, corrosive, sensitizing or oxidative substances. They also represent a risk of uncontrolled reaction, including the risk of fire and explosion, if incompatible chemicals are inadvertently mixed. Chemical hazards can most effectively be prevented through a hierarchical approach that includes:

- Replacement of the hazardous substance with a less hazardous substitute
- Implementation of engineering and administrative control measures to avoid or minimize the release of hazardous substances into the work environment keeping the level of exposure below internationally established or recognized limits
- Keeping the number of employees exposed, or likely to become exposed, to a minimum

- Communicating chemical hazards to workers through labeling and marking according to national and internationally recognized requirements and standards, including the International Chemical Safety Cards (ICSC), Materials Safety Data Sheets (MSDS), or equivalent. Any means of written communication should be in an easily understood language and be readily available to exposed workers and first-aid personnel
- Training workers in the use of the available information (such as MSDSs), safe work practices, and appropriate use of PPE

Air Quality

Poor air quality due to the release of contaminants into the work place can result in possible respiratory irritation, discomfort, or illness to workers. Employers should take appropriate measures to maintain air quality in the work area. These include:

- Maintaining levels of contaminant dusts, vapors and gases in the work environment at concentrations below those recommended by the ACGIH[68] as TWA-TLV's (threshold limit value)—concentrations to which most workers can be exposed repeatedly (8 hours/day, 40 hrs/week, week-after-week), without sustaining adverse health effects.
- Developing and implementing work practices to minimize release of contaminants into the work environment including:
  - Direct piping of liquid and gaseous materials
  - Minimized handling of dry powdered materials;
  - Enclosed operations
  - Local exhaust ventilation at emission / release points
  - Vacuum transfer of dry material rather than mechanical or pneumatic conveyance
  - Indoor secure storage, and sealed containers rather than loose storage
- Where ambient air contains several materials that have similar effects on the same body organs (additive effects), taking into account combined exposures using calculations recommended by the ACGIH[69]
- Where work shifts extend beyond eight (8) hours, calculating adjusted workplace exposure criteria recommended by the ACGIH[70]

Fire and Explosions

Fires and or explosions resulting from ignition of flammable materials or gases can lead to loss of property as well as possible injury or fatalities to project workers. Prevention and control strategies include:

- Storing flammables away from ignition sources and oxidizing materials. Further, flammables storage area should be:
  - Remote from entry and exit points into buildings
  - Away from facility ventilation intakes or vents
  - Have natural or passive floor and ceiling level ventilation and explosion venting
  - Use spark-proof fixtures
  - Be equipped with fire extinguishing devices and self-closing doors, and constructed of materials made to withstand flame impingement for a moderate period of time
- Providing bonding and grounding of, and between, containers and additional mechanical floor level ventilation if materials are being, or could be, dispensed in the storage area
- Where the flammable material is mainly comprised of dust, providing electrical grounding, spark detection, and, if needed, quenching systems

[68] ACGIH, 2005

[69] ACGIH, 2005.

[70] ACGIH, 2005.

- Defining and labeling fire hazards areas to warn of special rules (e.g. prohibition in use of smoking materials, cellular phones, or other potential spark generating equipment)
- Providing specific worker training in handling of flammable materials, and in fire prevention or suppression

Corrosive, oxidizing, and reactive chemicals

Corrosive, oxidizing, and reactive chemicals present similar hazards and require similar control measures as flammable materials. However, the added hazard of these chemicals is that inadvertent mixing or intermixing may cause serious adverse reactions. This can lead to the release of flammable or toxic materials and gases, and may lead directly to fires and explosions. These types of substances have the additional hazard of causing significant personal injury upon direct contact, regardless of any intermixing issues. The following controls should be observed in the work environment when handling such chemicals:

- Corrosive, oxidizing and reactive chemicals should be segregated from flammable materials and from other chemicals of incompatible class (acids vs. bases, oxidizers vs. reducers, water sensitive vs. water based, etc.), stored in ventilated areas and in containers with appropriate secondary containment to minimize intermixing during spills
- Workers who are required to handle corrosive, oxidizing, or reactive chemicals should be provided with specialized training and provided with, and wear, appropriate PPE (gloves, apron, splash suits, face shield or goggles, etc).
- Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first-aid should be ensured at all times. Appropriately equipped first-aid stations should be easily accessible throughout the place of work, and eye-wash stations and/or emergency showers should be provided close to all workstations where the recommended first-aid response is immediate flushing with water

Asbestos Containing Materials (ACM)

The use of asbestos containing materials (ACM) should be avoided in new buildings or as a new material in remodeling or renovation activities. Existing facilities with ACM should develop an asbestos management plan which clearly identifies the locations where the ACM is present, its condition (e.g. whether it is in friable form with the potential to release fibers), procedures for monitoring its condition, procedures to access the locations where ACM is present to avoid damage, and training of staff who can potentially come into contact with the material to avoid damage and prevent exposure. The plan should be made available to all persons involved in operations and maintenance activities. Repair or removal and disposal of existing ACM in buildings should only be performed by specially trained personnel[71] following host country requirements, or in their absence, internationally recognized procedures.[72]

2.5 Biological Hazards

Biological agents represent potential for illness or injury due to single acute exposure or chronic repetitive exposure. Biological hazards can be prevented most effectively by implementing the following measures:

- If the nature of the activity permits, use of any harmful biological agents should be avoided and replaced with an agent that, under normal conditions of use, is not dangerous or less dangerous to workers. If use of harmful agents can not be avoided, precautions should be taken to keep the risk of exposure as low as possible and maintained below internationally established and recognized exposure limits.

[71] Training of specialized personnel and the maintenance and removal methods applied should be equivalent to those required under applicable regulations in the United States and Europe (examples of North American training standards are available at: http://www.osha.gov/SLTC/asbestos/training.html)

[72] Examples include the American Society for Testing and Materials (ASTM) E 1368 - Standard Practice for Visual Inspection of Asbestos Abatement Projects; E 2356 - Standard Practice for Comprehensive Building Asbestos Surveys; and E 2394 - Standard Practice for Maintenance, Renovation and Repair of Installed Asbestos Cement Products.

- Work processes, engineering, and administrative controls should be designed, maintained, and operated to avoid or minimize release of biological agents into the working environment. The number of employees exposed or likely to become exposed should be kept at a minimum.
- The employer should review and assess known and suspected presence of biological agents at the place of work and implement appropriate safety measures, monitoring, training, and training verification programs.
- Measures to eliminate and control hazards from known and suspected biological agents at the place of work should be designed, implemented and maintained in close co-operation with the local health authorities and according to recognized international standards.

Biological agents should be classified into four groups[73]:

- ***Group 1:*** Biological agents unlikely to cause human disease, and consequently only require controls similar to those required for hazardous or reactive chemical substances;
- ***Group 2:*** Biological agents that can cause human disease and are thereby likely to require additional controls, but are unlikely to spread to the community;
- ***Group 3***: Biological agents that can cause severe human disease, present a serious hazard to workers, and may present a risk of spreading to the community, for which there usually is effective prophylaxis or treatment available and are thereby likely to require extensive additional controls;
- ***Group 4:*** Biological agents that can cause severe human disease, are a serious hazard to workers, and present a high risk of spreading to the community, for which there is usually no effective prophylaxis or treatment available and are thereby likely to require very extensive additional controls.

The employer should at all times encourage and enforce the highest level of hygiene and personal protection, especially for activities employing biological agents of Groups 3 and 4 above. Work involving agents in Groups 3 and 4 should be restricted only to those persons who have received specific verifiable training in working with and controlling such materials.

Areas used for the handling of Groups 3 and 4 biological agents should be designed to enable their full segregation and isolation in emergency circumstances, include independent ventilation systems, and be subject to SOPs requiring routine disinfection and sterilization of the work surfaces.

HVAC systems serving areas handling Groups 3 and 4 biological agents should be equipped with High Efficiency Particulate Air (HEPA) filtration systems. Equipment should readily enable their disinfection and sterilization, and maintained and operated so as to prevent growth and spreading of disease agents, amplification of the biological agents, or breeding of vectors e.g. mosquitoes and flies of public health concern.

[73] World Health Organization (WHO) Classification of Infective Microorganisms by Risk Group (2004).

2.6 Radiological Hazards

Radiation exposure can lead to potential discomfort, injury or serious illness to workers. Prevention and control strategies include:

- Places of work involving occupational and/or natural exposure to ionizing radiation should be established and operated in accordance with recognized international safety standards and guidelines.[74] The acceptable effective dose limits appear Table 2.6.1.
- Exposure to non-ionizing radiation (including static magnetic fields; sub-radio frequency magnetic fields; static electric fields; radio frequency and microwave radiation; light and near-infrared radiation; and ultraviolet radiation) should be controlled to internationally recommended limits[75].

Table 2.6.1. Acceptable Effective Dose Limits for Workplace Radiological Hazards

Exposure	Workers (min.19 years of age)	Apprentices and students (16-18 years of age)
Five consecutive year average – effective dose	20 mSv/year	
Single year exposure – effective dose	50 mSv/year	6 mSv/year
Equivalent dose to the lens of the eye	150 mSv/year	50 mSv/year
Equivalent dose to the extremities (hands, feet) or the skin	500 mSv/year	150 mSv/year

- In the case of both ionizing and non-ionizing radiation, the preferred method for controlling exposure is shielding and limiting the radiation source. Personal protective equipment is supplemental only or for emergency use. Personal protective equipment for near-infrared, visible and ultraviolet range radiation can include appropriate sun block creams, with or without appropriate screening clothing.

2.7 Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) provides additional protection to workers exposed to workplace hazards in conjunction with other facility controls and safety systems.

PPE is considered to be a last resort that is above and beyond the other facility controls and provides the worker with an extra level of personal protection. Table 2.7.1 presents general examples of occupational hazards and types of PPE available for different purposes. Recommended measures for use of PPE in the workplace include:

- Active use of PPE if alternative technologies, work plans or procedures cannot eliminate, or sufficiently reduce, a hazard or exposure
- Identification and provision of appropriate PPE that offers adequate protection to the worker, co-workers, and occasional visitors, without incurring unnecessary inconvenience to the individual
- Proper maintenance of PPE, including cleaning when dirty and replacement when damaged or worn out. Proper use of PPE should be part of the recurrent training programs for employees

[74] International Basic Safety Standard for protection against Ionizing Radiation and for the Safety of Radiation Sources and its three interrelated Safety Guides.

IAEA. http://www-ns.iaea.org/standards/documents/default.asp?sub=160

[75] For example ACGIH (2005) and International Commission for Non-Ionizing Radiation (ICNIRP).

- Selection of PPE should be based on the hazard and risk ranking described earlier in this section, and selected according to criteria on performance and testing established by recognized organizations[76].

Table 2.7.1. Summary of Recommended Personal Protective Equipment According to Hazard

Objective	Workplace Hazards	Suggested PPE
Eye and face protection	Flying particles, molten metal, liquid chemicals, gases or vapors, light radiation.	Safety Glasses with side-shields, protective shades, etc.
Head protection	Falling objects, inadequate height clearance, and overhead power cords.	Plastic Helmets with top and side impact protection.
Hearing protection	Noise, ultra-sound.	Hearing protectors (ear plugs or ear muffs).
Foot protection	Falling or rolling objects, pointed objects. Corrosive or hot liquids.	Safety shoes and boots for protection against moving & falling objects, liquids and chemicals.
Hand protection	Hazardous materials, cuts or lacerations, vibrations, extreme temperatures.	Gloves made of rubber or synthetic materials (Neoprene), leather, steel, insulating materials, etc.
Respiratory protection	Dust, fogs, fumes, mists, gases, smokes, vapors.	Facemasks with appropriate filters for dust removal and air purification (chemicals, mists, vapors and gases). Single or multi-gas personal monitors, if available.
	Oxygen deficiency	Portable or supplied air (fixed lines). On-site rescue equipment.
Body/leg protection	Extreme temperatures, hazardous materials, biological agents, cutting and laceration.	Insulating clothing, body suits, aprons etc. of appropriate materials.

2.8 Special Hazard Environments

Special hazard environments are work situations where all of the previously described hazards may exist under unique or especially hazardous circumstances. Accordingly, extra precautions or rigor in application of precautions is required.

Confined Space

A confined space is defined as a wholly or partially enclosed space not designed or intended for human occupancy and in which a hazardous atmosphere could develop as a result of the contents, location or construction of the confined space or due to work done in or around the confined space. A "permit-required" confined space is one that also contains physical or atmospheric hazards that could trap or engulf the person.[77]

Confined spaces can occur in enclosed or open structures or locations. Serious injury or fatality can result from inadequate preparation to enter a confined space or in attempting a rescue from a confined space. Recommended management approaches include:

- Engineering measures should be implemented to eliminate, to the degree feasible, the existence and adverse character of confined spaces.
- Permit-required confined spaces should be provided with permanent safety measures for venting, monitoring, and rescue operations, to the extent possible. The area adjoining an access to a confined space should provide ample room for emergency and rescue operations.

[76] Examples include the American National Standards Institute (ANSI), http://www.ansi.org/; National Institute for Occupational Safety and Health[76] (NIOSH), http://www.cdc.gov/niosh/homepage.html; Canadian Standards Association[76] (CSA), http://www.csa.ca/Default.asp?language=english; Mine Safety and Health Administration[76] (MSHA), http://www.msha.gov.

[77] US OSHA CFR 1910.146

- Access hatches should accommodate 90% of the worker population with adjustments for tools and protective clothing. The most current ISO and EN standards should be consulted for design specifications;
- Prior to entry into a permit-required confined space:
  - Process or feed lines into the space should be disconnected or drained, and blanked and locked-out.
  - Mechanical equipment in the space should be disconnected, de-energized, locked-out, and braced, as appropriate.
  - The atmosphere within the confined space should be tested to assure the oxygen content is between 19.5 percent and 23 percent, and that the presence of any flammable gas or vapor does not exceed 25 percent of its respective Lower Explosive Limit (LEL).
  - If the atmospheric conditions are not met, the confined space should be ventilated until the target safe atmosphere is achieved, or entry is only to be undertaken with appropriate and additional PPE.
- Safety precautions should include Self Contained Breathing Apparatus (SCBA), life lines, and safety watch workers stationed outside the confined space, with rescue and first aid equipment readily available.
- Before workers are required to enter a permit-required confined space, adequate and appropriate training in confined space hazard control, atmospheric testing, use of the necessary PPE, as well as the serviceability and integrity of the PPE should be verified. Further, adequate and appropriate rescue and / or recovery plans and equipment should be in place before the worker enters the confined space.

Lone and Isolated Workers

A lone and isolated worker is a worker out of verbal and line of sight communication with a supervisor, other workers, or other persons capable of providing aid and assistance, for continuous periods exceeding one hour. The worker is therefore at increased risk should an accident or injury occur.

- Where workers may be required to perform work under lone or isolated circumstances, Standard Operating Procedures (SOPs) should be developed and implemented to ensure all PPE and safety measures are in place before the worker starts work. SOPs should establish, at a minimum, verbal contact with the worker at least once every hour, and ensure the worker has a capability for summoning emergency aid.
- If the worker is potentially exposed to highly toxic or corrosive chemicals, emergency eye-wash and shower facilities should be equipped with audible and visible alarms to summon aid whenever the eye-wash or shower is activated by the worker and without intervention by the worker.

2.9 Monitoring

Occupational health and safety monitoring programs should verify the effectiveness of prevention and control strategies. The selected indicators should be representative of the most significant occupational, health, and safety hazards, and the implementation of prevention and control strategies. The occupational health and safety monitoring program should include:

- *Safety inspection, testing and calibration:* This should include regular inspection and testing of all safety features and hazard control measures focusing on engineering and personal protective features, work procedures, places of work, installations, equipment, and tools used. The inspection should verify that issued PPE continues to provide adequate protection and is being worn as required. All instruments installed or used for monitoring and recording of working environment parameters should be regularly tested and calibrated, and the respective records maintained.
- *Surveillance of the working environment:* Employers should document compliance using an appropriate combination of

portable and stationary sampling and monitoring instruments. Monitoring and analyses should be conducted according to internationally recognized methods and standards. Monitoring methodology, locations, frequencies, and parameters should be established individually for each project following a review of the hazards. Generally, monitoring should be performed during commissioning of facilities or equipment and at the end of the defect and liability period, and otherwise repeated according to the monitoring plan.

- *Surveillance of workers health:* When extraordinary protective measures are required (for example, against biological agents Groups 3 and 4, and/or hazardous compounds), workers should be provided appropriate and relevant health surveillance prior to first exposure, and at regular intervals thereafter. The surveillance should, if deemed necessary, be continued after termination of the employment.
- *Training:* Training activities for employees and visitors should be adequately monitored and documented (curriculum, duration, and participants). Emergency exercises, including fire drills, should be documented adequately. Service providers and contractors should be contractually required to submit to the employer adequate training documentation before start of their assignment.

Accidents and Diseases monitoring

- The employer should establish procedures and systems for reporting and recording:
  - Occupational accidents and diseases
  - Dangerous occurrences and incidents

  These systems should enable workers to report immediately to their immediate supervisor any situation they believe presents a serious danger to life or health.
- The systems and the employer should further enable and encourage workers to report to management all:
  - Occupational injuries and near misses
  - Suspected cases of occupational disease
  - Dangerous occurrences and incidents
- All reported occupational accidents, occupational diseases, dangerous occurrences, and incidents together with near misses should be investigated with the assistance of a person knowledgeable/competent in occupational safety. The investigation should:
  - Establish what happened
  - Determine the cause of what happened
  - Identify measures necessary to prevent a recurrence
- Occupational accidents and diseases should, at a minimum, be classified according to Table 2.10.1. Distinction is made between fatal and non-fatal injuries. The two main categories are divided into three sub-categories according to time of death or duration of the incapacity to work. The total work hours during the specified reporting period should be reported to the appropriate regulatory agency.

Table 2.9.1. Occupational Accident Reporting

a. Fatalities (number)	**b. Non-fatal injuries** (number) [78]	**c. Total time lost** non-fatal injuries (days)
a.1 Immediate	**b.1** Less than one day	
a.2 Within a month	**b.2** Up to 3 days	**c.1** Category b.2
a.3 Within a year	**b.3** More than 3 days	**c.2** Category b.3

[78] The day on which an incident occurs is not included in b.2 and b.3.

3.0 Community Health and Safety

3.1 Water Quality and Availability 77
Water Quality 77
Water Availability 77
3.2 Structural Safety of Project Infrastructure 78
3.3 Life and Fire Safety (L&FS) 79
Applicability and Approach 79
Specific Requirements for New Buildings 79
L&FS Master Plan Review and Approval 80
Specific Requirements for Existing Buildings 81
Other Hazards 81
3.4 Traffic Safety 81
3.5 Transport of Hazardous Materials 82
General Hazardous Materials Transport 82
Major Transportation Hazards 83
3.6 Disease Prevention 85
Communicable Diseases 85
Vector-Borne Diseases 85
3.7 Emergency Preparedness and Response 86
Communication Systems 86
Emergency Resources 87
Training and Updating 87
Business Continuity and Contingency 88
Applicability and Approach 89

This section complements the guidance provided in the preceding environmental and occupational health and safety sections, specifically addressing some aspects of project activities taking place outside of the traditional project boundaries, but nonetheless related to the project operations, as may be applicable on a project basis. These issues may arise at any stage of a project life cycle and can have an impact beyond the life of the project.

3.1 Water Quality and Availability

Groundwater and surface water represent essential sources of drinking and irrigation water in developing countries, particularly in rural areas where piped water supply may be limited or unavailable and where available resources are collected by the consumer with little or no treatment. Project activities involving wastewater discharges, water extraction, diversion or impoundment should prevent adverse impacts to the quality and availability of groundwater and surface water resources.

Water Quality

Drinking water sources, whether public or private, should at all times be protected so that they meet or exceed applicable national acceptability standards or in their absence the current edition of WHO Guidelines for Drinking-Water Quality. Air emissions, wastewater effluents, oil and hazardous materials, and wastes should be managed according to the guidance provided in the respective sections of the General EHS Guidelines with the objective of protecting soil and water resources.

Where the project includes the delivery of water to the community or to users of facility infrastructure (such as hotel hosts and hospital patients), where water may be used for drinking, cooking, washing, and bathing, water quality should comply with national acceptability standards or in their absence the current edition of with WHO Drinking Water Guidelines. Water quality for more sensitive well-being-related demands such as water used in health care facilities or food production may require more stringent, industry-specific guidelines or standards, as applicable. Any dependency factors associated with the deliver of water to the local community should be planned for and managed to ensure the sustainability of the water supply by involving the community in its management to minimize the dependency in the long-term.

Water Availability

The potential effect of groundwater or surface water abstraction for project activities should be properly assessed through a combination of field testing and modeling techniques, accounting for seasonal variability and projected changes in demand in the project area.

Project activities should not compromise the availability of water for personal hygiene needs and should take account of potential future increases in demand. The overall target should be the availability of 100 liters per person per day although lower levels may be used to meet basic health requirements.[79] Water volume requirements for well-being-related demands such as water use in health care facilities may need to be higher.

3.2 Structural Safety of Project Infrastructure

Hazards posed to the public while accessing project facilities may include:

- Physical trauma associated with failure of building structures
- Burns and smoke inhalation from fires
- Injuries suffered as a consequence of falls or contact with heavy equipment
- Respiratory distress from dust, fumes, or noxious odors
- Exposure to hazardous materials

Reduction of potential hazards is best accomplished during the design phase when the structural design, layout and site modifications can be adapted more easily. The following issues should be considered and incorporated as appropriate into the planning, siting, and design phases of a project:

- Inclusion of buffer strips or other methods of physical separation around project sites to protect the public from major hazards associated with hazardous materials incidents or process failure, as well as nuisance issues related to noise, odors, or other emissions
- Incorporation of siting and safety engineering criteria to prevent failures due to natural risks posed by earthquakes, tsunamis, wind, flooding, landslides and fire. To this end, all project structures should be designed in accordance with engineering and design criteria mandated by site-specific risks, including but not limited to seismic activity, slope stability, wind loading, and other dynamic loads
- Application of locally regulated or internationally recognized building codes[80] to ensure structures are designed and constructed in accordance with sound architectural and engineering practice, including aspects of fire prevention and response
- Engineers and architects responsible for designing and constructing facilities, building, plants and other structures should certify the applicability and appropriateness of the structural criteria employed.

International codes, such as those compiled by the International Code Council (ICC)[81], are intended to regulate the design, construction, and maintenance of a built environment and contain detailed guidance on all aspects of building safety, encompassing methodology, best practices, and documenting compliance. Depending on the nature of a project, guidance provided in the ICC or comparable codes should be followed, as appropriate, with respect to:

- Existing structures
- Soils and foundations
- Site grading
- Structural design
- Specific requirements based on intended use and occupancy
- Accessibility and means of egress
- Types of construction
- Roof design and construction
- Fire-resistant construction
- Flood-resistant construction

[79] World Health Organization (WHO) defines 100 liters/capita/day as the amount required to meet all consumption and hygiene needs. Additional information on lower service levels and potential impacts on health are described in "Domestic Water Quantity, Service Level and Health" 2003. http://www.who.int/water_sanitation_health/diseases/wsh0302/en/index.html

[80] ILO-OSH, 2001. http://www.ilo.org/public/english/protection/safework/cops/english/download/e000013.pdf

[81] ICC, 2006.

- Construction materials
- Interior environment
- Mechanical, plumbing and electrical systems
- Elevators and conveying systems
- Fire safety systems
- Safeguards during construction
- Encroachments into public right-of-way

Although major design changes may not be feasible during the operation phase of a project, hazard analysis can be undertaken to identify opportunities to reduce the consequences of a failure or accident. Illustrative management actions, applicable to hazardous materials storage and use, include:

- Reducing inventories of hazardous materials through inventory management and process changes to greatly reduce or eliminate the potential off-site consequences of a release
- Modifying process or storage conditions to reduce the potential consequences of an accidental off-site release
- Improving shut-down and secondary containment to reduce the amount of material escaping from containment and to reduce the release duration
- Reducing the probability that releases will occur through improved site operations and control, and through improvements in maintenance and inspection
- Reducing off-site impacts of releases through measures intended to contain explosions and fires, alert the public, provide for evacuation of surrounding areas, establish safety zones around a site, and ensure the provision of emergency medical services to the public

3.3 Life and Fire Safety (L&FS)

Applicability and Approach

All new buildings accessible to the public should be designed, constructed, and operated in full compliance with local building codes, local fire department regulations, local legal/insurance requirements, and in accordance with an internationally accepted life and fire safety (L&FS) standard. The Life Safety Code[82], which provides extensive documentation on life and fire safety provisions, is one example of an internationally accepted standard and may be used to document compliance with the Life and Fire Safety objectives outlined in these guidelines. With regard to these objectives:

- Project sponsors' architects and professional consulting engineers should demonstrate that affected buildings meet these life and fire safety objectives.
- Life and fire safety systems and equipment should be designed and installed using appropriate prescriptive standards and/or performance based design, and sound engineering practices.
- Life and fire safety design criteria for all existing buildings should incorporate all local building codes and fire department regulations.

These guidelines apply to buildings that are accessible to the public. Examples of such buildings include:

- Health and education facilities
- Hotels, convention centers, and leisure facilities
- Retail and commercial facilities
- Airports, other public transport terminals, transfer facilities

Specific Requirements for New Buildings

The nature and extent of life and fire safety systems required will depend on the building type, structure, construction, occupancy, and exposures. Sponsors should prepare a Life and Fire Safety Master Plan identifying major fire risks, applicable codes, standards and regulations, and mitigation measures. The Master

[82] US NFPA. http://www.nfpa.org/catalog/product.asp?category%5Fname=&pid=10106&target%5Fpid=10106&src%5Fpid=&link%5Ftype=search

Plan should be prepared by a suitably qualified professional, and adequately cover, but not be limited to, the issues addressed briefly in the following points. The suitably qualified professional selected to prepare the Master Plan is responsible for a detailed treatment of the following illustrative, and all other required, issues.

Fire Prevention

Fire prevention addresses the identification of fire risks and ignition sources, and measures needed to limit fast fire and smoke development. These issues include:

- Fuel load and control of combustibles
- Ignition sources
- Interior finish flame spread characteristics
- Interior finish smoke production characteristics
- Human acts, and housekeeping and maintenance

Means of Egress

Means of Egress includes all design measures that facilitate a safe evacuation by residents and/or occupants in case of fire or other emergency, such as:

- Clear, unimpeded escape routes
- Accessibility to the impaired/handicapped
- Marking and signing
- Emergency lighting

Detection and Alarm Systems

These systems encompass all measures, including communication and public address systems needed to detect a fire and alert:

- Building staff
- Emergency response teams
- Occupants
- Civil defense

Compartmentation

Compartmentation involves all measures to prevent or slow the spread of fire and smoke, including:

- Separations
- Fire walls
- Floors
- Doors
- Dampers
- Smoke control systems

Fire Suppression and Control

Fire suppression and control includes all automatic and manual fire protection installations, such as:

- Automatic sprinkler systems
- Manual portable extinguishers
- Fire hose reels

Emergency Response Plan

An Emergency Response Plan is a set of scenario–based procedures to assist staff and emergency response teams during real life emergency and training exercises. This chapter of the Fire and Life Safety Master Plan should include an assessment of local fire prevention and suppression capabilities.

Operation and Maintenance

Operation and Maintenance involves preparing schedules for mandatory regular maintenance and testing of life and fire safety features to ensure that mechanical, electrical, and civil structures and systems are at all times in conformance with life and fire safety design criteria and required operational readiness.

L&FS Master Plan Review and Approval

- A suitably qualified professional prepares and submits a Life and Fire Safety (L&FS) Master Plan, including preliminary drawings and specifications, and certifies that the design

meets the requirements of these L&FS guidelines. The findings and recommendations of the review are then used to establish the conditions of a Corrective Action Plan and a time frame for implementing the changes.

- The suitably qualified professional conducts a review as part of the project completion test at the time of life and fire safety systems testing and commissioning, and certifies that construction of these systems has been carried out in accordance with the accepted design. The findings and recommendations of the review are used as the basis for establishing project completion or to establish the conditions of a Pre-Completion Corrective Action Plan and a time frame for implementing the changes.

Specific Requirements for Existing Buildings

- All life and fire safety guideline requirements for new buildings apply to existing buildings programmed for renovation. A suitably qualified professional conducts a complete life and fire safety review of existing buildings slated for renovation. The findings and recommendations of the review are used as the basis to establish the scope of work of a Corrective Action Plan and a time frame for implementing the changes.
- If it becomes apparent that life and fire safety conditions are deficient in an existing building that is not part of the project or that has not been programmed for renovation, a life and fire safety review of the building may be conducted by a suitably qualified professional. The findings and recommendations of the review are used as the basis to establish the scope of work of a Corrective Action Plan and a time frame for implementing the changes.

Other Hazards

- Facilities, buildings, plants, and structures should be situated to minimize potential risks from forces of nature (e.g. earthquakes, tsunamis, floods, windstorms, and fires from surrounding areas).
- All such structures should be designed in accordance with the criteria mandated by situation-, climatic-, and geology-specific location risks (e.g. seismic activity, wind loading, and other dynamic loads).
- Structural engineers and architects responsible for facilities, buildings, plants and structures should certify the applicability and appropriateness of the design criteria employed.
- National or regional building regulations typically contain fire safety codes and standards[83] or these standards are found in separate Fire Codes.[84,85] Generally, such codes and regulations incorporate further compliance requirements with respect to methodology, practice, testing, and other codes and standards[86]. Such nationally referenced material constitutes the acceptable fire life safety code.

3.4 Traffic Safety

Traffic accidents have become one of the most significant causes of injuries and fatalities among members of the public worldwide. Traffic safety should be promoted by all project personnel during displacement to and from the workplace, and during operation of project equipment on private or public roads. Prevention and control of traffic related injuries and fatalities should include the adoption of safety measures that are protective of project workers and of road users, including those who are most vulnerable to road traffic accidents[87]. Road safety initiatives proportional to the scope and nature of project activities should include:

[83] For example, Australia, Canada, South Africa, United Kingdom

[84] Réglementation Incendie [des ERP]

[85] USA NFPA, 2006.

[86] Prepared by National Institutes and Authorities such as American Society for Testing and Materials (ASTM), British Standards (BS), German Institute of Standardization (DIN), and French Standards (NF)

[87] Additional information on vulnerable users of public roads in developing countries is provided by Peden et al., 2004.

- Adoption of best transport safety practices across all aspects of project operations with the goal of preventing traffic accidents and minimizing injuries suffered by project personnel and the public. Measures should include:
  - Emphasizing safety aspects among drivers
  - Improving driving skills and requiring licensing of drivers
  - Adopting limits for trip duration and arranging driver rosters to avoid overtiredness
  - Avoiding dangerous routes and times of day to reduce the risk of accidents
  - Use of speed control devices (governors) on trucks, and remote monitoring of driver actions
- Regular maintenance of vehicles and use of manufacturer approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure.

Where the project may contribute to a significant increase in traffic along existing roads, or where road transport is a significant component of a project, recommended measures include:

- Minimizing pedestrian interaction with construction vehicles
- Collaboration with local communities and responsible authorities to improve signage, visibility and overall safety of roads, particularly along stretches located near schools or other locations where children may be present. Collaborating with local communities on education about traffic and pedestrian safety (e.g. school education campaigns)[88]
- Coordination with emergency responders to ensure that appropriate first aid is provided in the event of accidents
- Using locally sourced materials, whenever possible, to minimize transport distances. Locating associated facilities such as worker camps close to project sites and arranging worker bus transport to minimizing external traffic
- Employing safe traffic control measures, including road signs and flag persons to warn of dangerous conditions

3.5 Transport of Hazardous Materials

General Hazardous Materials Transport

- Projects should have procedures in place that ensure compliance with local laws and international requirements applicable to the transport of hazardous materials, including:
  - IATA requirements[89] for air transport
  - IMDG Code[90] sea transport
  - UN Model Regulations[91] of other international standards as well as local requirements for land transport
  - Host-country commitments under the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their disposal and Rotterdam Convention on the prior Inform Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, if applicable to the project activities
- The procedures for transportation of hazardous materials (Hazmats) should include:
  - Proper labeling of containers, including the identify and quantity of the contents, hazards, and shipper contact information
  - Providing a shipping document (e.g. shipping manifest) that describes the contents of the load and its associated hazards in addition to the labeling of the containers. The shipping document should establish a chain-of-custody using multiple signed copies to show that the waste was properly shipped, transported and received by the recycling or treatment/disposal facility

[88] Additional sources of information for implementation of road safety measures is available at WHO, 1989, Ross et al., 1991, Tsunokawa and Hoban, 1997, and OECD, 1999

[89] IATA, 2005. www.iata.org

[90] IMO. www.imo.org/safety

[91] United Nations. Transport of Dangerous Goods - Model Regulations. 14th Revised Edition. Geneva 2005. http://www.unece.org/trans/danger/publi/unrec/rev14/14files_e.html

- Ensuring that the volume, nature, integrity and protection of packaging and containers used for transport are appropriate for the type and quantity of hazardous material and modes of transport involved
- Ensuring adequate transport vehicle specifications
- Training employees involved in the transportation of hazardous materials regarding proper shipping procedures and emergency procedures
- Using labeling and placarding (external signs on transport vehicles), as required
- Providing the necessary means for emergency response on call 24 hours/day

Major Transportation Hazards

Guidance related to major transportation hazards should be implemented in addition to measures presented in the preceding section for preventing or minimizing the consequences of catastrophic releases of hazardous materials, which may result in toxic, fire, explosion, or other hazards during transportation.

In addition to these aforementioned procedures, projects which transport hazardous materials *at or above the threshold quantities*[92] should prepare a Hazardous Materials Transportation Plan containing all of the elements presented below[93].

Hazard Assessment

The hazard assessment should identify the potential hazard involved in the transportation of hazardous materials by reviewing:

- The hazard characteristics of the substances identified during the screening stage
- The history of accidents, both by the company and its contractors, involving hazardous materials transportation
- The existing criteria for the safe transportation of hazardous materials, including environmental management systems used by the company and its contractors

This review should cover the management actions, preventive measures and emergency response procedures described below. The hazard assessment helps to determine what additional measures may be required to complete the plan.

Management Actions

- *Management of Change:* These procedures should address:
  - The technical basis for changes in hazardous materials offered for transportation, routes and/or procedures
  - The potential impact of changes on health and safety
  - Modification required to operating procedures
  - Authorization requirements
  - Employees affected
  - Training needs
- *Compliance Audit:* A compliance audit evaluates compliance with prevention requirements for each transportation route or for each hazardous material, as appropriate. A compliance audit covering each element of the prevention measures (see below) should be conducted at least every three years. The audit program should include:
  - Preparation of a report of the findings
  - Determination and documentation of the appropriate response to each finding
  - Documentation that any deficiency has been corrected.
- *Incident Investigation:* Incidents can provide valuable information about transportation hazards and the steps needed to prevent accidental releases. The implementation of incident investigation procedures should ensure that:
  - Investigations are initiated promptly
  - Summaries of investigations are included in a report
  - Report findings and recommendations are addressed

[92] Threshold quantities for the transport of hazardous materials are found in the UN – Transport of Dangerous Goods – Model Regulations cited above.

[93] For further information and guidance, please refer to International Finance Corporation (IFC) Hazardous Materials Transportation Manual. Washington, D.C. December 2000.

- Reports are reviewed with staff and contractors

- *Employee Participation:* There should be a written plan of action regarding the implementation of active employee participation in the prevention of accidents.

- *Contractors:* The plan should include procedures to ensure that:
  - The contractor is provided with safety performance procedures and safety and hazard information
  - Contractors observe safety practices
  - Verify that the contractor acts responsibly

  The plan should also include additional procedures to ensure the contractors will:
  - Ensure appropriate training for their employees
  - Ensure their employees know process hazards and applicable emergency actions
  - Prepare and submit training records
  - Inform employees about the hazards presented by their work

- *Training:* Good training programs on operating procedures will provide the employees with the necessary information to understand how to operate safely and why safe operations are needed. The training program should include:
  - The list of employees to be trained
  - Specific training objectives
  - Mechanisms to achieve objectives (i.e. hands-on workshops, videos, etc.)
  - Means to determine the effectiveness of the training program
  - Training procedures for new hires and refresher programs

Preventive Measures

The plan should include procedures to implement preventive measures specific to each hazardous material offered for transportation, including:

- Classification and segregation of hazardous materials in warehouses and transport units
- Packaging and packaging testing
- Marking and labeling of packages containing hazardous materials
- Handling and securing packages containing hazardous materials in transport units
- Marking and placarding of transport units
- Documentation (e.g. bills of lading)
- Application of special provisions, as appropriate

Emergency Preparedness and Response

It is important to develop procedures and practices for the handling of hazardous materials that allow for quick and efficient responses to accidents that may result in injury or environmental damage. The sponsor should prepare an Emergency Preparedness and Response Plan that should cover:

- *Planning Coordination:* This should include procedures for:
  - Informing the public and emergency response agencies
  - Documenting first aid and emergency medical treatment
  - Taking emergency response actions
  - Reviewing and updating the emergency response plan to reflect changes and ensuring that the employees are informed of such changes

- *Emergency Equipment:* The plan should include procedures for using, inspecting, testing, and maintaining emergency response equipment.

- *Training:* Employees should be trained in any relevant procedures

3.6 Disease Prevention

Communicable Diseases

Communicable diseases pose a significant public health threat worldwide. Health hazards typically associated with large development projects are those relating to poor sanitation and living conditions, sexual transmission and vector-borne infections. Communicable diseases of most concern during the construction phase due to labor mobility are sexually-transmitted diseases (STDs), such as HIV/AIDS. Recognizing that no single measure is likely to be effective in the long term, successful initiatives typically involve a combination of behavioral and environmental modifications.

Recommended interventions at the project level include[94]:

- Providing surveillance and active screening and treatment of workers
- Preventing illness among workers in local communities by:
  - Undertaking health awareness and education initiatives, for example, by implementing an information strategy to reinforce person-to-person counseling addressing systemic factors that can influence individual behavior as well as promoting individual protection, and protecting others from infection, by encouraging condom use
  - Training health workers in disease treatment
  - Conducting immunization programs for workers in local communities to improve health and guard against infection
  - Providing health services
- Providing treatment through standard case management in on-site or community health care facilities. Ensuring ready access to medical treatment, confidentiality and appropriate care, particularly with respect to migrant workers
- Promoting collaboration with local authorities to enhance access of workers families and the community to public health services and promote immunization

Vector-Borne Diseases

Reducing the impact of vector-borne disease on the long-term health of workers is best accomplished through implementation of diverse interventions aimed at eliminating the factors that lead to disease. Project sponsors, in close collaboration with community health authorities, can implement an integrated control strategy for mosquito and other arthropod-borne diseases that might involve:

- Prevention of larval and adult propagation through sanitary improvements and elimination of breeding habitats close to human settlements
- Elimination of unusable impounded water
- Increase in water velocity in natural and artificial channels
- Considering the application of residual insecticide to dormitory walls
- Implementation of integrated vector control programs
- Promoting use of repellents, clothing, netting, and other barriers to prevent insect bites
- Use of chemoprophylaxis drugs by non-immune workers and collaborating with public health officials to help eradicate disease reservoirs
- Monitoring and treatment of circulating and migrating populations to prevent disease reservoir spread
- Collaboration and exchange of in-kind services with other control programs in the project area to maximize beneficial effects
- Educating project personnel and area residents on risks, prevention, and available treatment
- Monitoring communities during high-risk seasons to detect and treat cases

[94] Additional sources of information on disease prevention include IFC, 2006; UNDP, 2000, 2003; Walley et al., 2000; Kindhauser, 2003; Heymann, 2004.

- Distributing appropriate education materials
- Following safety guidelines for the storage, transport, and distribution of pesticides to minimize the potential for misuse, spills, and accidental human exposure

3.7 Emergency Preparedness and Response

An emergency is an unplanned event when a project operation loses control, or could lose control, of a situation that may result in risks to human health, property, or the environment, either within the facility or in the local community. Emergencies do not normally include safe work practices for frequent upsets or events that are covered by occupational health and safety.

All projects should have an Emergency Preparedness and Response Plan that is commensurate with the risks of the facility and that includes the following basic elements:

- Administration (policy, purpose, distribution, definitions, etc)
- Organization of emergency areas (command centers, medical stations, etc)
- Roles and responsibilities
- Communication systems
- Emergency response procedures
- Emergency resources
- Training and updating
- Checklists (role and action list and equipment checklist)
- Business Continuity and Contingency

Additional information is provided for key components of the emergency plan, as follows below.

Communication Systems

Worker notification and communication

Alarm bells, visual alarms, or other forms of communication should be used to reliably alert workers to an emergency. Related measures include:

- Testing warning systems at least annually (fire alarms monthly), and more frequently if required by local regulations, equipment, or other considerations
- Installing a back-up system for communications on-site with off-site resources, such as fire departments, in the event that normal communication methods may be inoperable during an emergency

Community Notification

If a local community may be at risk from a potential emergency arising at the facility, the company should implement communication measures to alert the community, such as:

- Audible alarms, such as fire bells or sirens
- Fan out telephone call lists
- Vehicle mounted speakers
- Communicating details of the nature of the emergency
- Communicating protection options (evacuation, quarantine)
- Providing advise on selecting an appropriate protection option

Media and Agency Relations

Emergency information should be communicated to the media through:

- A trained, local spokesperson able to interact with relevant stakeholders, and offer guidance to the company for speaking to the media, government, and other agencies
- Written press releases with accurate information, appropriate level of detail for the emergency, and for which accuracy can be guaranteed

Emergency Resources

Finance and Emergency Funds

- A mechanism should be provided for funding emergency activities.

Fire Services

- The company should consider the level of local fire fighting capacity and whether equipment is available for use at the facility in the event of a major emergency or natural disaster. If insufficient capacity is available, fire fighting capacity should be acquired that may include pumps, water supplies, trucks, and training for personnel.

Medical Services

- The company should provide first aid attendants for the facility as well as medical equipment suitable for the personnel, type of operation, and the degree of treatment likely to be required prior to transportation to hospital.

Availability of Resources

Appropriate measures for managing the availability of resources in case of an emergency include:

- Maintaining a list of external equipment, personnel, facilities, funding, expert knowledge, and materials that may be required to respond to emergencies. The list should include personnel with specialized expertise for spill clean-up, flood control, engineering, water treatment, environmental science, etc., or any of the functions required to adequately respond to the identified emergency
- Providing personnel who can readily call up resources, as required
- Tracking and managing the costs associated with emergency resources
- Considering the quantity, response time, capability, limitations, and cost of these resources, for both site-specific emergencies, and community or regional emergencies
- Considering if external resources are unable to provide sufficient capacity during a regional emergency and whether additional resources may need to be maintained on-site

Mutual Aid

Mutual aid agreements decrease administrative confusion and provide a clear basis for response by mutual aid providers.

- Where appropriate, mutual aid agreements should be maintained with other organizations to allow for sharing of personnel and specialized equipment.

Contact List

- The company should develop a list of contact information for all internal and external resources and personnel. The list should include the name, description, location, and contact details (telephone, email) for each of the resources, and be maintained annually.

Training and Updating

The emergency preparedness facilities and emergency response plans require maintenance, review, and updating to account for changes in equipment, personnel, and facilities. Training programs and practice exercises provide for testing systems to ensure an adequate level of emergency preparedness. Programs should:

- Identify training needs based on the roles and responsibilities, capabilities and requirements of personnel in an emergency
- Develop a training plan to address needs, particularly for fire fighting, spill response, and evacuation

- Conduct annual training, at least, and perhaps more frequent training when the response includes specialized equipment, procedures, or hazards, or when otherwise mandated
- Provide training exercises to allow personnel the opportunity to test emergency preparedness, including:
  - Desk top exercises with only a few personnel, where the contact lists are tested and the facilities and communication assessed
  - Response exercises, typically involving drills that allow for testing of equipment and logistics
- Debrief upon completion of a training exercise to assess what worked well and what aspects require improvement
- Update the plan, as required, after each exercise. Elements of the plan subject to significant change (such as contact lists) should be replaced
- Record training activities and the outcomes of the training

Business Continuity and Contingency

Measures to address business continuity and contingency include:

- Identifying replacement supplies or facilities to allow business continuity following an emergency. For example, alternate sources of water, electricity, and fuel are commonly sought.
- Using redundant or duplicate supply systems as part of facility operations to increase the likelihood of business continuity.
- Maintaining back-ups of critical information in a secure location to expedite the return to normal operations following an emergency.

4.0 Construction and Decommissioning

4.1 Environment....89
Noise and Vibration....89
Soil Erosion....89
Air Quality....90
Solid Waste....90
Hazardous Materials....91
Wastewater Discharges....91
Contaminated Land....91
4.2 Occupational Health and Safety....92
4.3 Community Health and Safety....94
General Site Hazards....94
Disease Prevention....94
Traffic Safety....95

Applicability and Approach

This section provides additional, specific guidance on prevention and control of community health and safety impacts that may occur during new project development, at the end of the project life-cycle, or due to expansion or modification of existing project facilities. Cross referencing is made to various other sections of the General EHS Guidelines.

4.1 Environment{ TC "4.1 Environment" \f C \l "2" }

Noise and Vibration

During construction and decommissioning activities, noise and vibration may be caused by the operation of pile drivers, earth moving and excavation equipment, concrete mixers, cranes and the transportation of equipment, materials and people. Some recommended noise reduction and control strategies to consider in areas close to community areas include:

- Planning activities in consultation with local communities so that activities with the greatest potential to generate noise are planned during periods of the day that will result in least disturbance
- Using noise control devices, such as temporary noise barriers and deflectors for impact and blasting activities, and exhaust muffling devices for combustion engines.
- Avoiding or minimizing project transportation through community areas

Soil Erosion

Soil erosion may be caused by exposure of soil surfaces to rain and wind during site clearing, earth moving, and excavation activities. The mobilization and transport of soil particles may, in turn, result in sedimentation of surface drainage networks, which may result in impacts to the quality of natural water systems and ultimately the biological systems that use these waters. Recommended soil erosion and water system management approaches include:

Sediment mobilization and transport

- Reducing or preventing erosion by:
  - Scheduling to avoid heavy rainfall periods (i.e., during the dry season) to the extent practical
  - Contouring and minimizing length and steepness of slopes
  - Mulching to stabilize exposed areas
  - Re-vegetating areas promptly
  - Designing channels and ditches for post-construction flows
  - Lining steep channel and slopes (e.g. use jute matting)
- Reducing or preventing off-site sediment transport through use of settlement ponds, silt fences, and water treatment, and modifying or suspending activities during extreme rainfall and high winds to the extent practical.

Clean runoff management

- Segregating or diverting clean water runoff to prevent it mixing with water containing a high solids content, to minimize the volume of water to be treated prior to release

Road design

- Limiting access road gradients to reduce runoff-induced erosion
- Providing adequate road drainage based on road width, surface material, compaction, and maintenance

Disturbance to water bodies

- Depending on the potential for adverse impacts, installing free-spanning structures (e.g., single span bridges) for road watercourse crossings
- Restricting the duration and timing of in-stream activities to lower low periods, and avoiding periods critical to biological cycles of valued flora and fauna (e.g., migration, spawning, etc.)
- For in-stream works, using isolation techniques such as berming or diversion during construction to limit the exposure of disturbed sediments to moving water
- Consider using trenchless technology for pipeline crossings (e.g., suspended crossings) or installation by directional drilling

Structural (slope) stability

- Providing effective short term measures for slope stabilization, sediment control and subsidence control until long term measures for the operational phase can be implemented
- Providing adequate drainage systems to minimize and control infiltration

Air Quality

Construction and decommissioning activities may generate emission of fugitive dust caused by a combination of on-site excavation and movement of earth materials, contact of construction machinery with bare soil, and exposure of bare soil and soil piles to wind. A secondary source of emissions may include exhaust from diesel engines of earth moving equipment, as well as from open burning of solid waste on-site. Techniques to consider for the reduction and control of air emissions from construction and decommissioning sites include:

- Minimizing dust from material handling sources, such as conveyors and bins, by using covers and/or control equipment (water suppression, bag house, or cyclone)
- Minimizing dust from open area sources, including storage piles, by using control measures such as installing enclosures and covers, and increasing the moisture content
- Dust suppression techniques should be implemented, such as applying water or non-toxic chemicals to minimize dust from vehicle movements
- Selectively removing potential hazardous air pollutants, such as asbestos, from existing infrastructure prior to demolition
- Managing emissions from mobile sources according to Section 1.1
- Avoiding open burning of solid (refer to solid waste management guidance in Section 1.6)

Solid Waste

Non-hazardous solid waste generated at construction and decommissioning sites includes excess fill materials from grading and excavation activities, scrap wood and metals, and small concrete spills. Other non-hazardous solid wastes include office, kitchen, and dormitory wastes when these types of operations are part of construction project activities. *Hazardous solid waste* includes contaminated soils, which could potentially be encountered on-site due to previous land use activities, or small

amounts of machinery maintenance materials, such as oily rags, used oil filters, and used oil, as well as spill cleanup materials from oil and fuel spills. Techniques for preventing and controlling non-hazardous and hazardous construction site solid waste include those already discussed in Section 1.6.

Hazardous Materials

Construction and decommissioning activities may pose the potential for release of petroleum based products, such as lubricants, hydraulic fluids, or fuels during their storage, transfer, or use in equipment. These materials may also be encountered during decommissioning activities in building components or industrial process equipment. Techniques for prevention, minimization, and control of these impacts include:

- Providing adequate secondary containment for fuel storage tanks and for the temporary storage of other fluids such as lubricating oils and hydraulic fluids,
- Using impervious surfaces for refueling areas and other fluid transfer areas
- Training workers on the correct transfer and handling of fuels and chemicals and the response to spills
- Providing portable spill containment and cleanup equipment on site and training in the equipment deployment
- Assessing the contents of hazardous materials and petroleum-based products in building systems (e.g. PCB containing electrical equipment, asbestos-containing building materials) and process equipment and removing them prior to initiation of decommissioning activities, and managing their treatment and disposal according to Sections 1.5 and 1.6 on Hazardous Materials and Hazardous Waste Management, respectively
- Assessing the presence of hazardous substances in or on building materials (e.g., polychlorinated biphenyls, asbestos-containing flooring or insulation) and decontaminating or properly managing contaminated building materials

Wastewater Discharges

Construction and decommissioning activities may include the generation of sanitary wastewater discharges in varying quantities depending on the number of workers involved. Adequate portable or permanent sanitation facilities serving all workers should be provided at all construction sites. Sanitary wastewater in construction and other sites should be managed as described in Section 1.3.

Contaminated Land

Land contamination may be encountered in sites under construction or decommissioning due to known or unknown historical releases of hazardous materials or oil, or due to the presence of abandoned infrastructure formerly used to store or handle these materials, including underground storage tanks. Actions necessary to manage the risk from contaminated land will depend on factors such as the level and location of contamination, the type and risks of the contaminated media, and the intended land use. However, a basic management strategy should include:

- Managing contaminated media with the objective of protecting the safety and health of occupants of the site, the surrounding community, and the environment post construction or post decommissioning
- Understanding the historical use of the land with regard to the potential presence of hazardous materials or oil prior to initiation of construction or decommissioning activities
- Preparing plans and procedures to respond to the discovery of contaminated media to minimize or reduce the risk to health, safety, and the environment consistent with the approach for Contaminated Land in Section 1.6
- Preparation of a management plan to manage obsolete, abandoned, hazardous materials or oil consistent with the approach to hazardous waste management described in Section 1.6.

Successful implementation of any management strategy may require identification and cooperation with whoever is responsible and liable for the contamination.

4.2 Occupational Health and Safety{ TC "4.2 Occupational Health and Safety" \f C \l "2" }

Over-exertion

Over-exertion, and ergonomic injuries and illnesses, such as repetitive motion, over-exertion, and manual handling, are among the most common causes of injuries in construction and decommissioning sites. Recommendations for their prevention and control include:

- Training of workers in lifting and materials handling techniques in construction and decommissioning projects, including the placement of weight limits above which mechanical assists or two-person lifts are necessary
- Planning work site layout to minimize the need for manual transfer of heavy loads
- Selecting tools and designing work stations that reduce force requirements and holding times, and which promote improved postures, including, where applicable, user adjustable work stations
- Implementing administrative controls into work processes, such as job rotations and rest or stretch breaks

Slips and Falls

Slips and falls on the same elevation associated with poor housekeeping, such as excessive waste debris, loose construction materials, liquid spills, and uncontrolled use of electrical cords and ropes on the ground, are also among the most frequent cause of lost time accidents at construction and decommissioning sites. Recommended methods for the prevention of slips and falls from, or on, the same elevation include:

- Implementing good house-keeping practices, such as the sorting and placing loose construction materials or demolition debris in established areas away from foot paths
- Cleaning up excessive waste debris and liquid spills regularly
- Locating electrical cords and ropes in common areas and marked corridors
- Use of slip retardant footwear

Work in Heights

Falls from elevation associated with working with ladders, scaffolding, and partially built or demolished structures are among the most common cause of fatal or permanent disabling injury at construction or decommissioning sites. If fall hazards exist, a fall protection plan should be in place which includes one or more of the following aspects, depending on the nature of the fall hazard[95]:

- Training and use of temporary fall prevention devices, such as rails or other barriers able to support a weight of 200 pounds, when working at heights equal or greater than two meters or at any height if the risk includes falling into operating machinery, into water or other liquid, into hazardous substances, or through an opening in a work surface
- Training and use of personal fall arrest systems, such as full body harnesses and energy absorbing lanyards able to support 5000 pounds (also described in this section in Working at Heights above), as well as fall rescue procedures to deal with workers whose fall has been successfully arrested. The tie in point of the fall arresting system should also be able to support 5000 pounds
- Use of control zones and safety monitoring systems to warn workers of their proximity to fall hazard zones, as well as

[95] Additional information on identification of fall hazards and design of protection systems can be found in the United States Occupational Health and Safety Administration's (US OSHA) web site: http://www.osha.gov/SLTC/fallprotection/index.html

securing, marking, and labeling covers for openings in floors, roofs, or walking surfaces

Struck By Objects

Construction and demolition activities may pose significant hazards related to the potential fall of materials or tools, as well as ejection of solid particles from abrasive or other types of power tools which can result in injury to the head, eyes, and extremities. Techniques for the prevention and control of these hazards include:

- Using a designated and restricted waste drop or discharge zones, and/or a chute for safe movement of wastes from upper to lower levels
- Conducting sawing, cutting, grinding, sanding, chipping or chiseling with proper guards and anchoring as applicable
- Maintaining clear traffic ways to avoid driving of heavy equipment over loose scrap
- Use of temporary fall protection measures in scaffolds and out edges of elevated work surfaces, such as hand rails and toe boards to prevent materials from being dislodged
- Evacuating work areas during blasting operations, and using blast mats or other means of deflection to minimize fly rock or ejection of demolition debris if work is conducted in proximity to people or structures
- Wearing appropriate PPE, such as safety glasses with side shields, face shields, hard hats, and safety shoes

Moving Machinery

Vehicle traffic and use of lifting equipment in the movement of machinery and materials on a construction site may pose temporary hazards, such as physical contact, spills, dust, emissions, and noise. Heavy equipment operators have limited fields of view close to their equipment and may not see pedestrians close to the vehicle. Center-articulated vehicles create a significant impact or crush hazard zone on the outboard side of a turn while moving. Techniques for the prevention and control of these impacts include:

- Planning and segregating the location of vehicle traffic, machine operation, and walking areas, and controlling vehicle traffic through the use of one-way traffic routes, establishment of speed limits, and on-site trained flag-people wearing high-visibility vests or outer clothing covering to direct traffic
- Ensuring the visibility of personnel through their use of high visibility vests when working in or walking through heavy equipment operating areas, and training of workers to verify eye contact with equipment operators before approaching the operating vehicle
- Ensuring moving equipment is outfitted with audible back-up alarms
- Using inspected and well-maintained lifting devices that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job-site elevations.

Dust

- Dust suppression techniques should be implemented, such as applying water or non-toxic chemicals to minimize dust from vehicle movements
- PPE, such as dusk masks, should be used where dust levels are excessive

Confined Spaces and Excavations

Examples of confined spaces that may be present in construction or demolition sites include: silos, vats, hoppers, utility vaults, tanks, sewers, pipes, and access shafts. Ditches and trenches may also be considered a confined space when access or egress is limited. In addition to the guidance provided in Section 2.8 the occupational hazards associated with confined spaces and excavations in construction and decommissioning sites should be prevented according to the following recommendations:

- Controlling site-specific factors which may contribute to excavation slope instability including, for example, the use of excavation dewatering, side-walls support, and slope gradient adjustments that eliminate or minimize the risk of collapse, entrapment, or drowning
- Providing safe means of access and egress from excavations, such as graded slopes, graded access route, or stairs and ladders
- Avoiding the operation of combustion equipment for prolonged periods inside excavations areas where other workers are required to enter unless the area is actively ventilated

Other Site Hazards

Construction and decommissioning sites may pose a risk of exposure to dust, chemicals, hazardous or flammable materials, and wastes in a combination of liquid, solid, or gaseous forms, which should be prevented through the implementation of project-specific plans and other applicable management practices, including:

- Use of specially trained personnel to identify and remove waste materials from tanks, vessels, processing equipment or contaminated land as a first step in decommissioning activities to allow for safe excavation, construction, dismantling or demolition
- Use of specially trained personnel to identify and selectively remove potentially hazardous materials in building elements prior to dismantling or demolition including, for example, insulation or structural elements containing asbestos and Polychlorinated Biphenyls (PCBs), electrical components containing mercury[96]
- Use of waste-specific PPE based on the results of an occupational health and safety assessment, including respirators, clothing/protective suits, gloves and eye protection

[96] Additional information on the management and removal of asbestos containing building materials can be found in ASTM Standard E2356 and E1368

4.3 Community Health and Safety{ TC "4.3 Community Health and Safety" \f C \l "2" }

General Site Hazards

Projects should implement risk management strategies to protect the community from physical, chemical, or other hazards associated with sites under construction and decommissioning. Risks may arise from inadvertent or intentional trespassing, including potential contact with hazardous materials, contaminated soils and other environmental media, buildings that are vacant or under construction, or excavations and structures which may pose falling and entrapment hazards. Risk management strategies may include:

- Restricting access to the site, through a combination of institutional and administrative controls, with a focus on high risk structures or areas depending on site-specific situations, including fencing, signage, and communication of risks to the local community
- Removing hazardous conditions on construction sites that cannot be controlled affectively with site access restrictions, such as covering openings to small confined spaces, ensuring means of escape for larger openings such as trenches or excavations, or locked storage of hazardous materials

Disease Prevention

Increased incidence of communicable and vector-borne diseases attributable to construction activities represents a potentially serious health threat to project personnel and residents of local communities. Recommendations for the prevention and control of communicable and vector-borne diseases also applicable to

construction phase activities are provided in Section 3.6 (Disease Prevention).

Traffic Safety

Construction activities may result in a significant increase in movement of heavy vehicles for the transport of construction materials and equipment increasing the risk of traffic-related accidents and injuries to workers and local communities. The incidence of road accidents involving project vehicles during construction should be minimized through a combination of education and awareness-raising, and the adoption of procedures described in Section 3.4 (Traffic Safety).

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