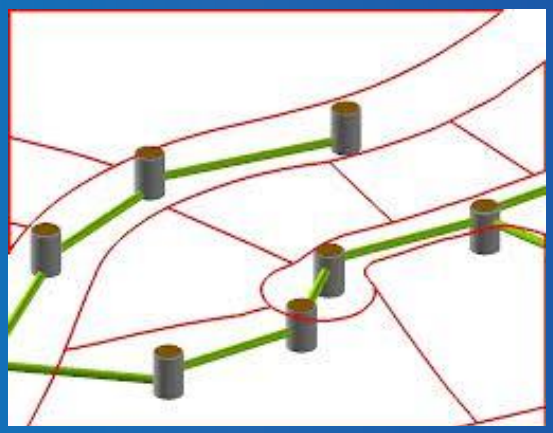
Appendix 4a



THE COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION (CDR)

ENVIRONMENTAL AND SOCIAL SAFEGUARD STUDIES FOR LAKE QARAOUN POLLUTION PREVENTION PROJECT

EXPANSION OF ZAHLE SEWAGE NETWORKS

INITIAL ENVIRONMENTAL EXAMINATION & ENVIRONMENTAL MANAGEMENT PLAN

January 29, 2015

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LIST OF ACRONYMS

BWE	Bekaa Water Establishment
CDR	Council for Development and Reconstruction
CEMP	Construction Environmental Management Plan
dB	Decibel
EDL	Electricité du liban
EIA	Environmental Impact Assessments
ELARD	Earth Link and Advanced Resources Development
EMP	Environmental Management Plan
EU	European Union
GoL	Government of Lebanon
HSE	Health, Safety and Environment
IEE	Initial Environmental Examination
IFC	International Finance Corporation
LRA	Litani River Authority
MoE	Ministry of Environment
MoEW	Ministry of Energy and Water
MoIM	Ministry of Interior and Municipalities
MoPH	Ministry of Public health
MoPWT	Ministry of Public Works and Transport
PM	Particulate Matter
PPE	Personal Protective Equipment
RAP	Resettlement Action Plan
WB	World Bank
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

I. INTRODUCTION

Earth Link and Advanced Resources Development s.a.l. (ELARD) has prepared an Initial Environmental Examination (IEE) and Environmental Management Plan (EMP) for component 1 – package 1 of the Lake Qaraoun Pollution Prevention Project that aims at expanding the sewage collection in Zahle to connect to Zahle Wastewater Treatment Plant (WWTP) (the "Project").

This project aims at implementing certain components of the Business Plan to Combat Pollution at the Qaraoun Lake that was prepared by the Ministry of Environment. As a result of this plan, a follow-up Committee led by the Litani River Authority (LRA) was assigned by the government to follow-up implementation of the plan. The government has requested financial assistance from the World Bank, which is supporting the implementation of the following components:

1. Component 1- Improve the collection of municipal sewage
2. Component 2- Increase the adoption of Integrated Pest Management (IPM) practices
3. Component 3- Technical Studies in Solid Waste Management and Capacity Building and Project Management

This study addresses the impacts of Package 1 (expansion of sewage collection to connect to Zahle WWTP, which is expected to become operational in February 2015) under Component 1.

This project requires an EMP to be submitted to the World Bank as per its Operational Policy 4.01 on environmental assessment and an IEE to be submitted to the Ministry of Environment (MoE) as per decree 8633/2012. In compliance with the Environmental and Social Management Framework (ESMF) prepared for this project, and as agreed with the WB and the MoE, one report that combines the EMP and IEE including the most stringent requirements of both has been prepared. The IEE structure, which is inclusive of EMP outline, has been adopted and the study includes the EMP requirements such as the need for public consultation and disclosure.

The EMP/IEE aims to identify and assess possible impacts resulting from the Project and to propose measures to minimize the significance of negative impacts and maximize the benefits of positive ones.

II. LEGAL AND INSTITUTIONAL FRAMEWORK

The IEE is governed by Lebanon's main Environmental Framework Law (Law 444/2002 on Environmental Protection) and the Lebanese EIA decree which has been recently published in the official Gazette as Decree No. 8633 published in the official gazette on August 16, 2012.

The Country Environmental Analysis of Lebanon (CEA)[1] conducted an assessment of the Lebanese national EIA system and determined the similarities and difference between the

[1] The Country Environment Analysis (CEA) of Lebanon, the World Bank, April 2011

national EIA system and the World Bank operational policy OP 4.01 on environmental assessment and the European Commission (EC) EIA Regulations no. 97/11. The assessment showed that the features of the Lebanese EIA system are compatible with most of the World Bank EA Policy (OP 4.01) and the EC EIA regulations.

The main governmental institutions which play a role in the permitting and supervision of the sewer networks construction and operation include the Council for Development and Reconstruction (CDR), Ministry of Energy and Water (MoEW), Bekaa Water Establishment (BWE), Ministry of Public Works and Transport (MoPWT), and Ministry of Environment (MoE). At a regional level, the Municipality of Zahle, Saadnayel, Qaa El Reem, Taalabaya, Ferzol, and Hazzerta municipalities also play a role. The Litani River Authority (LRA) is also the government body mandated to manage the Litani River and is also the head of the Qaraoun Committee.

Main identified national environmental standards and regulations relevant to the Project include, inter alia, the following:

- Ministerial Decision No. 52/1 (1996), MoE, specifying the National Standards for Environmental Quality and the Environmental Limit Values for Air and Water;
- Ministerial Decision No. 8/1 (2001), MoE, updating Decision No. 52/1; setting "Emission Standards for Air Pollutants And Wastewater Discharges from Classified Establishments and Wastewater Treatment Plants";
- Decree 64 (1988), environmental protection against hazardous waste that could harm air, water, biodiversity, soil, and people; states fines for activities that result in pollution and hazards to the environment and public health;
- Decision 320 (1926), related to the protection and use of water bodies belonging to the public domain.

III. PROJECT DESCRIPTION

The proposed project is aiming at constructing 109 Km of sewer networks in Zahle (including Karak and Ksara), Saadnayel; Quaa El Rim; Taalabaya, Ferzol, and Hezzerta, along the public roads to connect these villages to Zahle's WWTP which is currently under construction (expected to be completed in February 2015). The project includes also the rehabilitation of part of the old network, and the establishment of 6,000 house connections. The project will construct also about 10 km of the main collector that connects the village of Qabb Elias to the planned WWTP in El Marej.

IV. DESCRIPTION OF THE ENVIRONMENT

The sewer networks are going to be constructed in Zahle (including Karak and Ksara), Saadnayel, Quaa El Rim, Taalabaya, Ferzol, Hezzerta, and Qabb Elias. These villages are located in the caza of Zahle, Bekaa Governorate of Lebanon. The Project's surrounding land-use is shown in Figure 1.

Physical Environment

Climate and Meteorology

Like the rest of Lebanon, Zahle enjoys a typically eastern Mediterranean climate characterized by hot and dry summers, and mild to cool winters where most of the precipitation is concentrated. The climate in Zahle features however some continental characteristics due to the town's altitude and inland location, in the rain shadow of the Lebanon Mountains.

Ambient Air Quality

The literature review revealed a lack of ambient air quality data for the Project site. Since the greater Zahle area is rural, the main potential sources of pollution are traffic (knowing that the study area is not congested) and private generators; air pollution levels are expected to be within applicable standards.

Noise

The noise baseline study consisted of determining and quantifying the existing baseline sound environment and noise sources. Ambient sound pressure levels were measured at 15 locations at along the network route and at nearby receptors that will potentially be affected by the construction and operation phases. Periods of measurement included only daytime conditions, representing the construction working hours during the Project execution. The recorded Leq, exceeded applicable standards for rural residential areas and industrial areas.

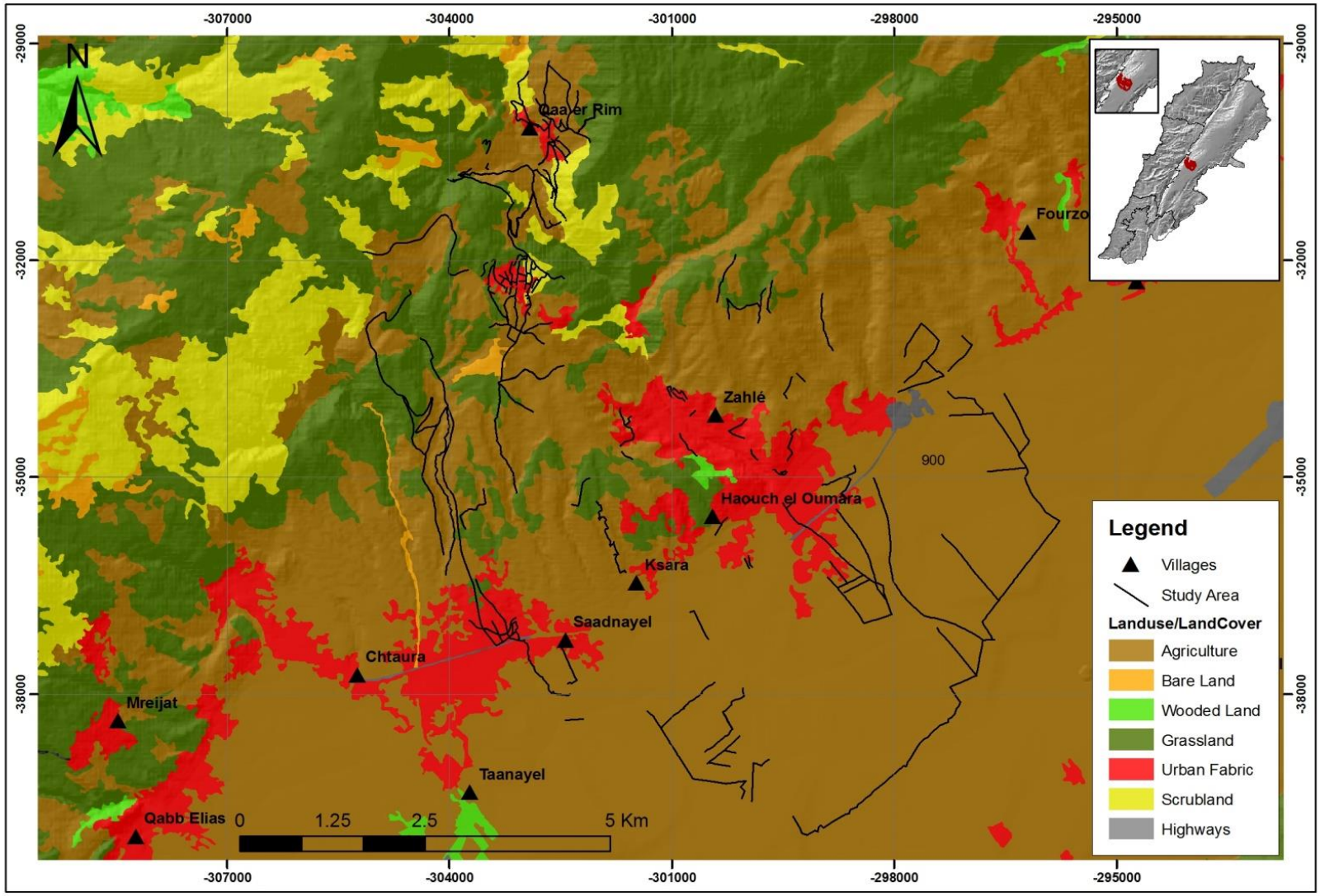

Figure 1 Land Use Map of the Project Area

Biological Environment

The rapid ecological survey was conducted on August 29, 2014 to document baseline conditions. No significant or endangered floral species (i.e. herbal, wood or vegetative cover) were identified along the planned network route.

Geology

The study area is located in Bekaa at around 40km inland from the Mediterranean Sea. It is situated in the cadastral boundaries of Zahle. The geology of the project area was studied over an extent of around 286 km^2.

Hydrogeology

Each of the formations in the study area exhibits different hydrogeological characteristics. The major aquifers in the study area are the Kesrouane Jurassic Formation (J4), the Sannine-Maameltein Cretaceous Formation (C4-C5), the Eocene Limestone Formation (e2b), the Miocene Limestone Formation (mL) and the Quaternary-Neogene deposits (Q-cg). These formations are fractured in nature with groundwater flowing mainly through the fractures.

The study area has about two (2) rivers and 167 springs, forming the main source of fresh water in the area.

Tectonics and Seismicity

The Study Area lies to the east of the Yammouneh Fault and west of the Rashaya Fault which are the closest faults to the study area.

Socio-economic Environment

The project area falls under the jurisdiction of Zahle, Qaa El Reem, Hazzerta, Ferzol, Taalabaya, Saadnayel, and Qabb Elias municipalities, in the caza of Zahle.

The description of the project area is presented in Table 1

Table 1 Project Area Description

Name of Village	Administrative Setup and Description of the Project Area
Hezzerta	Hezzerta covers an area of 6,778,335 m^2 (60% agricultural area and 40% residential area) and is located at an altitude of 1,380 m. The total number of residents is 8,980 residents amongst which 4500 are permanent and 4480 are seasonal residents.
Kaa El Rim	Kaa El Rim is located at an altitude estimated between 1200 and 1900 m and covers an area of 30,000,000 m^2. The total number of residents is 2600 amongst which 2000 are permanent and 600 are seasonal residents.

Name of Village	Administrative Setup and Description of the Project Area
Saadnayel	Saadnayel covers an area of 5,000,000 m² is located at an altitude of 950 m and is part of the Union of Municipalities of Zahle Caza. The total number of residents is 20,000 amongst which 15,000 are permanent and 5000 are seasonal residents.
Taalabaya	Taablaya, located at an altitude of 900 m, covers an area of 5,000,000 m2 and is part of the Union of Municipalities of Zahle Caza. The total number of residents is about 45,000 amongst which 44,000 are permanent and 1,000 are seasonal residents.
Ferzol	Ferzol, located at an altitude of 900-1000 m, covers an area of 18,000,000 m² and is part of the Union of Municipalities of Zahle Caza. The total number of residents varies between 6000-7,000.
Zahle	Zahlé is located at an altitude of 1010 m and covers an area of 700000000 m². The total number of residents is 220000 amongst which 180000 are permanent and 40000 are seasonal residents.
Qabb Elias	Qabb Elias, located at an altitude of 950 m, covers an area of 32,000,000 m2 and is part of the Union of Municipalities of Central Bekaa in Zahle Caza. The total number of residents is 55,000 amongst which 40,000 are permanent and 15,000 are seasonal residents.

V. ENVIRONMENTAL IMPACT ASSESSMENT

A summary of environmental impacts before and after implementation of mitigation measures is provided in Table 2 and Table 3.

Table 2 Impact Summary Table with No Mitigation Measures in Place

	Receptors							
Activity / source of the impact	**Ambient air quality**	**Sound Quality**	**Ecology**	**Soil and Groundwater**	**Surface Water**	**Socio-Economy**	**Traffic**	**Occupational and Public H&S**
Construction Phase								
General Construction Activities	2C							
Exhaust and dust emissions	2C							
Site Levelling, Excavation and Soil Compaction Activities	2C	3C	2A	2C		4B	3B	
Preparation of access roads in the valleys					3C			
Accidental Spills of Fuel and Oil and Chemicals			2A	3C	3C			
Inadequate storage of wastewater and solid wastes			2A	3C	3C			

Activity / source of the impact	Receptors							
	Ambient air quality	Sound Quality	Ecology	Soil and Groundwater	Surface Water	Socio-Economy	Traffic	Occupational and Public H&S
Land acquisition for pipelines construction						4B		
Movement of vehicles to transport people and materials pipeline crossing through the different villages of the project							3B	
Job creation						6C		
Increased pressure on existing infrastructure						2A		
Injuries to the public and workers								3B
Operation Phase								
Traffic								
Site Levelling, Excavation, material transportation, and compaction activities		3A				4A		
Change in soil topography				2C				
Accidental Spills of Fuel and Oil and Chemicals				3B	2B			
Leakage from pipelines			3B	3B	2B			
Beneficial impact of providing new sewer networks, and rehabilitation of old network parts						6B		
Excavation of paved roads		3A					2A	
Emissions due to Energy and Fuel Consumption	2A							
Increased health and safety risks due to traffic related accidents and open trenches during pipes repair								3B
Stop wastewater pollution from connected villages						6B		

LEGEND

Consequences
1 – Negligible
2 – Minor
3 – Moderate
4 – Major
5 – Catastrophic
6– Beneficial

Likelihood
A – Low
B – Medium
C – High

Acceptability
Beneficial
Negligible with minor mitigation
Acceptable with EMS in place
Unacceptable

Table 3 Impact Summary Table with Mitigation Measures in Place

Activity / source of the impact	Receptors							
	Ambient air quality	Sound Quality	Ecology	Soil And Groundwater	Surface Water	Socio-Economy	Traffic	Occupational and Public H&S
Construction Phase								
General Construction Activities	1C							
Exhaust and dust emissions	1C							
Site Levelling, Excavation, material transportation, and compaction activities	1C	2B	1A	2B			2A	
Preparation of access roads in the valleys					2B			
Accidental Spills of Fuel and Oil and Chemicals			1A	2A	2B			
Inadequate storage of wastewater and solid wastes			1A	2A	2B			
Land acquisition for pipelines construction						3B		
Movement of vehicles to transport people and materials pipeline crossing through the different villages of the project							2A	
Injuries to the public and workers								2A
Operation Phase								
Traffic								
Site Levelling, Excavation and Soil Compaction Activities for maintenance		2A						
Change in soil topography				2B				
Accidental Spills of Fuel and Oil and Chemicals				2B	2A			
Leakage from pipelines			3A	2B	2A			
Emissions due to Energy and Fuel Consumption	1A							
Increased health and safety risks due to traffic related accidents and open trenches during pipes repair								2A

LEGEND

Consequences		**Likelihood**	**Acceptability**
1 – Negligible	4 – Major	A – Low	Beneficial
2 – Minor	5 – Catastrophic	B – Medium	Negligible with minor mitigation
3 – Moderate	6– Beneficial	C – High	Acceptable with EMS in place
			Unacceptable

Proposed mitigations for construction and operation impacts are summarized in Table 4 and Table 5 respectively. The cost of implementing the EMP is roughly estimated around $100,000.

Table 4 Construction Phase Environmental Management Plan

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
Air Quality	Exhaust emissions from vehicular transport and construction equipment operation	• Inspect all equipment and vehicles to be used for the project prior to their deployment to the site as well as at regular intervals during the construction sequence to identify any emerging leakage incidents during construction; • Continually use properly designed, maintained and operated equipment/vehicles by the construction contractor, proper engine fuel mixtures, regularly serviced exhaust emission systems and proper engine tuning. These precautionary measures contribute significantly to a reduction in identified air pollutant emissions; • Investigate the environmental benefits of employing environmentally friendly equipment by the contractor, such as machinery with higher fuel efficiency or those equipped with air pollution control devices to minimize exhaust emissions; • Avoid idling vehicles and equipment engines that are left running unnecessarily; and • Maintain and report monthly fuel consumption records to ensure that the vehicles are running properly and leading to excessive gaseous emissions to air.	No additional cost	• Contractor's mechanical engineer and environmental officer • Supervision consultant appointed by CDR • Municipality Engineer
	Dust generation from soil disturbance during site excavation and site preparation	• Install sandbags or other erosion control measures to prevent silt runoff to public roadways where applicable; • Minimize handling of dusty materials and drop heights for materials transfer to lorries; • Ensure site roads are kept regularly damped down, compacted or suitably surfaced to minimize dust emissions	5000 USD cost of sheets and water for spraying	• Contractor's civil engineer and environmental officer • Supervision

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
		from vehicle use; • Implement approved water-spraying procedures as needed; • Enforce a maximum speed limit of 20 km/h throughout the work sites; • When possible delay compaction activities until the beginning of the wet season or when more water is available; • Maintain stockpiles (if any) at minimum heights and forming long-term stockpiles into the optimal shape to reduce wind erosion; and • Cover all incoming and outgoing trucks from the site.		consultant appointed by CDR • Municipality Engineer
Noise	Increase in noise level from construction activities	• Use the quietest available equipment where possible; • Equip all internal combustion engine driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment; • Operate and maintain all equipment to be used in accordance with manufacturer's instructions for low noise operation. Engine covers will be used at all times; • Switch off engines when not in use; • Site noisy equipment away from noise sensitive areas and position them behind stockpiles or other barriers to provide acoustic screening; • Properly plan deliveries to and from the sites to minimize impacts; • Prior to initiating the works near to noise sensitive receivers, notify residents of the plans, including expected duration; • Inform staff and workers onsite on the impact of noise and the regulatory requirements; and • Control the speed of vehicle movement on site and in the surrounding area.	10,000 USD (mufflers)	• Contractor's HSE officer • Supervision consultant appointed by CDR • Municipality Engineer

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
Ecology	Impacts on biodiversity	• Design a landscape plan that enhances the landscape aesthetic value using local and native population flora; • When detected, sensitive species or habitats should be conserved; • All waste resulting from construction works, land reclamation, or any other activity should be collected and disposed properly in an allocated disposal site. Littering in the project area and surrounding areas should be prevented; and • All affected areas must be replanted with indigenous species appropriate to the respective sites, by agreement with ecological experts.	1000 USD/month (part time ecological expert during construction phase)	• Contractor's environmental officer • Supervision consultant appointed by CDR • Municipality Engineer
Soil and groundwater	Temporary or permanent change in topography, soil erosion and collapse from grading, trenching, or excavation	• Dispose of surplus material at designated waste locations; • Segregate wastes that can be salvaged and store them temporarily for later use; • Direct materials that cannot be reclaimed or re-used is to designated dumping areas; • Place clear markers indicating the limits of the construction trenches and stockpiling area of excavated materials to restrict the equipment and personnel movement limiting the physical disturbance to land and soils in adjacent areas; • Stabilize the soils in trenches directly after completion of each stage of works where fill should avoid pockets of segregated materials, it should use well-graded materials, and it should be compacted to recognized standards; • Avoid executing excavation works under aggressive weather conditions; and • Erect erosion control barriers around work site during site preparation and construction.	--	• Contractor's civil engineer and foreman • Supervision consultant appointed by CDR • Municipality Engineer
	Change in soil and groundwater quality from poor waste management, and accidental spills and leaks of fuel and Oil	• Store and handle hazardous wastes in appropriate storage facilities; (tanks/containers) and sites; • Prepare procedures for storage and handling of hazardous wastes and raw materials (e.g. batteries, chemicals, fuel) as part of the Contractor's Waste Management Plan;	About 5,000 USD for transportation of wastes to the	• Contractor's civil engineer and environmen

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
		• Provide collection trays and absorbent material on site in case of accidental spills; • Carry out maintenance, refueling and cleaning of vehicles and equipment at designated sites with adequate leakage prevention (e.g. impermeable surface); • In case of any contamination, remove contaminated soil and treat it or disposed of it in a manner appropriate to the type of contamination present; • Prohibit leaving material stockpiled on-site during the rainy season without being covered; • Execute concrete batching, if required, in designated place where the wastes are contained and transferred to the proper disposal place; • Clean concrete ready-mix vehicles on site in special prepared place where the concrete wastes are contained and disposed in the approved places; • Provide garbage bins on site for workers to dispose their refuse. Wastes shall be collected regularly and disposed of according to the municipalities' requirements; • Prepare a hydrotest management plan and get it approved prior to start of Hydrotesting; • Discharge hydrotest water away from the stockpiled excavation or bedding material in a way that will not cause damage to the adjacent locations; • Contain wastewater generated by workers during the construction period in septic tanks to be pumped and discharged later into the appropriate designated place; • Conduct routine inspection and maintenance of equipment for risk minimization; • Store and handle fuels and lubricants within containment facilities (e.g. bunded areas, leak proof trays, etc.) designed to prevent the release of spilled substances to the soil and groundwater environment, and these facilities should be maintained and kept drained of rainwater;	designated places	tal officer • Supervision consultant appointed by CDR • Municipality Engineer

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
		• Ensure the presence of trained employees capable of dealing with small scale spill hazards; and • Ensure the total diversion of the sewer flow before removing old networks pipelines.		

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
Surface water	Change in surface water and sediments quality from possible leakage of fuel/ oil/ chemicals and inadequate storage and disposal of wastewater, solid waste (domestic waste and construction waste) and hazardous waste that will be generated from the construction activities.	• Prevent run-off from cleared or disturbed areas into rivers, streams or surface water bodies by using sediment control methods, such as, silt fences, sandbags, hay bales, drop down structures, detention basins, diversion banks, gabions, etc. All erosion and sediment control structures are to be regularly inspected and maintained, whereby the sieving shall be removed and disposed at a designated site; • Place all spoil from water body crossings in the construction right-of-way at least three (3) meters from the water's edge, or in additional extra work areas. Use sediment barriers to prevent the flow of spoil or heavily silt-laden water into any water body; • Prohibit leaving trenches through canals that are dry or contain non-moving water at the time of crossing open for more than 24 hours; • Carry out the pipelines and manholes installation of seasonal streams preferably in the dry season; • Notify downstream users of water canals of works 10 days prior to the diversion activities if needed; • Complete streambed and bank stabilization before returning flow to the water body channel; and • If hydro testing water is to be discharged into water bodies, ensure that the water quality conforms to the applicable guidelines in MoE Decision No. 8/1/2001 (National Standards for Environmental Quality).	--	• Contractor's civil engineer and environmental officer • Supervision consultant appointed by CDR • Municipality Engineer

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
Socio economic	Damage to the Existing Infrastructure and Potential Water Pollution	• Trial pits shall be executed along the network route to locate the existing infrastructure components; • Sewer lines shall be installed at least 3 meters horizontally from and 0.3 meters lower than existing water main lines; • Where the separation requirements cannot be met due to topography, inadequate right-of-way easements, or conflicts with other provisions of these regulations, lesser separation is permissible if: - The water main and the sewer are located as far apart as feasible within the conditions listed above; - The water main and the sewer are not installed within the same trench; and - The sewer line is appropriately constructed to prevent contamination of the water in the main by sewer leakage. • No water main lines should pass through or come into contact with a sewer manhole	--	• Contractor's civil engineer and environmental officer • Supervision consultant appointed by CDR • Municipality Engineer
	Land Acquisition for Pipelines Installation	• Preparation of a resettlement policy framework (RPF) that: - Sets up the criteria of eligibility for compensation and for the different categories of losses and affected persons, - Describes the methods used for valuing the eligible assets, - Describes institutional arrangements, roles of different institutions involved in resettlement planning, implementation and monitoring, and - Describes the methodology for consulting with Project Affected Persons (PAP) • Preparation of a resettlement action plan (RAP) to be approved by the CDR and the World Bank.	20,000 USD 10,000 USD per RAP	• CDR

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
Traffic	Increase in traffic due to	• Keep traffic to designated roads, position necessary diversion signs, schedule transport of workers and materials to avoid peak hours	--	• Contractor's HSE officer • Supervision consultant appointed by CDR • Municipality Engineer
Occupational and Public Health	Nuisance to workers	• Prepare an HSE procedure in accordance with the applicable standards; • Prohibit keeping trenches open till the next working day. If this is deemed necessary, install barriers to avoid falls into the trenches; • Fence off all construction sites to prevent unauthorized access to hazardous areas; • Communicate identified hazards to crew members during the site specific orientation at the start of the job and train them on medical emergency response; • Post adequate signs throughout the Project area, in visible locations, indicating type of operation and other information and appropriate medical / emergency action response. The signs should be in Arabic; • Keep the site clean and tidy at all times; • Take appropriate measures for the storage, handling, transportation and disposal of all waste material; • Provide basic training in construction, health and safety, first aid and the environment to the construction team; • During construction activities, take all the necessary measures	3,000 USD/month (HSE officer) 15,000 USD (Training of the construction team)	• Contractor's HSE officer • Supervision consultant appointed by CDR • Municipality Engineer

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
		to prevent accidents with awareness training, defining clear procedures and mandating the use of personal protection equipment (PPE), including eye protection, dust masks, hard hats, gloves, high visibility jackets, hearing protection equipment, proper clothing, safety boots, safe ladders, etc.; • Reinstate all disturbed services and facilities in a time that will cause the least disturbance possible to the community; • Develop guidelines for site safety where any excavation, material dumps, soil dumps or other obstructions that are likely to cause injury to any person should be suitably fenced off and at night protected by red warning lights; • Develop guidelines for the safe transportation, use, and storage of construction vehicles and equipment; • Handle, store, use and process branded materials in accordance with manufacturer's instructions and recommendations; • Properly maintain PPE, including cleaning it when dirty and replacing damaged or worn-out equipment. Proper use of PPE should be part of the recurrent training programs for employees and laborers; and • Ensure that qualified first-aid can be provided at all times. Properly equipped first-aid stations should be easily accessible throughout the work sites.		

Table 5 Operation Phase Environmental Management Plan

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
Noise	Increase in noise level from maintenance activities	• Prior to initiating the works near to noise sensitive receivers, notify residents of the plans, including expected duration; • Switch off equipment and generators when not in use; and • Equip all internal combustion engine driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment.	No additional cost	• MoEW/BWE representative
Ecology	Impacts on biodiversity from possible leaks in pipelines installed in the valleys	• Continuous monitoring of visible leaks along the pipelines routes in the valleys; and • In case of any contamination, stop directly the flow and manage the spill.	2000 USD /month	• MoEW/BWE representative
Soil and groundwater	Temporary or permanent change in topography, soil erosion and collapse from grading, trenching, or excavation	• Stabilize the soils in trenches directly after completion of each stage of works where fill should avoid pockets of segregated materials, it should use well-graded materials, and it should be compacted to recognized standards; and • Avoid executing excavation works under aggressive weather conditions.	No additional cost	• MoEW/BWE representative

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
	Change in soil and groundwater quality from poor waste management, accidental spills and leaks of fuel and oil, and potential spills of raw wastewater from pipelines.	• Continuous monitoring of visible leaks along the pipelines routes; • In case of any contamination, remove contaminated soil and treat it or disposed of it in a manner appropriate to the type of contamination present; and • Prohibit leaving material stockpiled on-site during the rainy season without being covered.	2000 USD/.month	• MoEW/BWE representative
Surface water	Change in surface water and sediments quality from possible leakage of fuel/ oil/ wastewater.	• Prevent run-off from cleared or disturbed areas into rivers, streams or surface water bodies by using sediment control methods, such as, silt fences, sandbags, hay bales, drop down structures, detention basins, diversion banks, gabions, etc. All erosion and sediment control structures are to be regularly inspected and maintained, whereby the sieving shall be removed and disposed at a designated site.	1000 USD/month	• MoEW/BWE representative

VI. CONSULTATION ON THE EMP/IEE

A consultation meeting was held on September 13, 2014 in Chtaura to discuss the findings of the EMP/IEE. Table 6 summarizes the proceedings of the meeting.

Table 6 Concerns Raised during the Public Consultation Meeting

Name	Party	Comment/Question	Answer	Integration of Comments in the Study
Kassem Mathloom	Alkhyara Municipality and Union of Municipalities of the Plain	Some of the presented impacts on groundwater are negative whereas wastewater projects are known to have positive impacts	The overall project impact on groundwater is positive, however, the impacts mentioned in the presentation were related to construction activities and potential leakage of wastewater during operation	--
Lawyer Toufik Al Hindi	Zahle and Bekaa Chamber of Commerce and Industry	Now, water networks are being implemented and installed on public roads and in the next phase wastewater networks will be implemented and excavations will be executed again on public roads. There should be a coordination mechanism to avoid re-excavating the roads	Projects are implemented based on the financing availability which makes the coordination difficult	--
Lawyer Nathrat Andokian	Anjar Municipality	• The study doesn't mention the mechanism for coordination with municipalities.	• The main aim of this workshop is to coordinate with municipalities, unions, and organizations, to take their comments and opinions and include them in the study.	The report describes the role of municipalities in implementing the environmental and social management and monitoring plan especially during the construction phase of the project (Section **Error! Reference ource not found.**).
Ibrahim Nasrallah	Union of Municipalities of Zahle Caza	There is an area in Ferzol that cannot be connected to Ferzol WWTP due to topographical reasons and could be connected to Zahle WWTP.	The deisgn consultant will visit the area and investigate the possibility of connecting it to Zahle network	The area will be included in the EMP
Melhem Fayez Ghoson	Ferzol Municipality	There is an area in Ferzol that is not connected to Ferzol WWTP, and needs to be connected to Zahle WWTP		
Osama Ibrahim	Al Salam Organization	• Salam Organization has had a lot of activities last year and now through 18 environmental committee of the civil society distributed in the villages (USAID Fund) it is working on	The support of the local NGOs is needed during the implementation of the project and the workshop aim is to involve these NGOs; however, the legal mechanism that	--

Name	Party	Comment/Question	Answer	Integration of Comments in the Study
		environmental files. Therefore the organization would like to be part in this project in promoting awareness	describes the engagement methods during the execution of the project is not available at this stage.	

1 INTRODUCTION

1.1 GENERAL OVERVIEW

Earth Link and Advanced Resources Development s.a.l. (ELARD) has prepared an Initial Environmental Examination (IEE) and Environmental Management Plan (EMP) for component 1 – package 1 of the Lake Qaraoun Pollution Prevention Project that aims at expanding the sewage collection in Zahle to connect to Zahle Wastewater Treatment Plant (WWTP) (the "Project").

This project aims at implementing certain components of the Business Plan to Combat Pollution at the Qaraoun Lake that was prepared by the Ministry of Environment. As a result of this plan, a follow-up Committee led by the Litani River Authority (LRA) was assigned by the government to follow-up implementation of the plan. The government has requested financial assistance from the World Bank, which is supporting the implementation of the following components:

1. Component 1- Improve the collection of municipal sewage
2. Component 2- Feasibility Studies in Solid Waste Management
3. Component 3- Improve the quality of agricultural runoff
4. Component 4- Capacity Building and Project Management

This study addresses the impacts of Package 1 (expansion of sewage collection to connect to Zahle WWTP, which is expected to become operational in February 2015) under Component 1.

This project requires an EMP to be submitted to the World Bank as per its Operational Policy 4.01 on environmental assessment and an IEE to be submitted to the Ministry of Environment (MoE) as per decree 8633/2012. In compliance with the Environmental and Social Management Framework (ESMF) prepared for this project, and as agreed with the WB and the MoE, one report that combines the EMP and IEE including the most stringent requirements of both has been prepared. The IEE structure, which is inclusive of EMP outline, has been adopted and the study includes the EMP requirements such as the need for public consultation and disclosure. This report is subsequently referred to as Environmental Assessment (EA) report

The EMP/IEE aims to identify and assess possible impacts resulting from the Project and to propose measures to minimize the significance of negative impacts and maximize the benefits of positive ones.

1.2 EA REPORT OBJECTIVES

The EA is an important decision-making tool to ensure that the environmental hazards and effects of the Project are identified and evaluated prior to its commencement and that appropriate control measures are implemented in a timely manner.

The objectives of this EA study are to:

- Identify applicable Lebanese legislations, policies, standards as well as international treaties, agreements, industry standards and guidelines relevant to the Project;
- Provide a detailed description of Project activities;
- Describe the environmental baseline conditions of the Study Area covering the physical, biological, and socio-economic elements likely to be affected by the proposed Project activities;
- Identify and assess the potential impacts of Project activities on environmental and social resources;
- Identify the nature and extent of any significant potential environmental and social impacts be they positive (beneficial) or negative (adverse), temporary or permanent. This shall include routine (planned) operations and non-routine/accidental (unplanned) events;
- Identify any significant cumulative impacts related to the Project;
- Propose appropriate mitigation measures to minimize the significance of the identified impacts;
- Identify any residual impacts following application of mitigation;
- Identify, assess and specify methods, measures and standards to be included in the detailed design, operation and handover of the Project, which are necessary to mitigate these impacts and reduce them to acceptable levels; and
- Conduct and report on public consultation.

1.3 THE PROJECT PROPONENTS

1.3.1 The World Bank

The World Bank is providing financial assistance to the project. A total of 50 million USD have been allocated to implement the four components of the project, out of which 45 million USD are allocated for Component 1 to improve the collection of municipal sewage. The World Bank shall also provide technical assistance and backstop the implementation of the project.

1.3.2 The Council for Development and Reconstruction (CDR)

The CDR is leading the execution of the project and provides procurement, engineering and supervision services. The CDR shall ensure that the recommendations of this EA study for Zahle wastewater networks are included in the Terms of Reference (TOR) of the contractors executing the construction activities.

The CDR will be also responsible for the expropriation procedures if resettlement is needed during the execution of the project's activities. In addition to that, the CDR will prepare the necessary reports to be submitted to the World Bank (WB) as part of the financing agreement.

1.3.3 The Ministry of Energy and Water (MoEW) and Bekaa Water Establishment (BWE)

MoEW is an institutional partner responsible for water and wastewater management in the country. It shall provide, through the BWE, overall supervision of the implementation of the works and ensure the project is implemented in line with national strategies and plans related to the sector.

1.3.4 The Ministry of Environment (MoE)

The Ministry of Environment shall ensure that environmental safeguards are implemented throughout design, construction and operation of the project. MoE shall ensure that the requirements of Decree 8633/2012 are duly complied with, including reviewing the quality of the EA study and the implementation of the EMP.

1.3.5 Engineering Consultant

Rafik El Khoury and Partners (RELK) consultancy has been assigned by the CDR to provide engineering services to this project and prepare detailed engineering, Bill of Quantity and tender documents for the implementation of the Zahle sewage networks. RELK shall integrated the findings of the EA study into the detailed design; the EMP shall be an integral part of the tender documents.

1.3.6 EA Practitioner

ELARD has been assigned by the CDR to act as the environmental and social safeguard consultant for this project. ELARD has prepared the EA study in close coordination with project proponents and other stakeholders.

1.4 BACKGROUND INFORMATION

1.4.1 Project Location

Zahle Wastewater Treatment Plant (WWTP) is currently under construction with funding from the Italian Protocol. The plant is expected to become operational in February 2015 and is designed to serve about 214,000 persons equivalent in 2015 and 300,000 in 2030. The estimated daily average flow for 2015 is 38,000 m^3 and 56,000 m^3 2030. The plant will connect to an existing network of about 300 km. The project intends to finance the construction of 109 km of new sewerage network, the rehabilitation of part of the old network, and 6,000 house connections. The project will also construct the main pipeline that connects Qabb Elias to the planned WWTP in EL Marej. The area that will be covered is Greater Zahlé (including Karak and Ksara), Saadnayel; Quaa El Rim; Taalabaya, Ferzol, Hezzerta, and Qabb Elias (Figure 1-1).

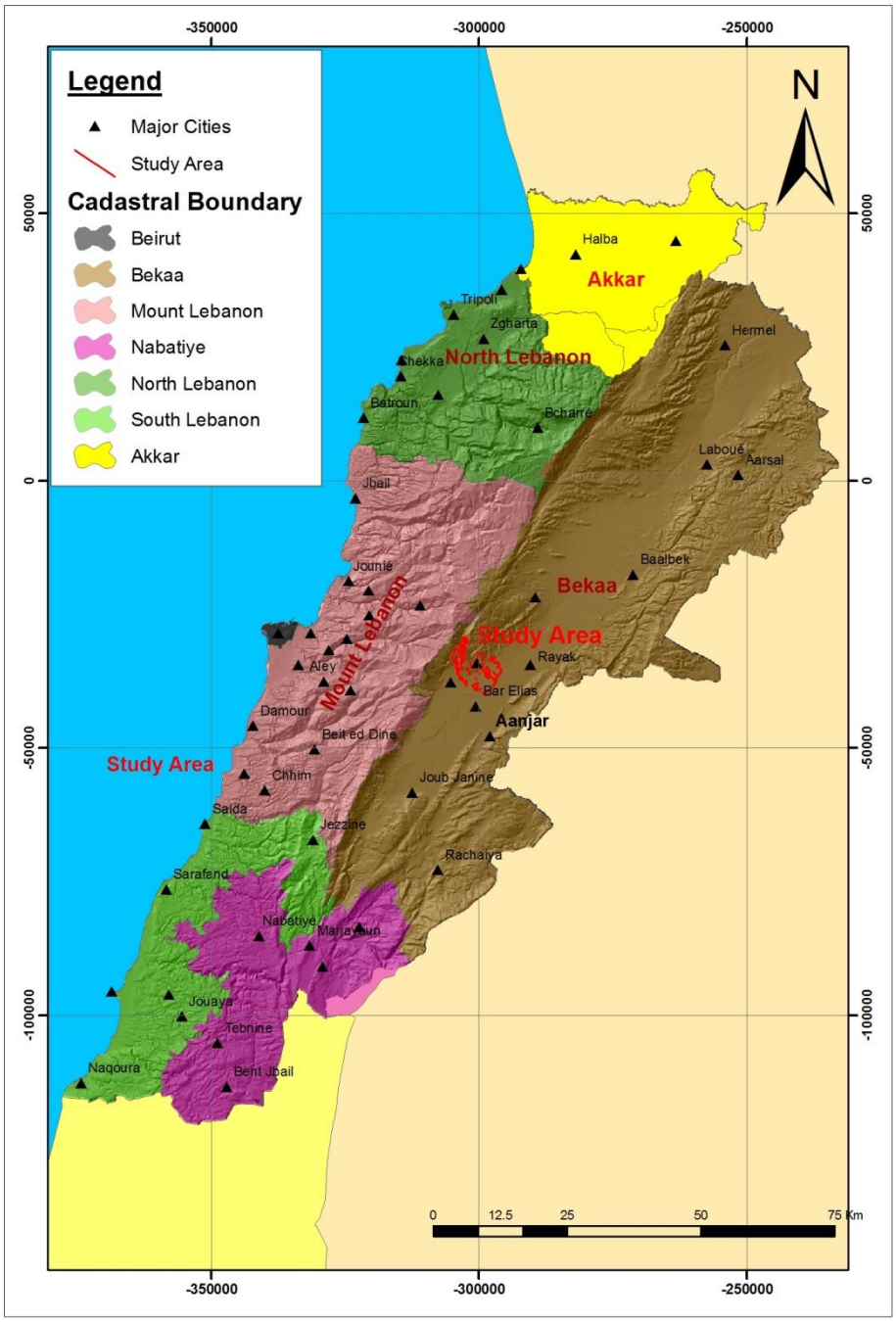

Figure 1-1 Project Location General Overview

1.4.2 Project Need and Objectives

The Litani River is the principal artery of Lebanon, exceeding 170 km in length, and its major water structure is the Qaraoun dam, which forms the Qaraoun Lake (or reservoir). In 1959, the Qaraoun Lake, the largest artificial Lake in Lebanon, was built to produce hydropower, and provide water for irrigation and potable water supply.

The Lake is situated in the West Bekaa at an altitude of 800 m and covers an area of 12 km^2. The Lake has a capacity to hold 220 million m^3. Approximately 70-80% of its storage capacity is used for irrigation and hydropower. The Lake's waters irrigate about 30% of the country's

irrigated land with 1,400 hectares (ha) of the agricultural area in the Bekaa valley and 36,000 ha in the South of Lebanon, and generate electricity in the Markaba (34 Mega Watt (MW)), Awali (108 MW) and Joun (48 MW) hydropower plants.

Pollution is however a serious problem affecting the quality of the Litani River and the Qaraoun lake. Despite the current water uses, the Litani River and the Qaraoun Lake are polluted by four major sources, i.e., municipal wastewater, industrial wastewater, solid waste and agricultural chemicals including non-degradable pesticides. Pollution from the above sources led to deterioration of water quality in the Litani River and Qaraoun Lake which are now contaminated with high concentrations of ammonia, nitrites and fecal coliforms, urban runoff (TPH) and organic industrial pollution, such as phenols and TPH. Lake Qaraoun was found to exceed the world average concentrations in lakes with regard to metals such as Arsenic (As), Cadmium (Cd), Mercury (Hg) and Vanadium (V) which has resulted in making the lake unsuitable for drinking and contact water sports, and fit for irrigation only with restrictions (ELARD 2011).

To address this critical situation, the Ministry of Environment of the Government of Lebanon (GoL) has completed a Business Plan which identifies the major sources of pollution in the Qaraoun Lake and recommends appropriate solutions including detailed prioritized investments for each polluting sector. The GoL has requested the WB to provide financial and technical assistance for some activities of the business plan.

1.5 EA REPORT STRUCTURE

The EMP/IEE report consists of the following sections:

- Introduction;
- Institutional and Regulatory Framework;
- Project Description;
- Environmental Baseline Study;
- Public Participation;
- Environmental and Social Impact Assessment;
- Environmental Management Plan;
- References; and
- Appendices.

2 LEGAL AND INSTITUTIONAL FRAMEWORK

2.1 INTRODUCTION

This section presents an overview of public and private institutional stakeholders relevant to the Project, as well as applicable legislation, policies, standards and international treaties and agreements setting the regulatory environmental requirements associated with the Project.

The objective is to ensure compliance not only with Lebanese environmental laws and regulations, but also with relevant international agreements of which Lebanon is signatory and to observe non-statutory corporate standards and good practice guidance.

2.2 INSTITUTIONAL FRAMEWORK RELEVANT TO THE PROTECTION OF THE ENVIRONMENT

Various governmental institutions play a role in the permitting and supervision of the Project. These include the Council for Development and Reconstruction (CDR), Ministries of Public Works and Transport (MoPWT), Environment (MoE), Energy and Water (MoEW), Interior and Municipalities (MoIM), in addition to the Bekaa Water Establishment (BWE). Furthermore, the Litani River Authority (LRA) and the members of the Qaraoun Committee created to follow-up on the implementation of the business plan to combat pollution will provide oversight to the implementation of the project activities.

At a local level, the municipalities of Zahle, Qaa El Reem, Hazzerta, Taalbaya, Ferzol, and Saadnayel are primary stakeholders in this specific project. The role of the different institutions with a particular focus on environmental protection is summarized in Table 2-1.

Table 2-1 Public Administrations Concerned with the Protection of the Environment

Public Administration	Prerogatives
Council for Development and Reconstruction (CDR)	The CDR will lead the execution of the project and designate competent parties to implement them. The CDR will also supervise the implementation of the Environmental Management and Monitoring Plan (EMMP) and will make sure that the recommendations are included in the Terms of Reference (TOR) of the contractors executing the construction activities. The CDR will be also responsible for the expropriation procedures if resettlement is needed during the execution of component 1 activities. In addition to that, the CDR will prepare the necessary reports to be submitted to the World Bank.
Ministry of Environment (MoE)	MoE is the national competent authority responsible for the protection of the environment in Lebanon. MoE is responsible for reviewing the IEE report for the Project and for issuing the conditions for approval of the Project. Upon approval of the IEE, MoE is responsible to enforce and supervise the implementation of the Environmental Management and Monitoring Plan (EMMP).

Public Administration	Prerogatives
Ministry of Energy and Water (MoEW)/ Bekaa Water Establishment (BWE)	The MoEW, through the Bekaa Water and Wastewater Establishment (BWE), is responsible for wastewater and potable water management. The MoEW will be responsible for approving the design of wastewater networks, and other matters related to water resources management. The BWE will monitor the EMP/IEE recommendations for the project activities during the operation phase.
Ministry of Interior and Municipalities (MoIM)	MoIM manages the affairs of Municipalities and Unions of Municipalities and stops all kinds of infractions and violations, and oversees local authorities' affairs and operations.
Ministry of Public Works and Transportation (MoPWT)	According to Decree 13379/1998, the Directorate General of Roads and Buildings of the MoPWT is responsible for the inspection of sewage networks. Moreover, public roads fall under the MoPWT's authority. Consequently, it is important to coordinate with the MoPWT when implementing the project.
Municipalities concerned by the project	The Municipalities will supervise the implementation of the EMMP and particularly the EMP/IEE recommendations related to the activities of the current project. The municipality is responsible to manage complaints from local residents and may be involved if complaints are received during Project implementation.
Litani River Authority (LRA)	LRA has overall responsibility for the management of the Litani River and the Qaraoun lake. It shall oversee the implementation of this project which contributes to the protection of the quality of the river and the lake.

2.3 RELEVANT LEBANESE REGULATIONS AND STANDARDS

2.3.1 Overview of the Legal Framework in Lebanon

The Lebanese Constitution represents the strongest legislative text in Lebanon and when in contradiction with the Constitution, a proposed legislation(s) cannot be issued. International treaties/agreements ratified by Lebanon have the second priority in the Lebanese legislative framework. The legal structure in Lebanon is shown in Figure 2-1.

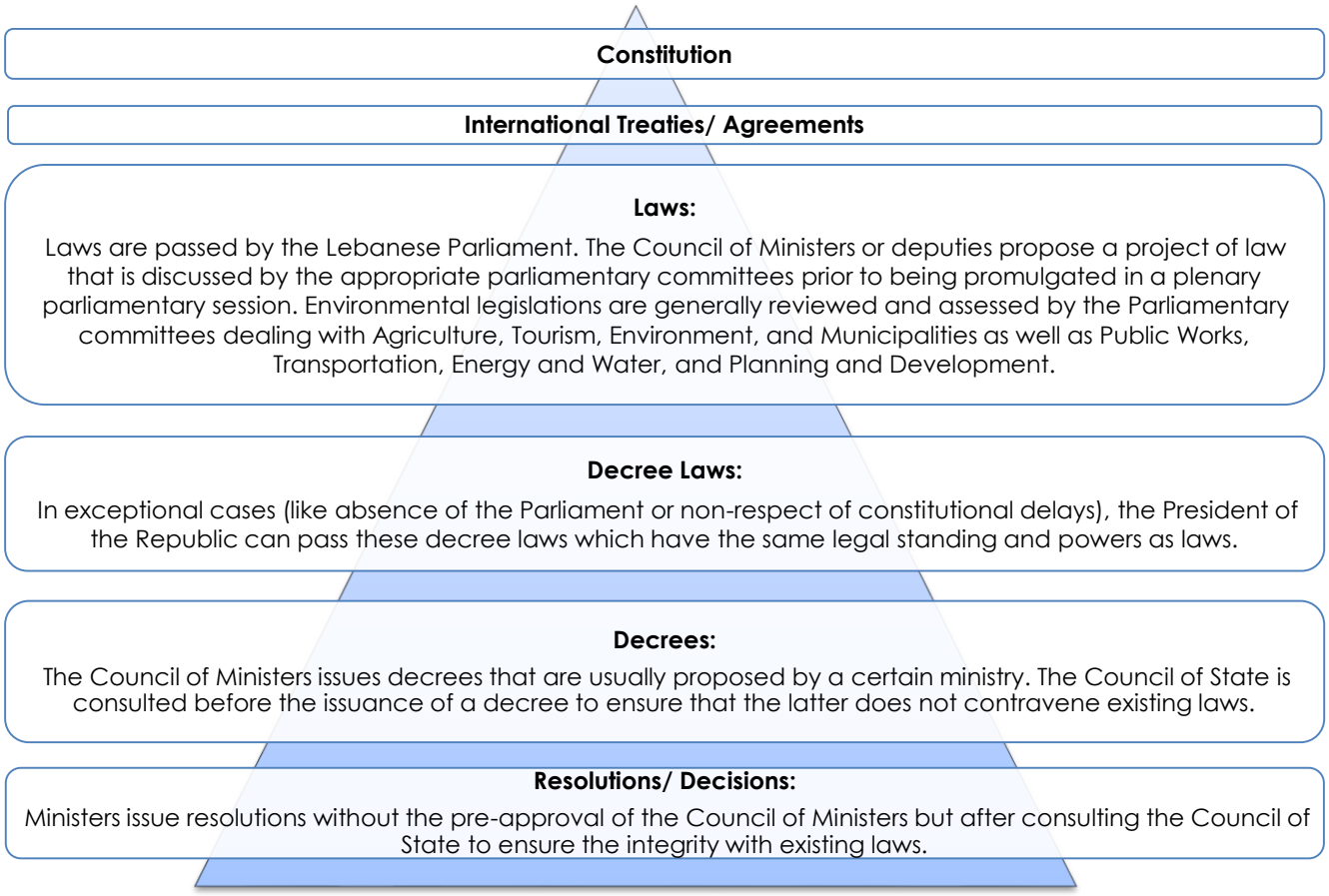

Figure 2-1 Hierarchy of Legislation in Lebanon

2.3.2 Synopsis of the Legislative Framework for Environmental Protection

Until 2012, Lebanese environmental regulations were generally scarce with some dating back several decades. In 2012, 4 laws and 4 decrees drafted in the past decade were approved by the Council of Ministers, and laws are currently being studied by relevant parliamentary committees. Table 2-2 presents an overview of the main environmental legislations found in Lebanon dealing with the management of water resources, solid waste and wastewater as well as air quality and pollution control; these legislations are listed in reverse chronological order.

Table 2-2 Summary of Relevant Environmental Legislations

Year	Law / Decree	Relevant Provisions
2014	Law 251	Designating General Attorneys and Judges for investigating environmental litigation cases
2012	Environmental Prosecutor Draft Law	Establishing an Environmental Prosecutor
2012	Air Act Draft Law	Protection of Air Quality
2012	Decree 8157	Establishing the National Council for the Environment and specifying its mandates and organization
2012	Decree 8633	The EIA decree is under the Framework of Environmental Law. It stipulates the EIA procedures and regulations related to all development Projects that have a potential impact on the environment.
2012	Decree 8213	Strategic Environmental Assessment of Policies, Plans and Programs in the public sector
2011	Circular 10/1	Monitoring the operation and exploitation of generators
2009	Decree 2275	Application Decree on the Organization and mandates of the MoE, its divisions and departments.
2005	Law 690	Law on the Organization of the MoE. The Law gives the MoE the prerogative to set the standards and norms for the protection of coastal zone, river beds and different water resources taking into account the protection of the environment and the conservation of its natural resources.
2004	Law 646	Construction Law – Amendment of the Decree-law 148/83
2002	Law 444	Environment Protection Law
2002	Decision 5/1	Review of "Initial Environmental Examination" report
2001	MoE Decision 8/1	National Standards for Environmental Quality
1996	MoE Decision 52/1	Specifying the National Standards for Environmental Quality and the Environmental Limit Values for Air and Water
1991	Law 58	Expropriation law which was modified later on by the Law enacted on 12/08/2006
1983	Decree-Law 70	Related to land use planning, including allotment and conjunction (ضم وفرز) of land in residential areas, guidelines for landscaping, expansion of cities and villages, restructuring of old neighborhoods and new built-up areas for aesthetic or sanitary purposes, rehabilitation of old neighborhoods and those destroyed by disasters
1983	Decree-Law 69	Decree-law on urban planning
1983	Decree-Law 68	Organizing drilling to extend lines of public services in roads تنظيم أشغال الحفر لمد خطوط الخدمات العامة في الطرق وبراحتها
1977	Law 118 article 74	License for digging roads to extend public water pipes
1977	Law 118 article 51	Regulate traffic and public transport

Year	Law / Decree	Relevant Provisions
1974	Decree 8735	Protection against pollution from solid and liquid waste (prohibiting the digging of wells for the disposal of raw sewage, banning sewage infiltration from septic tanks and the use of untreated sewage for the irrigation of vegetables and some fruit trees), and assigning solid waste management to municipalities
1951	Law 9/11/1951	Soil conservation, reforestation and protection from grazing animals
1943	Decree Law 22	Natural Sites and Landscapes
1939	Law	Protection of Natural Sites and Landscapes in Lebanon
1933	Decree 2761	Provides guidelines related to Wastewater Management and Disposal; related to the pollution caused by the discharge of liquid waste, emphasizes the prohibition of direct or indirect wastewater discharges and waste disposal into water streams.
1932	Decree law 16 L	Mandates the establishment of buffer zones for the protection of all surface and groundwater resources from any type of activity/potential source of pollution. Requirements for buffering are found in Decision 320/26
1926	Decision 320	Related to the protection and use of water bodies belonging to the public domain

2.3.3 EIA Decree and Project Relevance to Environmental Protection Law

The Project is governed by Lebanon's main Environmental Framework Law (Law 444/2002 on Environmental Protection). Law 444 lists different environmental receptors and resources and proposes means for their protection.

The EIA decree 8633/2012 abides by specifications and standard criteria for environmental standards and requirements and sets principles and measures necessary to assess the environmental impact of development Projects. The EIA decree lists all the activities for which EIA or permit conditions are mandatory, and those that require an IEE such as the current Project (refer to Appendices 1, 2 and 3 of EIA decree). The main steps of the EA Implementation Process in Lebanon are summarized in the schematic diagram of Figure 2-2 as described in Appendix 9 of the EIA Decree.

The Country Environmental Analysis of Lebanon (CEA)[2] conducted an assessment of the Lebanese national EIA system and determined the similarities and difference between the national EIA system and the World Bank operational policy OP 4.01 on environmental assessment and the European Commission (EC) EIA Regulations no. 97/11. The assessment showed that the features of the Lebanese EIA system are compatible with most of the World Bank EA Policy (OP 4.01) and the EC EIA regulations.

[2] The Country Environment Analysis (CEA) of Lebanon, the World Bank, April 2011

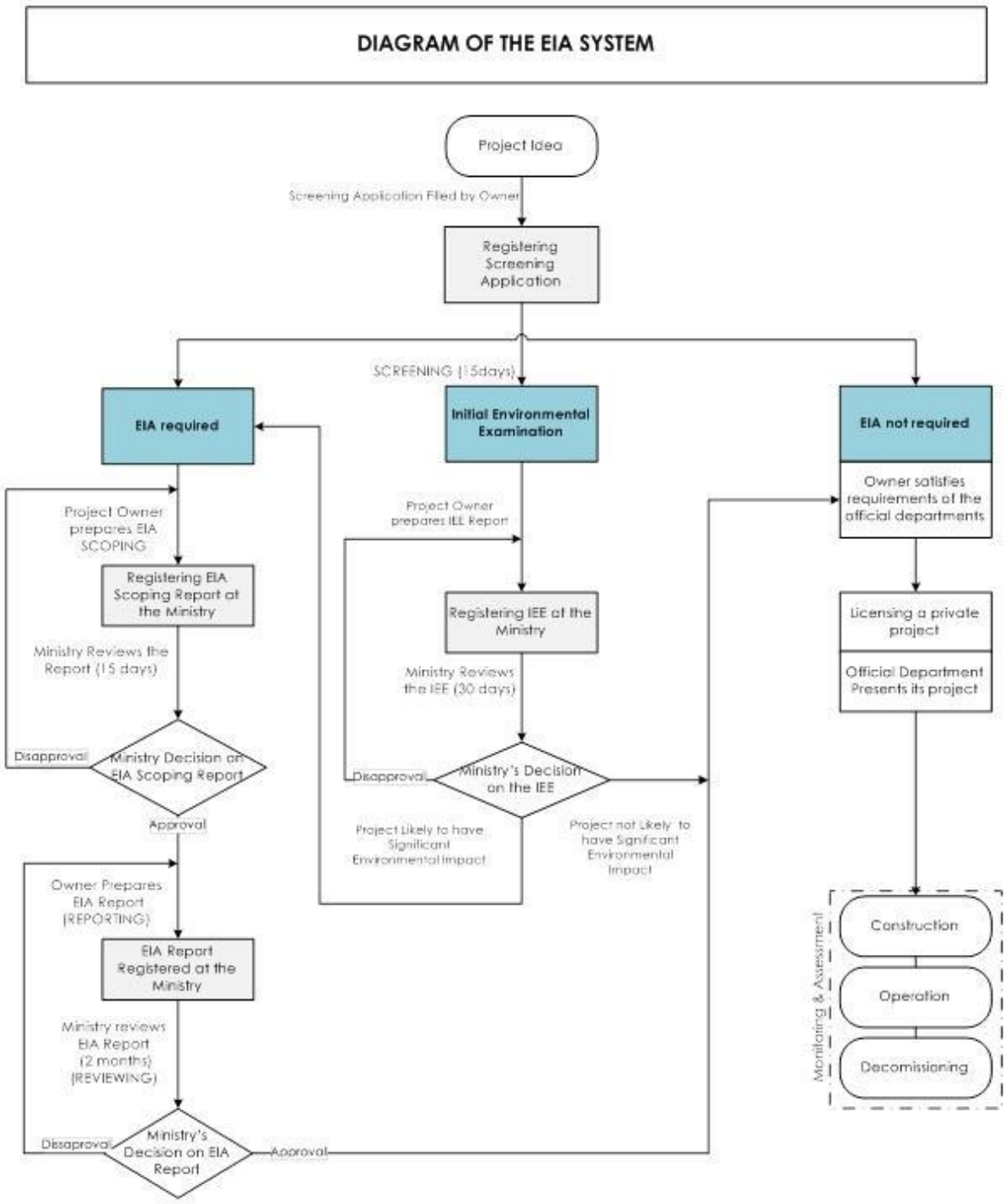

Figure 2-2 Schematic Diagram of the EA Licensing Procedure

2.3.4 Relevant National Environmental Standards

The main legislative texts that stipulate environmental standards in Lebanon are listed in Table 2-3. National emission and discharge standards were established by the MoE in Decision 52/1 dated 1996 and later updated in the Ministerial Decision 8/1 dated 2001. Decree 1039 of 1999 sets permissible standards for drinking water parameters. The relevant national standards are detailed in APPENDIX B and grouped into the following:

- Ambient Air Quality and Stack Emissions;
- Noise;
- Drinking Water Standards;
- Wastewater Emissions and Wastewater Reuse.

Table 2-3 Relevant National Environmental Standards

Relevant Standards*		
Ministerial Decision No. 52/1 MoE	29/7/1996	National Standards for Environmental Quality and Environmental Limit Values for Air, Noise, Water and Soil
Ministerial Decision No. 8/1, MoE	30/1/2001	Updates/replaces Decision 52/1 by developing National Standards for Environmental Quality (NSEQ) related to air pollutants and liquid waste emitted from classified establishments and wastewater treatment plants into receiving water bodies.

2.4 INTERNATIONAL AGREEMENTS, TREATIES, GUIDELINES, AND STANDARDS

2.4.1 International Agreements and Treaties

Lebanon has ratified 50 International Conventions (48 actually in force). Those treaties and conventions which are most relevant to the proposed Project activities are in Table 2-4.

Table 2-4 Ratified or Signed International Agreements Relevant to the Project

Agreement	Objective	Relevance to Project
Convention on Biological Diversity, Rio de Janeiro - 1992 Ratified by Lebanon in 1994	1. To conserve biological diversity; 2. To use biological diversity in a sustainable way; and 3. To share the benefits of biological diversity fairly and equitably.	Protection and conservation of biodiversity during construction and operation activities
Convention to Combat Desertification - 1994 Ratified by Lebanon in 1994	To combat desertification	Control land clearance and Project footprint size
The Framework Convention on Climate Change, or Global Warming Convention (UNFCCC)– 1992 Ratified by Lebanon in 1994	To achieve stabilization of greenhouse gas concentrations in the atmosphere in order to prevent dangerous anthropogenic interference with climate system	Reduce greenhouse gas emissions from construction and operation activities

Agreement	Objective	Relevance to Project
Vienna Convention for the Protection of the Ozone Layer – 1985 Montreal protocol on ozone-depleting substances - 1987 and its amendments Ratified by Lebanon between 1993 and 1999	To protect human health and the environment from any activity that modifies the ozone layer Adopt measures to control human activities found to have adverse impact on the ozone layer	Regulate the use of ODS (ozone depleting substances) during all phases of the Project
International Labour Convention No. 139, 120 and 136 Lebanon has ratified 50 International Labor Conventions (48 actually in force)	To prevent vocational risks ensuing from cancer causing materials and tools Deals with sanitation in offices To protect workers against the risks of intoxication ensuing from benzene	Protect workers' health and ensures proper sanitation and hygiene for base camps, work environment and offices

2.4.2 International Guidelines and Standards

The IEE report first refers to national legislation and international conventions ratified by Lebanon. Whenever confronted with a lack of relevant national legislation, international standards are referred to (particularly International Finance Corporation (IFC)/World Bank and European Union (EU) standards). The relevant ambient air quality standards, noise guidelines and Indicative Values for Treated Sanitary Sewage Discharges are provided in APPENDIX B as described in the IFC General EHS Guidelines (2007)[3].

[3] International Finance Corporation, (2007), Environmental, Health and Safety Guidelines. General EHS Guidelines, Washington, 2007, pp4.

3 PROJECT DESCRIPTION

3.1 PROJECT SITE

The proposed project is aiming at constructing about 109 Km of sewer networks in Zahle (including Karak and Ksara), Saadnayel; Quaa El Rim; Taalabaya, Ferzol, and Hezzerta, along the public roads to connect these villages to Zahle's WWTP which is currently under construction (expected to be completed in February 2015). The project includes also the rehabilitation of part of the old network, and the establishment of 6,000 house connections. The project will construct also about 10 km of the main collector that connects the village of Qabb Elias to the planned WWTP in El Marej.

3.2 PROJECT COMPONENTS

The project includes the construction of 120 km of new sewerage network, 6,000 house connections, and the rehabilitation of part of the old network (Figure 3-1).

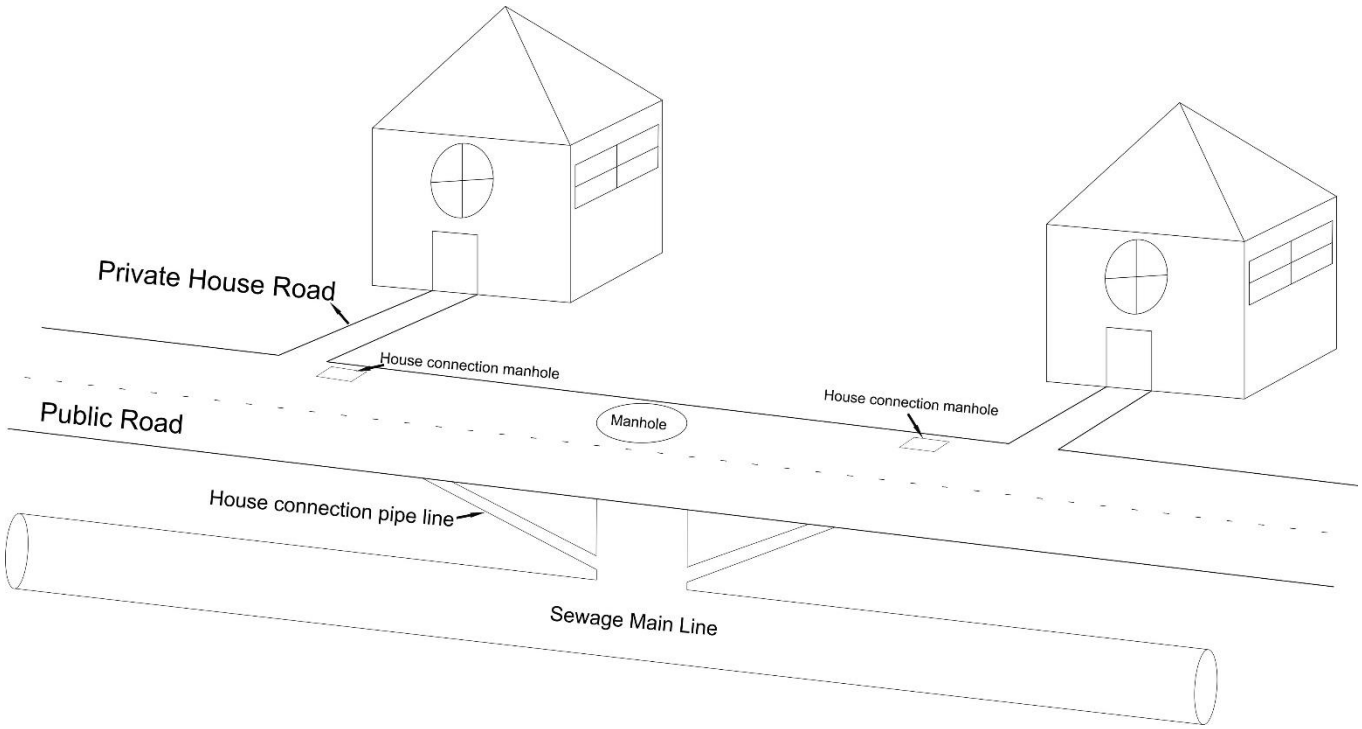

Figure 3-1 Project Components

3.3 CONSTRUCTION PHASE

3.3.1 Construction Schedule and Main Activities

The duration of construction activities for the sewage networks is detailed in Table 3-1.

Table 3-1 Construction Schedule for Sewage Networks

Activity	Duration
Mobilization, materials delivery to site	2 months
Excavation, sand bedding, pipe laying, hydrotesting, backfilling, and reinstatement	20 months
Commissioning	2 months
Total Period	**24 months**

3.3.2 Construction Material

The raw materials that will be used during the construction phase of the project include the following:

- Manhole covers and fittings;
- UPVC/GRP pipes and fittings;
- Reinforced concrete manholes;
- Bedding materials (gravel, sand…);
- Bitumen for asphalt; and
- Lubricants, oil, grease.

Sourcing of bedding materials will be from duly permitted sites; these have not yet been defined and will be defined once the contractor is selected.

3.3.3 Construction Equipment

The quantity of equipment and machinery to be used during the construction phase of the Project is not available at this stage; however, a list of the type of the equipment and machinery to be needed is shown in Table 3-2.

Table 3-2 List of Equipment and Machinery to be used during Construction

Equipment/Machinery
Asphalt saw
Excavator
Bulldozer
Jack hammer
Generator
Air compressor
Roller compactor
Plate compactor
Concrete vibrator
Dump truck

Equipment/Machinery
Water tanker
Fuel tanker
Concrete mixer truck
Truck mounted concrete pump + boom arm
Trencher
Mobile crane
Backhoe loader
Skid steer loader
Asphalt spreaders/pavers
Dumper
Mechanical trowels
Pickups with Telescopic crane
Pickups/canters
4x4 and small cars
Welding machines (for HDPE, Arc Welding for steel…)

*** Not available at this stage**

3.3.4 Power Supply and Energy Consumption

During the construction phase of the project, power will be needed for:

- Temporary site premises; and
- Concrete vibrators, welding machines.

For each construction site, the needed electricity will be supplied by Electricité Du Liban/Zahle (EDL/Z) and a 60 KVA generator for site offices and two 12 KVA generators that will be moved on site along the excavation corridors will be required.

The fuel consumption during the construction phase is presented in Table 3-3.

Table 3-3 Estimated Fuel Quantities

Item	Quantity (l/day)
60 KVA generator for site premises	107
12 KVA generator for site tools (concrete vibrators, , welding machines)	29.7

The fuel consumption of the equipment and machinery is not available at this stage.

Fuel for the 60 KVA generator will be stored in a 1500 L diesel fuel tank, whereas fuel for the equipment, machines and 12 kVA generators will not be stored on-site and will be outsourced on need-basis.

3.3.5 Water Supply

The water during construction will be needed for concrete batching activities, hydrotesting, compaction and daily domestic use of workers. A 22,000 Liters Polyethylene (PE) tank or two PE tanks each of Size 10,000 L both manufactured locally will be available on site for domestic use, while tankers will supply water from providers in the area for the other activities. It is estimated that the housed 20 workers in addition to the other 25 workers/employees will consume about 4,000 L /day per construction site (each village).

1,500 L/day of water will be consumed for compaction activities in each village. Water consumption quantities for concrete batching activities and hydrotesting are not available at this stage and will be estimated by the selected contractor.

3.3.6 Wastewater Generation during Construction

The domestic wastewater generated during construction is estimated to be 3200 L/day per construction site (each village). Wastewater will be discharged into a septic tank that will be constructed prior to the start of works and will be regularly emptied by service providers.

3.3.7 Solid Waste Management during Construction

A reduce, re-use, recycle strategy will be adopted during construction. Domestic waste generated during this phase will be disposed of along with municipal waste in Zahle's sanitary landfill.

Construction and demolition waste and debris which cannot be recycled will be appropriately disposed of at a location approved by the involved municipalities.

Residual oils from the generator will be recycled. No waste will be left on-site after the completion of construction works. Hazardous wastes from the maintenance activities and use of chemicals (oil grease, bitumen…) shall be disposed in locations to be duly defined in close coordination with the relevant municipalities and the MoE.

3.3.8 Manpower, Transportation, and Security

The number of workers needed varies between 40 and 50 across the construction activities. The average manpower required is 45 workers/day for 24 months. A labor camp will be located on site. There is still a lack of data on the location of the labor camp at this stage of the EA as no contractor has been assigned.

Raw material and generated wastes will be transported to and from the site by dump trucks.

In order to ensure worker health and safety, the Health, Safety and Environmental protection manual of the Supervising consultant will be included in the TORs of the Contractor to be followed during construction.

3.4 OPERATION PHASE

During the operation phase the employees and maintenance teams of the BWE will carry out daily operation and maintenance activities of the wastewater network.

3.4.1 Power Supply and Energy Efficiency Measures

The wastewater network will serve the Zahle (including Karak and Ksara), Saadnayel; Quaa El Rim, Hezzerta and part of Ferzol. For the operation phase, no power will be needed.

3.4.2 Water Supply

No water is needed for the operation and maintenance phase.

3.4.3 Wastewater Management

No wastewater will be generated during the operation/ maintenance phase except in the case of leakage from pipelines. This is further discussed in subsequent sections of the report.

3.4.4 Solid Waste Management

Solid wastes will be generated during maintenance when there will be excavation of the trenches to fix the pipes. Surplus backfilling material shall be transported to designated places to landfills in Zahle.

4 DESCRIPTION OF THE ENVIRONMENT

4.1 PROJECT BOUNDARIES / DEFINITION OF THE STUDY AREA

The sewer networks are going to be constructed in Zahle (including Karak and Ksara), Saadnayel, Quaa El Rim, Taalabaya, Hezzerta, Qabb Elias, and part of Ferzol. These villages are located in the caza of Zahle, Bekaa Governorate of Lebanon. An identification of the Project's surrounding land-use is shown in Figure 4-1.

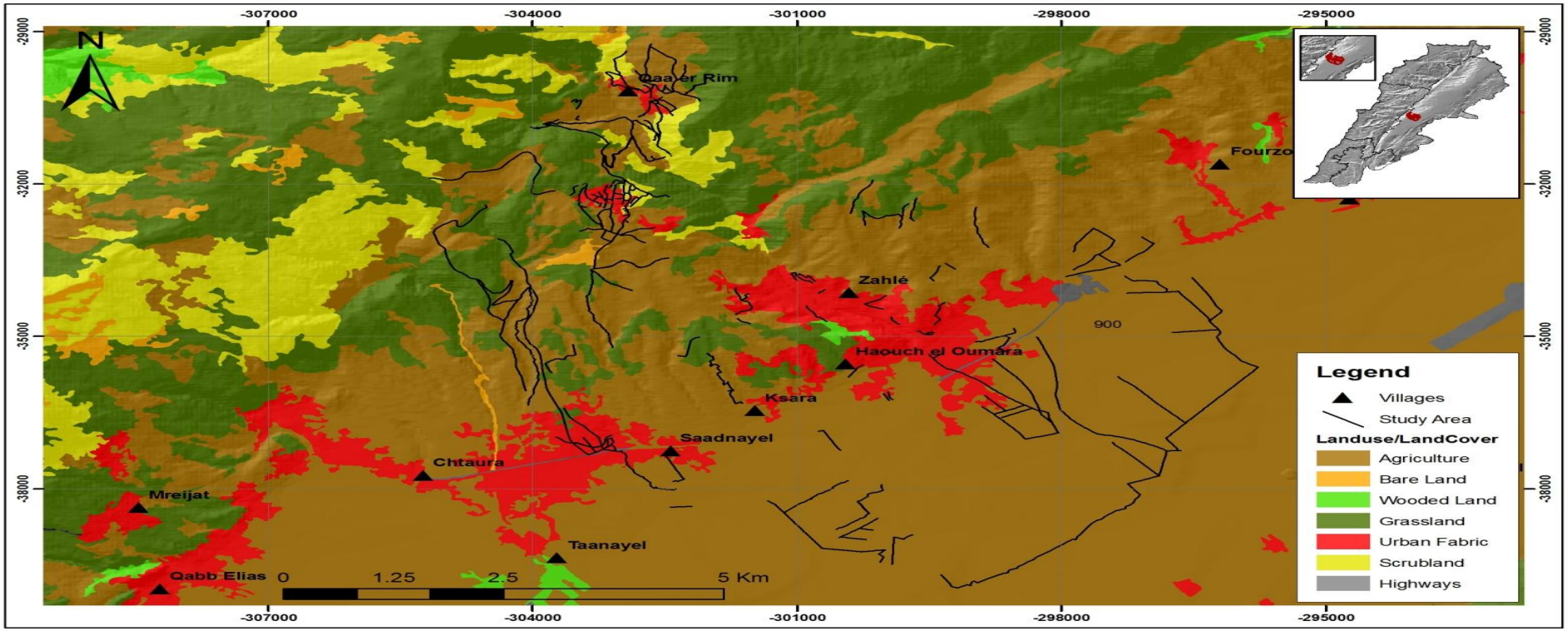

Figure 4-1 Land Use Map in the Project's Area (Source: LNCSR-LMoA, 2002)

Project's existing pollution sources are shown in Table 4-1. Sensitive receptors include the housing units along the network route, commercial buildings, agricultural plots, Berdawni River, and Litani River.

Table 4-1 Pollution Sources Surrounding the Project Site

Pollution Source/ Industry	Approximate shortest distance to the project(m)	Number	Village
Chocolate and sweets	6-10	2	Qaa El Rim
Plastic bottles	90-120	2	Qaa El Rim
Sanitary paper & Corrugated Board	19	1	Qaa El Rim
Alcohol	43	1	Qaa El Rim
Dairy products	9	1	Qaa El Rim
Paper & Cardboard	10-18	2	Qaa El Rim
Quarry	3	1	Zahle
Winery	240	1	Zahle
Ready mix concrete	33-46	2	Zahle
Pepper and grains	22	1	Zahle
Agricultural Machines	10	1	Zahle
Halawa, Tahineh & Turkish delight	16	1	Zahle
Farms Equipment & Steel	15	1	Zahle
Plastic products	15-60	5	Zahle
Natural Juices	59	1	Zahle
Paper	39	1	Zahle
Olive oil Mill and Artificial coal	22	1	Zahle
Metallic products	12-23	5	Zahle
Ice cream	26	1	Zahle
Rock Cutting	31	1	Zahle
Dairy products	14-51	2	Zahle
Farm	47	1	Zahle

4.2 PHYSICAL ENVIRONMENT

4.2.1 Climate and Meteorology

Zahle enjoys a typically eastern Mediterranean climate characterized by hot and dry summers, and mild to cool winters where most of the precipitation is concentrated. The climate in Zahle features however some continental characteristics due to the town's altitude and inland location, in the rain shadow of the Lebanon Mountains. Data presented below were collected at Houch El Omara Weather Station and Tel Amara Weather Station.

4.2.1.1 Temperature

The study area features more extreme temperatures (i.e. hotter summers and cooler winters) than coastal areas. Average minimal and maximal temperatures recorded between January 2009 and January 2012 are presented in Figure 4-2. Average monthly temperatures ranged between a minimum of 5.39°C in January 2009 and a maximum of 36 °C in August 2010. Peaks of over 30 °C occurred on a few days each summer (July - August).

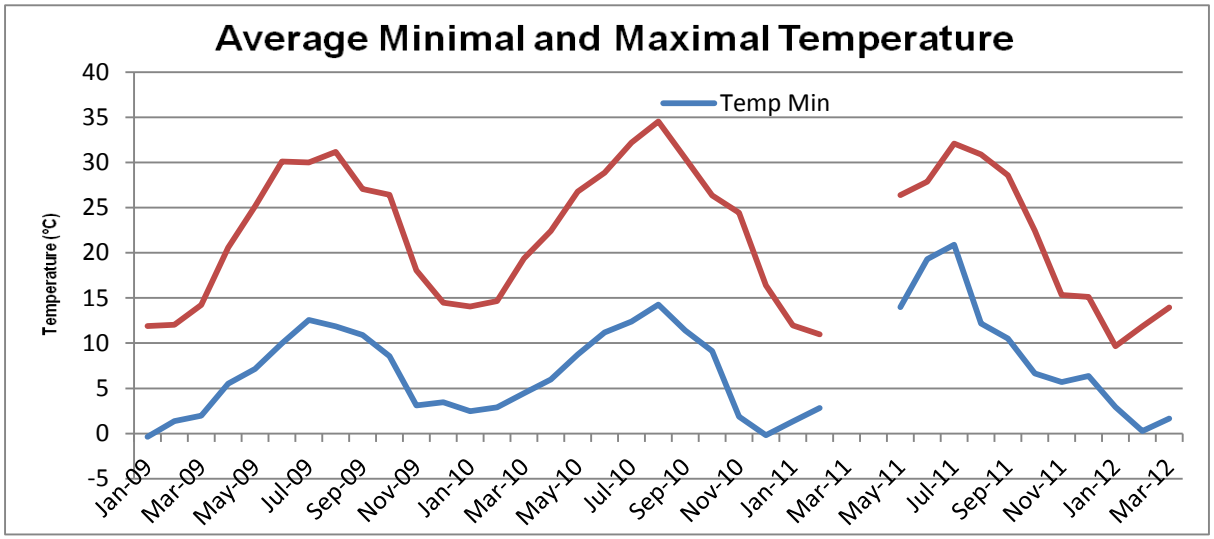

Figure 4-2 Minimum and Maximum Temperatures in Houch el Omara Weather Station (Jan 2009- Jan 2012)

4.2.1.2 Wind

The maximum wind speed reported at the Tel Amara weather station for the period between January 2009 and January 2012 ranged between 3.38 m/sec in November 2010 and 8.46 m/sec in February 2009, while average speed ranged between 0.97m/sec in November 2010 and 2.46 m/sec in June 2010, as illustrated in Figure 4-3Figure 4-3 Average and maximum wind speeds in Tal Amara Weather Station (Jan 2009 – Jan 2012)

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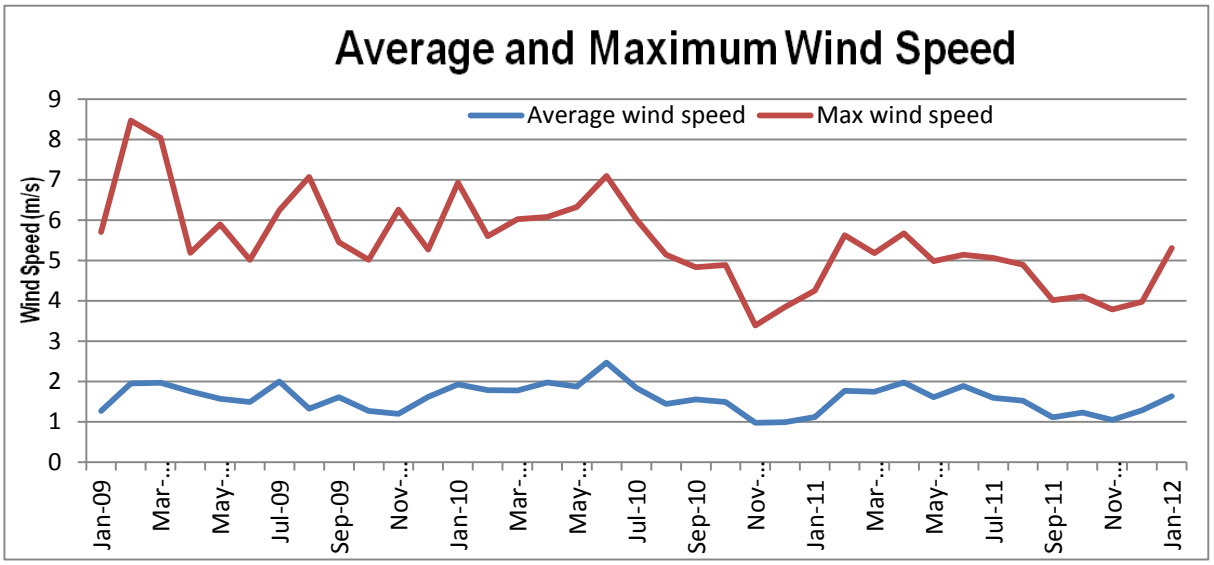

Figure 4-3 Average and maximum wind speeds in Tal Amara Weather Station (Jan 2009 – Jan 2012)

Wind direction results revealed a prevailing yearly average wind blowing from the southwest and northwest almost equally in Zahle area (Figure 4-4).

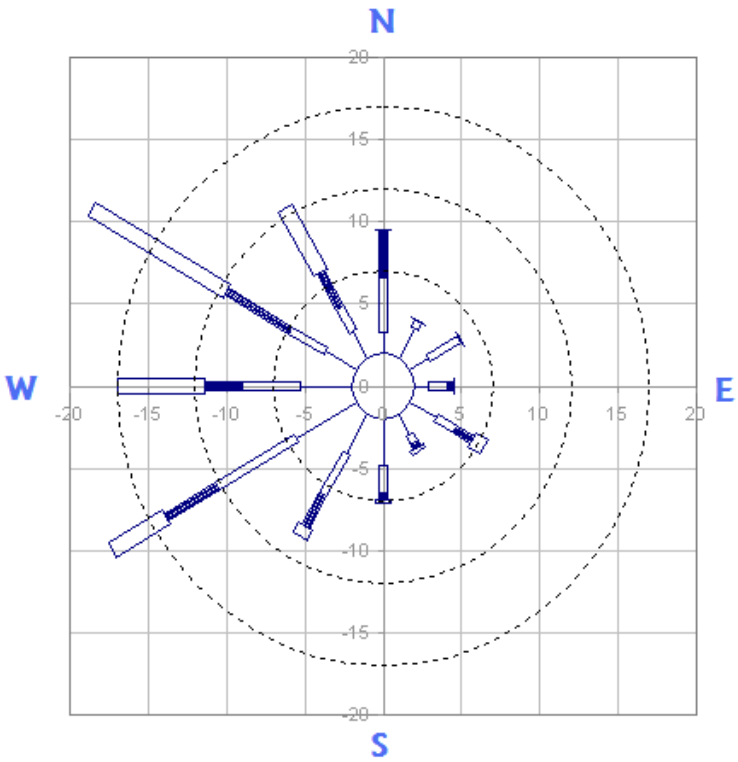

Figure 4-4 Wind Direction at Zahle (Source: MOEW/UNDP/CEDRO, 2011. The National Wind Atlas of Lebanon)

A rainfall map of the Study Area is provided in Figure 4-5, showing that the average yearly precipitation in Zahle is ranging between 500 and 1400 mm/year.

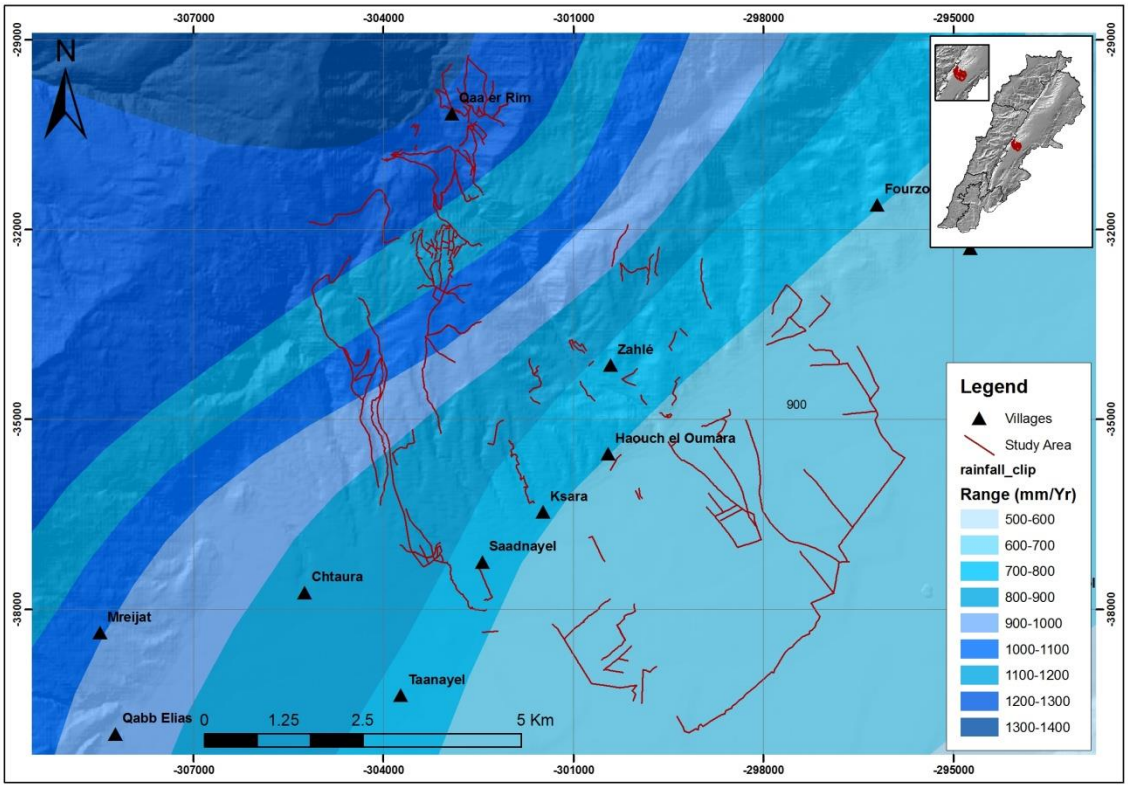

Figure 4-5 Rainfall Map of the Study Area *(Source: Plassard, J., 1972)*

4.2.2 Ambient Air Quality

Air pollution is defined as the modification of the natural characteristics of the atmosphere by any chemical, physical or biological contaminant such as Particulate Matter (PM), Carbon Monoxide (CO), Ozone, Nitrogen Dioxide (NO_2) and Sulphur Dioxide (SO_2) (WHO, 2011).

Sources of pressures on ambient air quality in Lebanon can be natural phenomena or anthropogenic activities such as transportation (vehicles), energy production (power plants, private generators and gas stations), industrial manufacturing processes, construction, quarries, fireworks, burning tires, open dumping and wars (MoE/UNDP/ECODIT, 2011). The cost of environmental degradation from air pollution related problems in Lebanon is estimated at $170 million/year (1.02% of the GDP) (World Bank, 2004).

Private cars are excessively used by the Lebanese population for daily commuting, thus, the transportation sector is one of the leading sources of air pollution in the country. Fuels and lubricants used in vehicles are a major source of Particulate Matter (PM), sulphur dioxide (SO_2), Nitrogen Oxides (NO_x), Carbon Monoxide (CO), and carbonyls emissions (Afif et al., 2009; Kouyoumjian & Saliba, 2006; Moussa et al., 2006; Saliba et al., 2006, 2007). Those air pollutants are identified for the risk they represent through long-term or short-term exposure, for their toxicity, or even for their environmental interference.

The literature review revealed a lack of ambient air quality data for the Project site. Since the greater Zahle area is rural, the main potential sources of pollution are traffic (knowing that the study area is not congested) and private generators, air pollution levels are expected to be within applicable standards.

4.2.3 Noise

4.2.3.1 Survey Strategy

Noise measurements were carried out on August 27, 28, and 29 2014 in the project area along the network path during day time to be representative of the working hours of the project construction. The Type 1 sound level meter used complies with the latest IEC standards and American National Standards Institute (ANSI). It was factory-calibrated in April 2013. It was also calibrated before and after each set of measurements according to the manufacturer's guidelines.

The monitoring locations for the noise measurements were selected to be representative of the studied area and away from being influenced by interferences such as wind, impulsive sounds and electromagnetic radiation from high voltage transmission lines. The noise measurement locations are shown in and described in Figure 4-6 and described in Table 4-2.

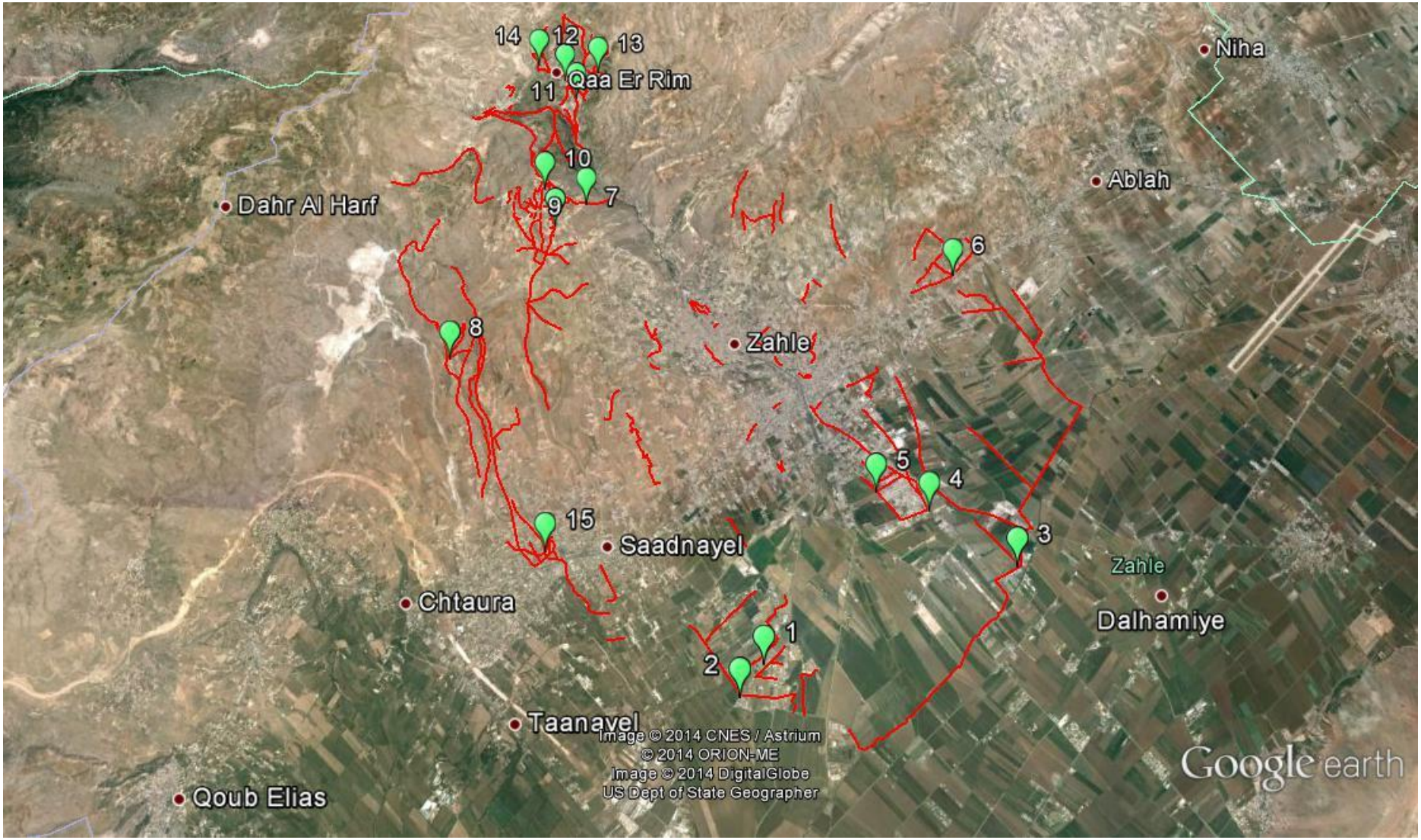

Figure 4-6 Noise Measurement Locations

Table 4-2 Description of the Noise Monitoring Locations

Monitoring location	Coordinates		Village	Nearby sources and sensitive receptors
	Latitude	Longitude		
Location 1	33°48'25.23"N	35°54'16.02"E	Saadnayel	Rural residential units
Location 2	33°48'12.03"N	35°54'3.17"E	Saadnayel	Rural residential units
Location 3	33°49'3.49"N	35°56'29.20"E	Zahle	Agricultural area
Location 4	33°49'29.18"N	35°55'46.06"E	Zahle	Industrial area
Location 5	33°49'38.95"N	35°55'19.81"E	Zahle	Industrial area
Location 6	33°51'17.96"N	35°56'8.90"E	Zahle	Agricultural area
Location 7	33°51'54.91"N	35°52'47.80"E	Hazzerta	Rural area/no residents
Location 8	33°50'44.15"N	35°51'32.96"E	Zahle	Rural residential area
Location 9	33°51'44.37"N	35°52'30.83"E	Hazzerta	Rural residential units
Location 10	33°52'2.46"N	35°52'25.10"E	Hazzerta	Rural residential units
Location 11	33°52'50.74"N	35°52'42.00"E	Qaa El Reem	Rural residential units
Location 12	33°53'0.10"N	35°52'35.76"E	Qaa El Reem	Rural residential units/school/church
Location 13	33°52'59.84"N	35°52'55.27"E	Qaa El Reem	Agricultural area
Location 14	33°53'8.80"N	35°52'20.62"E	Qaa El Reem	Rural residential units
Location 15	33°49'16.49"N	35°52'24.13"E	Saadnayel	Residential units

4.2.3.2 Sound Monitoring Results

A summary of noise monitoring results is provided in Table 4-3. The measured sound pressure levels were compared to the Lebanese standards for environmental noise as per MoE Decision No. 52/1/1996. The exceedances can be attributed to traffic.

Table 4-3 Summary of Measured Baseline Sound Level

Location	Time/Period	Sampling Date (2014)	Area type	Limit For Ambient Noise Levels dB(A) in Selected Regions (Decision 52/1)	Sound Level Values in dB(A)*	
					L_{EQ}	L_{MAX}
Location 1	Day Time (7:00.-18:00)	28-8-2014	Residential areas with some construction sites or commercial activities or located near a road	50 - 60	47.20	73.60
Location 2	Day Time (7:00.-18:00)	28-8-2014	Residential areas with some construction sites or commercial activities or located near a road	50 - 60	59.00	101.70
Location 3	Day Time (7:00.-18:00)	29-8-2014	Rural residential area	35 - 45	**56.90**	95.00
Location 4	Day Time (7:00.-18:00)	29-8-2014	Industrial	60 - 70	66.20	84.40
Location 5	Day Time (7:00.-18:00)	28-8-2014	Industrial	60 - 70	51.70	97.70
Location 6	Day Time (7:00.-18:00)	29-8-2014	Residential areas with some construction sites or commercial activities or located near a road	50 - 60	52.90	67.10
Location 7	Day Time (7:00.-18:00)	28-8-2014	Rural residential area	35 - 45	**51.20**	63.00
Location 8	Day Time (7:00.-18:00)	29-8-2014	Rural residential area	35 - 45	**47.50**	59.30
Location 9	Day Time (7:00.-18:00)	29-8-2014	Rural residential area	35 - 45	**47.40**	57.10
Location 10	Day Time (7:00.-18:00)	27-8-2014	Rural residential area	35 - 45	**68.60**	85.50
Location 11	Day Time (7:00.-18:00)	28-8-2014	Rural residential area	35 - 45	**56.70**	76.50
Location 12	Day Time (7:00.-18:00)	27-8-2014	Rural residential area	35 - 45	**57.10**	74.30
Location 13	Day Time (7:00.-18:00)	27-8-2014	Rural residential area	35 - 45	**53.70**	77.00
Location 14	Day Time (7:00.-18:00)	27-8-2014	Rural residential area	35 - 45	**60.20**	88.40
Location 15	Day Time (7:00.-18:00)	29-8-2014	Residential areas with some construction sites or commercial activities or located near a road	50 - 60	50.70	91.70

* Exceedances to the standards are highlighted in bold

4.2.4 Biological Environment

The ecological survey was conducted on August 29, 2014 to document baseline conditions. No significant or endangered floral species (*i.e.* herbal, wood or vegetative cover) were identified along the planned network route. The planned network will be placed along the paved roads and in parallel to the Berdaouni and Litani River. A section of the network (about 8 km) will be installed in seasonal streams.

Flora Species

No 'area of special concern' is located along the planned network route. Areas of special concern include areas designated as having national or international importance, i.e. world heritage sites, wetlands, biosphere reserves, wildlife refuges, or protected areas. No endangered or endemic species, or even critical ecosystems or habitats were recorded during the field visit (Figure 4-7).

The main flora species identified in the Project area and are indicators of site degradation are *Calicotome villosa (Vahl) Link, Origanum syriacum L., Poterium spinosum L., Smilax aspera L., Capparis spinosa L., Asparagus acutifolius L., Rhus coriaria L., Salvia fruticosa Miller, Teucrium polium L., Spartium junceum L., Echinops viscosus Reichenb., Sambucus ebulus L.*

Figure 4-7 Ecological Survey General Sites Overview

Fauna

No traces of fauna species of high ecological value were observed along the planned network route.

4.2.5 Geological Setting

4.2.5.1 Geology

The study area is located in Bekaa at around 40km inland from the Mediterranean Sea. It is situated in the cadastral boundaries of Zahle. The geology of the project area was studied over an extent of around 286 km^2 (Figure 4-8 and Figure 4-9).

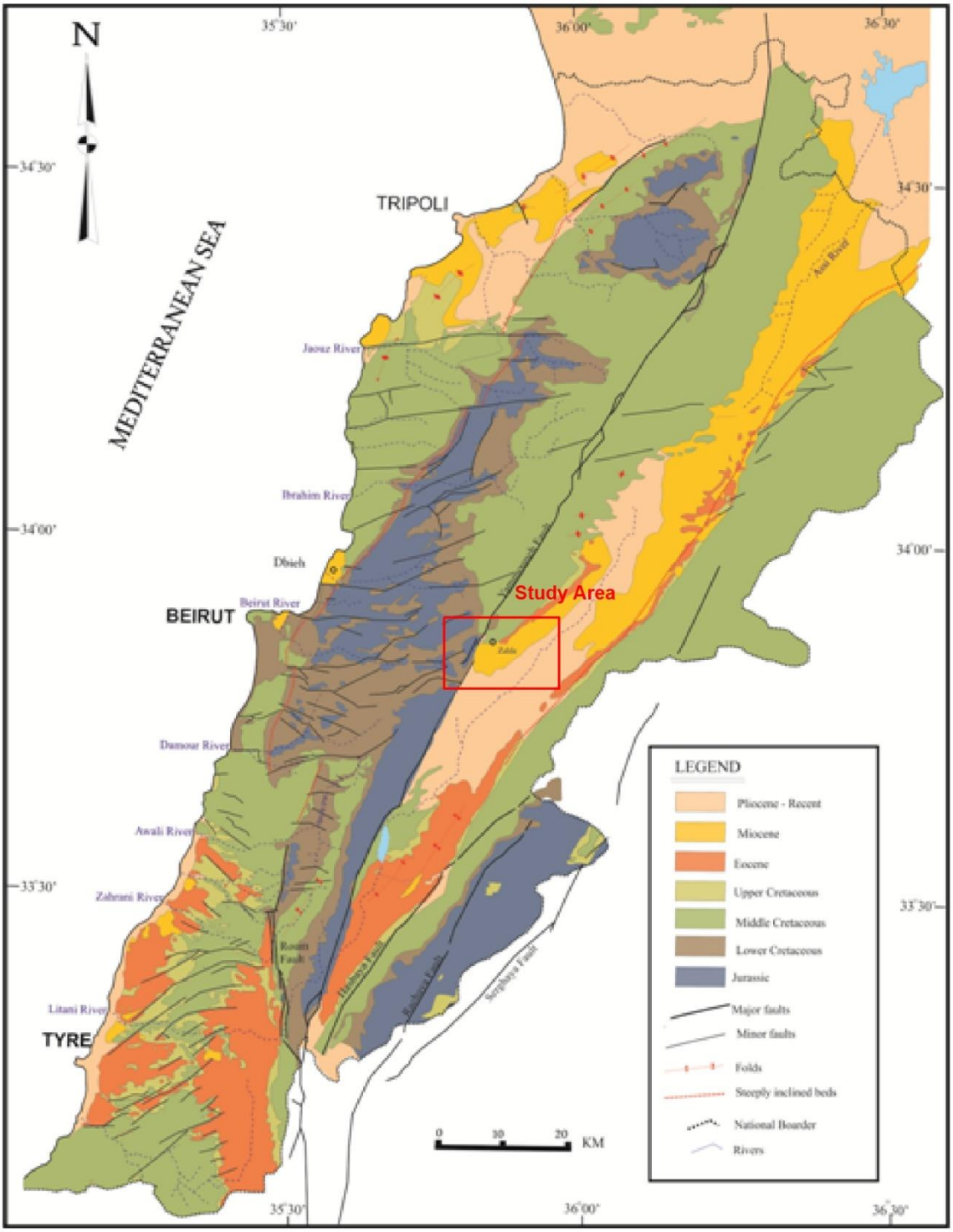

Figure 4-8 General Geological and Tectonic Map of Lebanon Showing the Study Area
(Adapted from Dubertret 1/200,000 Map. 1945)

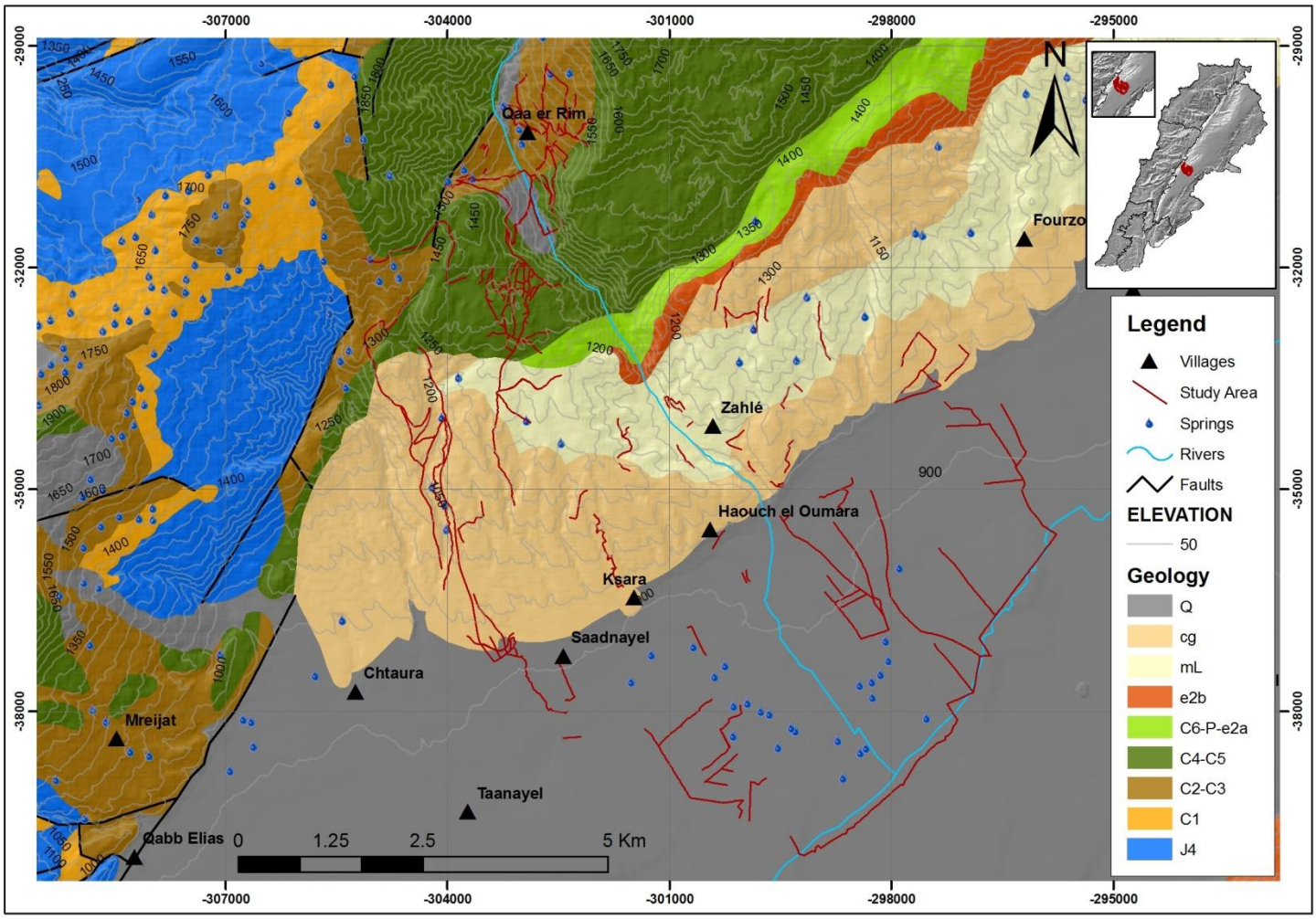

Figure 4-9 Geological Map of the Study Area

(Adapted from Dubertret 1/50,000 Map. 1951)

4.2.5.2 Stratigraphy

Different geological formations are outcropping within the study area, mainly the Quaternary Deposits (Q), the Neogene Conglomerates (cg), the Miocene Limestone (mL), the Eocene Limestone (e2b), the Chekka Formation (C6-P-e2a), the Chouf sandstone (C1), the Aptain-Albian Limestone Formation (C2-C3), the Cretaceous Limestone (Sannine-Maameltein Formation-C4-C5) and the Jurassic Limestone (Kesrouane Formation-J4). The project extend over five (5) different geologic formations; the Quaternary Deposits (Q), the Neogene Conglomerates (cg), the Miocene Limestone Formation (mL), the Sannine-Maameltein Cretaceous Formation (C4-C5) and the Aptain-Albian Limestone Formation (C2-C3).

The lithological characteristics of the above-mentioned formations in the study area are described in the following paragraphs:

The Quaternary-Neogene Deposits (Q-cg) in the study area are composed of two separate distinctive layers: The first is the Neogene conglomerates with calcareous cement and the second is the Quaternary non-consolidated deposits with a clay matrix and silt. This is the most exposed formation in the central and southern part on the study area. The thickness ranges from several tens of meters at the peripheries to more than 1km in the central parts close to the axis of the Bekaa syncline.

The Miocene Limestone (mL) in the study area is mainly composed of marls, Lacustrine marls (continental succession), lacustrine limestone and conglomerates. The thickness of this formation is estimated to reach a maximum of 200m at the core of the syncline.

The Eocene Limestone Formation (e2b) in the study area is mainly composed of Brecia and marly limestone. The thickness of this formation is estimated to range between several tens of meters at the peripheries to around 350-400m towards the core of the Bekaa syncline.

The Chekka Formation (C6) in the study area is composed of white chalk and marly chalk. It lies above the Sannine-Maamiltain Formation and estimated to be around 500m in thickness.

The Sannine-Maameltein Formation (C4-C5) in the study area is composed of well bedded limestone and dolomitic limestone with occasional calcareous shale intercalation, with alternating sequence of limestone and marly. The C4-C5 formation is highly jointed and karstified with an estimated thickness ranging between 700 to 900m. The Sannine-Maamiltain Formation is outcropping in the northern part of the study area.

The Hammana-Mdeirej Formation (C2-C3) is composed of massive fractured cliff forming limestone (C2), and green marls, carbonates with local basalts (C3). It is estimated to be around 300m in thickness.

The Chouf Sandstone Formation (C1) is composed is coarse to fine sandstone with quartz, clay, coal and local volcanic. It is estimated to be around 50m in thickness, mainly outcropping in the western part of the map.

The Kesrouane Jurassic Formation (J4) is primarily composed of karstified, massive to medium bedded limestone units with horizons of dolomitic limestone, thin marly limestone and chert

nodules. It mainly outcrops in the western part of the study area. The thickness of the Kesrouane Jurassic formation is estimated to be around 1000 m.

4.2.5.3 Hydrogeology

Each of the formations exhibits different hydrogeological characteristics. The major aquifers in the study area are the Kesrouane Jurassic Formation (J4), the Sannine-Maameltein Cretaceous Formation (C4-C5), the Eocene Limestone Formation (e2b), the Miocene Limestone Formation (mL) and the Quaternary-Neogene deposits (Q-cg) (Table 4-4). These formations are fractured in nature with groundwater flowing mainly through the fractures.

The study area has about two (2) rivers and 167 springs, forming the main source of fresh water in the area.

Table 4-4 Table showing the major hydrogeological units in the study area

Formation Name/ Code	Aquifer Type	Description/Karstification
Quaternary Deposits (Q)	Semi Aquifer	Major porous medium semi-Aquifer. Groundwater might percolate to and from the underlying aquifers.
Neogene Conglomerates (cg)	Semi Aquifer	The conglomerates form a porous medium aquifer where water might leak from the underlying Aquifer
Miocene Limestone (mL)	Aquifer	Acts as an important karstic aquifer under favorable conditions. Groundwater is stored and transmitted in fractures and conduits.
Eocene Limestone (e2b)	Aquifer	Acts as an important aquifer with major karsitification and high recharge. It is mainly present in south Lebanon
Sannine-Maameltein (C4-C5)	Aquifer	These limestone formations represent the major water towers in Lebanon; they are widely exposed and highly karstified. Major recharge of this aquifer is from snow.
Kesrouane Jurassic (J4)	Aquifer	One of the major water towers of Lebanon. It is deeply karstified to the lower units. It is one of the widest exposed units in Lebanon with a thickness of1000m. Groundwater is stored and transmitted in fractures and conduits

4.2.5.4 Tectonics and Seismicity

Lebanon is located on the eastern coast of the Mediterranean Sea, along the Dead Sea Transform Fault system. The Dead Sea Transform Fault system in Lebanon has several surface expressions, represented in major faults (Yammouneh, Roum, Hasbaya, Rachaya and Serghaya faults), in uplifts as high mountainous terrain (Mount Lebanon and Anti Lebanon), and from the seismic activity record. Recent work has categorized the Lebanese section of the Dead Sea Transform Fault as being a strong seismic activity zone (Khair et al., 2000).

The Study Area lies to the east of the Yammouneh Fault and west of the Rashaya Fault which are the closest faults to the study area.

In terms of seismicity and according to the United States Geological Survey (USGS) earthquake hazard program, the two recent earthquakes occurred in Lebanon. The first was in off shore Jbail on Sunday May 25, 2014 at 15:22 pm UTC. This earthquake had a magnitude of 3.8 on the Richter scale and occurred at a depth of 22.5 km below the surface. The second took place in Saida area south Lebanon on July 6, 2014 it had a magnitude of 4.0 on Richter scale and occurred at a depth of 9km. (Figure 4-10 and Figure 4-11).

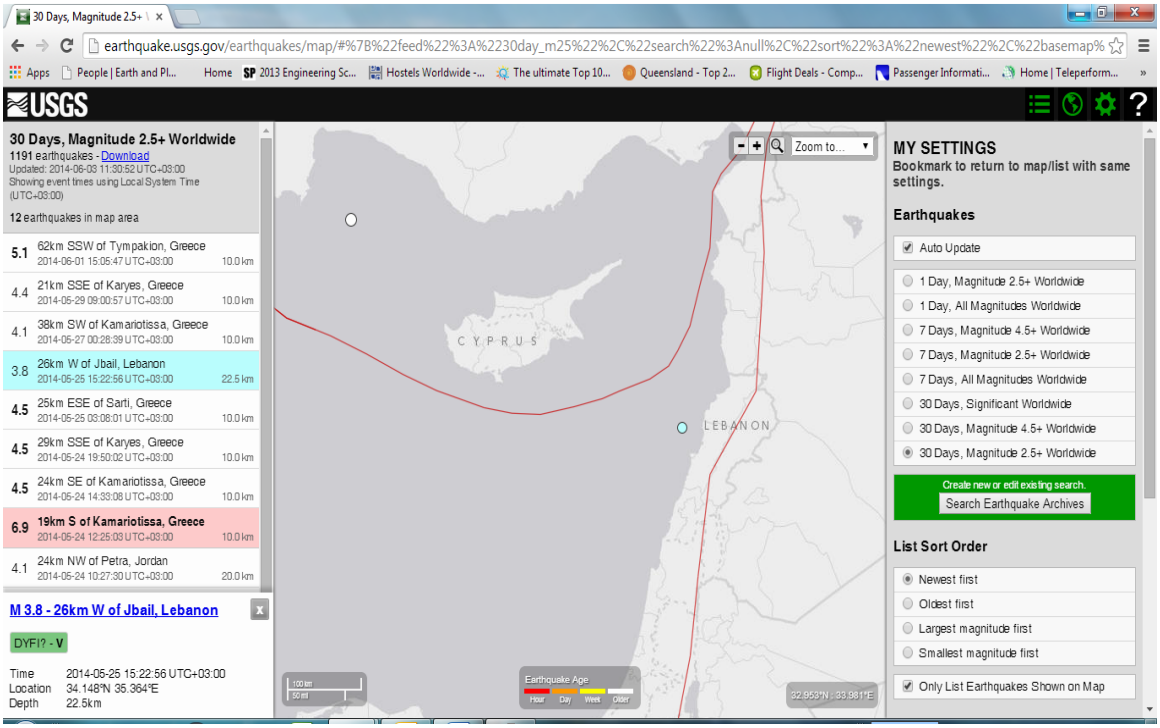

Figure 4-10 Map Showing the Most Recent Earthquake in Lebanon

(source: http://earthquake.usgs.gov)

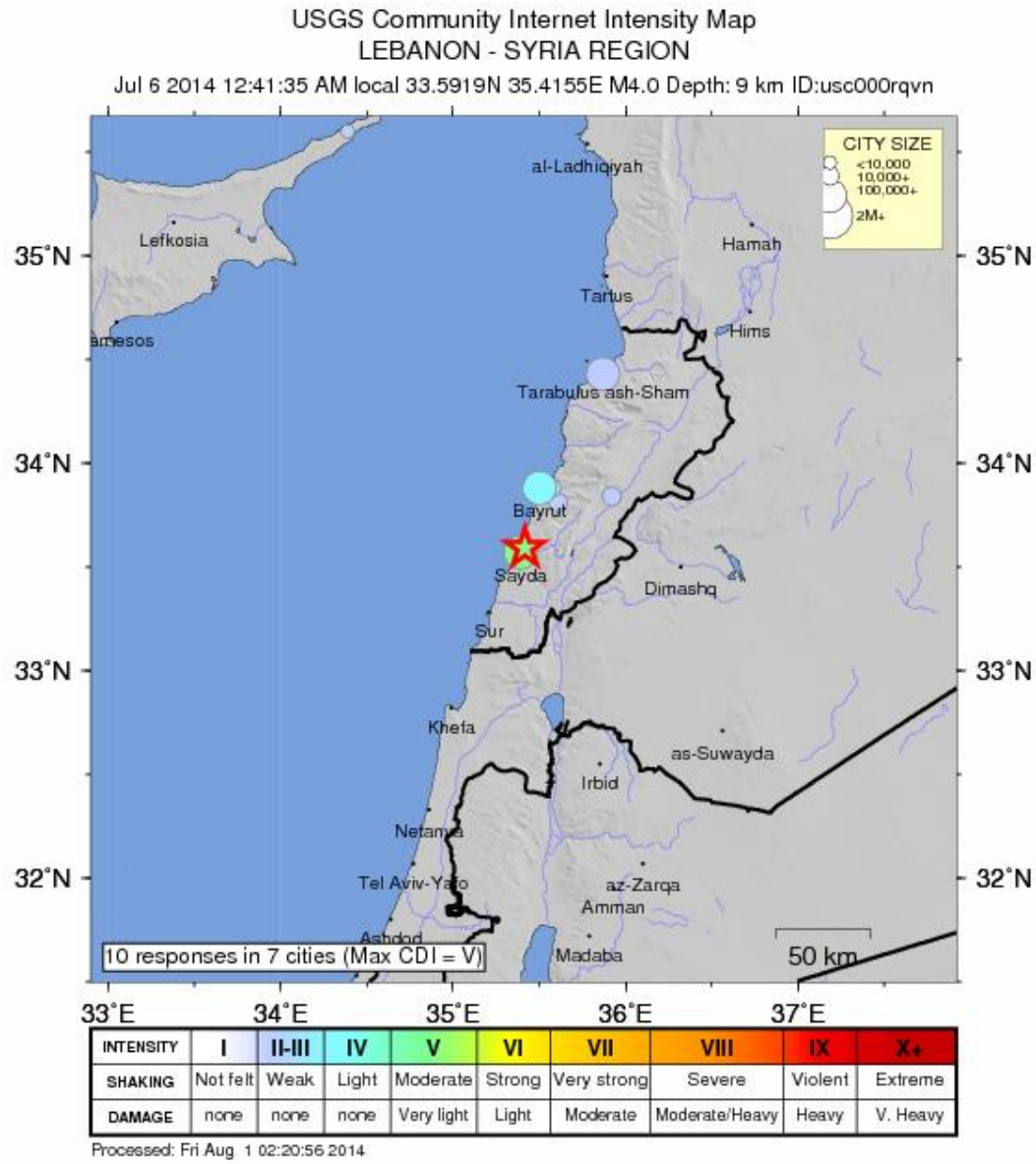

Figure 4-11 Map Showing the Most Recent Earthquake in Lebanon

(source: http://earthquake.usgs.gov)

A historical seismicity map and a seismic hazard map of the region are presented in Figure 4-12 and Figure 4-12 and respectively.

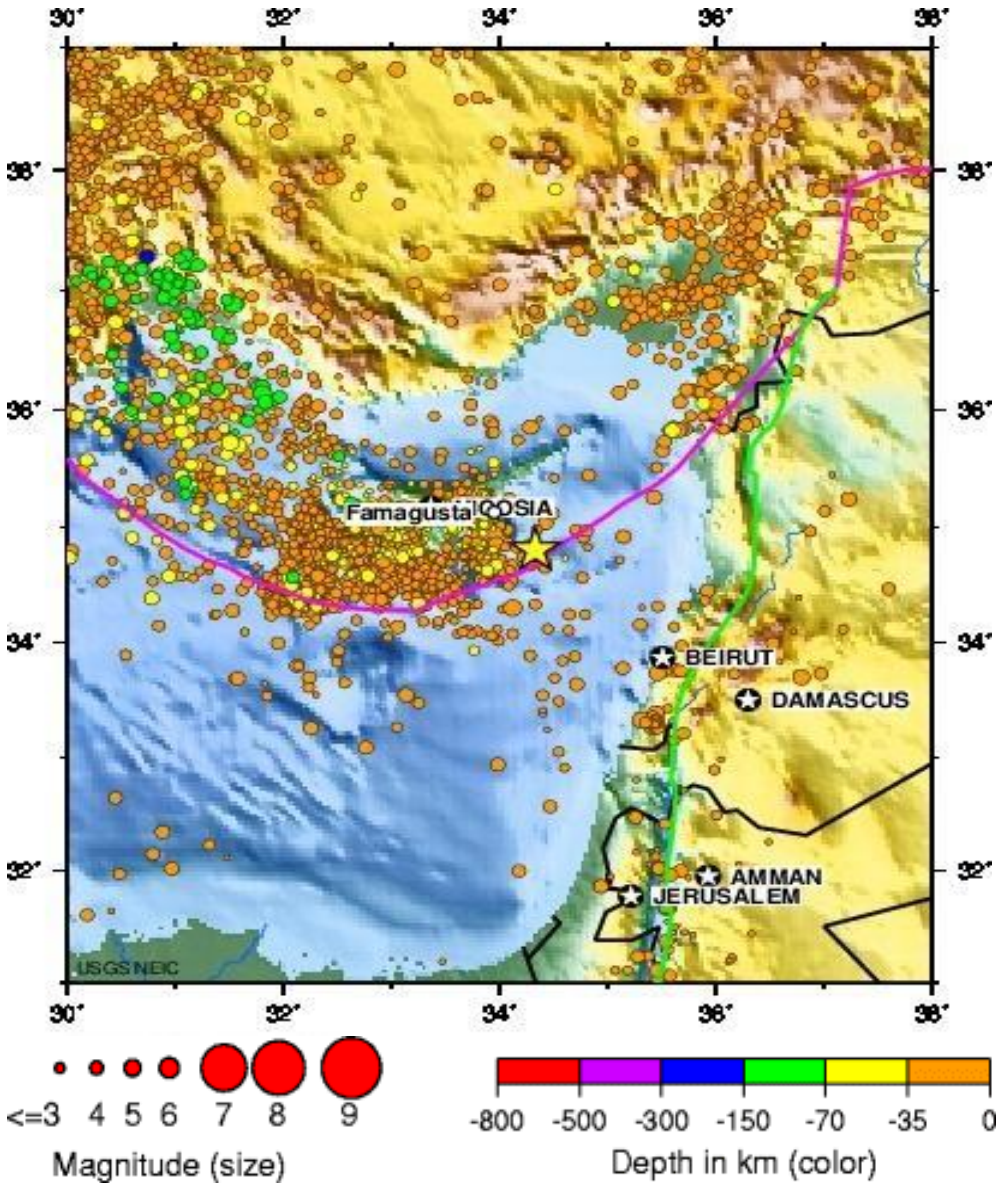

Figure 4-12 Historical Seismicity of the Region (1990 to Present)
(Source: **http://earthquake.usgs.gov***)*

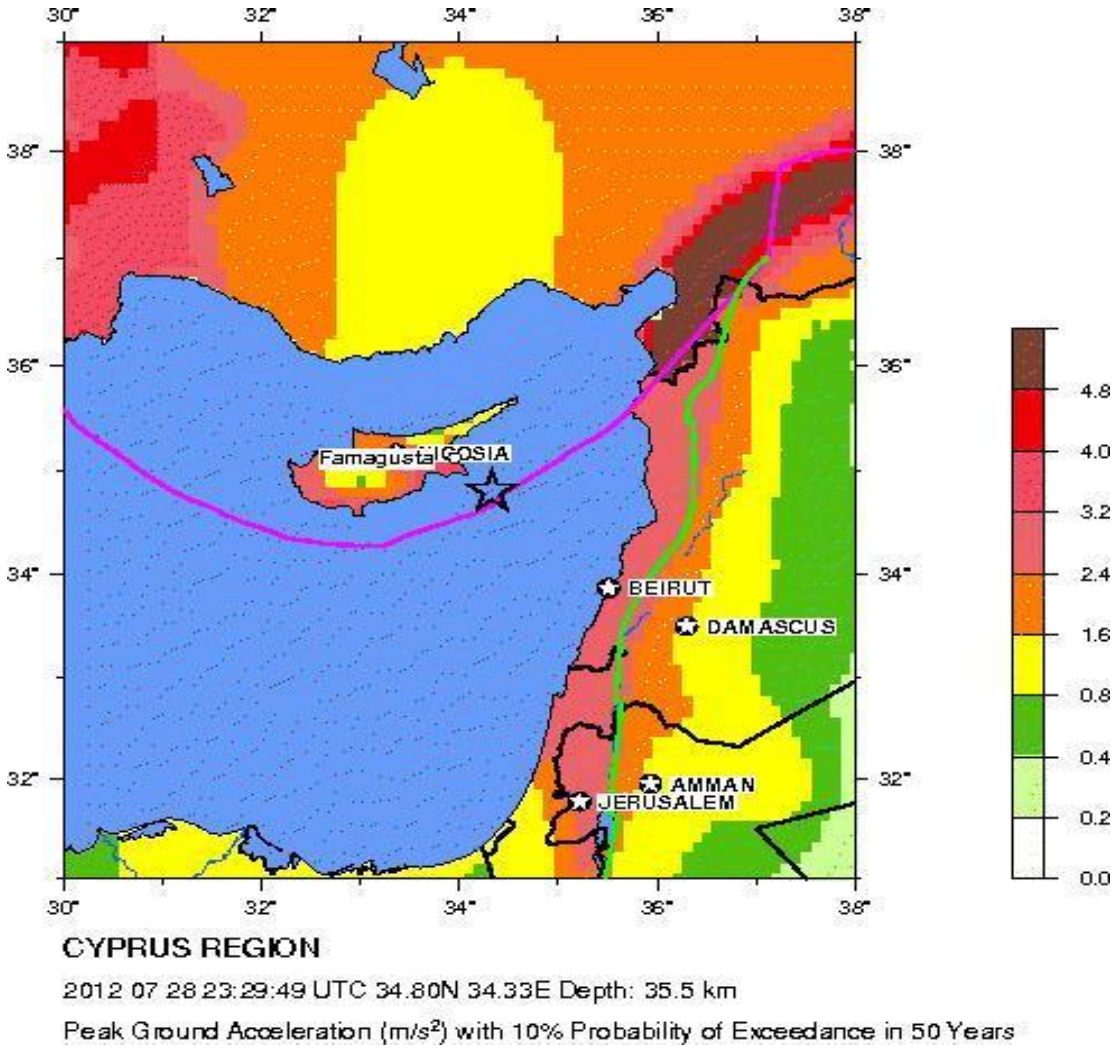

Figure 4-13 Seismic Hazard Map
(Source: **http://earthquake.usgs.gov***)*

4.2.6 Socio-Economic Environment

Information about the villages related to this project were obtained through an extensive desk review of databases which hold socio-economic data on the villages, and through field surveys for various IEEs, EIAs in Zahle area that ELARD has prepared.

4.2.6.1 Administrative Setup and Description of the Project Area

The project area falls under the jurisdiction of Zahle, Qaa El Reem, Hazzerta, Taalabaya, Ferzol, Saadnayel, and Qabb Elias municipalities, in the caza of Zahle.

The description of the project area is presented in Table 4-5.

Table 4-5 Project Area Description

Name of Village	Administrative Setup and Description of the Project Area
Hezzerta	Hezzerta covers an area of 6,778,335 m^2 (60% agricultural area and 40% residential area) and is located at an altitude of 1,380 m. The total number of residents is 8,980 residents amongst which 4500 are permanent and 4480 are seasonal residents.
Kaa El Rim	Kaa El Rim is located at an altitude estimated between 1200 and 1900 m and covers an area of 30,000,000 m^2. The total number of residents is 2600 amongst which 2000 are permanent and 600 are seasonal residents.
Saadnayel	Saadnayel covers an area of 5,000,000 m^2 is located at an altitude of 950 m and is part of the Union of Municipalities of Zahle Caza. The total number of residents is 20,000 amongst which 15,000 are permanent and 5000 are seasonal residents.
Taalabaya	Taablaya, located at an altitude of 900 m, covers an area of 5,000,000 m2 and is part of the Union of Municipalities of Zahle Caza. The total number of residents is about 45,000 amongst which 44,000 are permanent and 1,000 are seasonal residents.
Ferzol	Ferzol, located at an altitude of 900-1000 m, covers an area of 18,000,000 m^2 and is part of the Union of Municipalities of Zahle Caza. The total number of residents varies between 6000-7,000.
Zahle	Zahlé is located at an altitude of 1010 m and covers an area of 700000000 m^2. The total number of residents is 220000 amongst which 180000 are permanent and 40000 are seasonal residents.
Qabb Elias	Qabb Elias, located at an altitude of 950 m, covers an area of 32,000,000 m2 and is part of the Union of Municipalities of Central Bekaa in Zahle Caza. The total number of residents is 55,000 amongst which 40,000 are permanent and 15,000 are seasonal residents.

4.2.6.2 *Water Supply and Wastewater in the Project Area*

The water supply and wastewater infrastructure of the project area is presented in Table 4-6.

Table 4-6 Project Area Water Supply and Wastewater

Name of Village	Water Supply and Waste Water
Hazzerta	Hazzerta's water supply is from 2 public wells located at the boundary of the village and El Berdaouni spring situated in Kaa El Rim, in addition to private water wells. Hazzerta has a good sewerage system established in 1997 funded by the state and partially rehabilitated in 2010. Only 70% of the units are connected due to the geographical topography. The sewage is discharged in the Berdaouni River.

Name of Village	Water Supply and Waste Water
Kaa El Rim	Kaa El Rim's water supply is ensured by spring water (El Berdawni spring) located at the North West of the village. The current existing sewage network collects wastewater and dispose it in the Berdawni River.
Saadnayel	Saadnayel's drinking water source is mainly spring water from "Jdita Springs" and private water wells. Saadnayel has a good sewerage system established in 1980 funded by the residents and partially rehabilitated in 1998. About 80% of the housing units are connected and the sewage is discharged in the Litani River.
Taalabaya	Taablaya's water supply is mainly from spring water (Jdita Springs) and private water wells. As for the sanitation service, the sewerage system is in a bad condition and the sewage is directly discharged in the Berdawni River.
Ferzol	El Ferzol's water supply is from two public wells and a spring (EL Habiss Spring). Approximately 50% of the houses in EL Ferzol are connected to sewer network where domestic wastewater is diverted into a small WWTP before being discharged in the Litani River.
Zahlé	Zahle's water supply is ensured by 7 public wells, spring water (El Berdaouni spring), and private water wells. Domestic wastewater is collected by means of a sewage network that covers about 90% of the housing units and discharged in the Berdaouni River. Rapid growth of the city requires the rehabilitation of old network pipelines to handle the increasing flow.
Qabb Elias	Qabb Elias' water supply is from two public wells, spring water from Ra'ess El Ain, and private water wells. About 90% of the housing units are connected to a sewage network that discharges wastewater into the Litani River.

4.2.6.3 *Solid Waste*

The waste management infrastructure of the project area is described in Table 4-7.

Table 4-7 Project Area Waste Management

Name of Village	Waste Management
Hazzerta	Solid wastes are discharged in a dumping site located in the village, on the internal main road
Kaa El Rim	Solid wastes are collected by hydraulic trucks then disposed in Zahle's sanitary landfill

Name of Village	Waste Management
Saadnayel	Solid wastes are discharged in Zahle's landfill
Taalabaya	The generated solid wastes are disposed in Zahle's sanitary landfill.
Ferzol	The generated solid wastes are disposed in Zahle's sanitary landfill.
Zahle	Solid wastes are collected by hydraulic trucks and then disposed in Zahle's sanitary landfill.
Qabb Elias	The generated solid wastes are disposed in Qabb Elias dump.

5 ENVIRONMENTAL IMPACT ASSESSMENT

5.1 IMPACT IDENTIFICATION AND ASSESSMENT METHODOLOGY

5.1.1 Impact Identification

The identification and analysis of impacts consists of appraising the information submitted by the Project Proponent, in conjunction with the baseline information of the site. Impacts from similar projects, as cited by literature, and as documented by ELARD for other similar projects conducted elsewhere, were also examined so as to identify potentially significant impacts on the environment and surrounding communities. After identifying the Project impacts, the IEE evaluates their significance and determines mitigation measures to eliminate/minimize these impacts.

The Leopold matrix was developed to summarize all identified impacts during project construction and operation phases (refer to Table 5-1). The matrix describes the potential impacts through identifying the sources/activities that might have a positive or negative effects.

Table 5-1 Impact Identification Matrix for the Construction and Operation Phases

Project Component \ Environmental Component		PHYSICAL ENVIRONMENT										BIOLOGICAL ENVIRONMENT										SOCIAL ENVIRONMENT									
		Agricultural Land	Soil Erosion	Slope Stability	Energy/Mineral Resources	Surface Water Quantity	Surface Water Quality	Groundwater Quantity	Soil & Groundwater Quality	Air Quality	Noise	Aquatic Ecosystems	Wetland Ecosystems	Terrestrial Ecosystems	Endangered Species	Migratory Species	Beneficial Plants	Beneficial Animals	Pest Plants	Pest Animals	Disease Vectors	Public Health	Resource/ Land use	Distribution Systems	Employment	At Risk Population	Migrant Population	Community Stability	Cultural/Religious Values	Tourism/ Recreation	Nutrition
Construction	Excavation and backfilling for pipelines on public roads		-L	-L					-M	-L	-M											-L	-L	-L	+L						
Construction	Compaction									-M	-H											-L			+L						
Construction	Service road preparation, excavation and installation of pipelines in the valleys					-M	-M							-L											+L						
Construction	Reinstatement		+L	+L					-L	+M	-H											-L			+M						
Construction	Expropriation for pipelines																											-H			
Operation	Operation of pipelines						+H		+H													+H			+M			+H			
Operation	Maintenance of pipelines						-L		-L													-L			+L						

Key: **Beneficial:** **+H High** **+M Medium** **+L Low** **Adverse:** **-H High** **-M Medium** **-L Low**

5.1.2 Environmental Impact Screening and Assessment

Impact screening involves the examination and evaluation of the change inflicted on the baseline environment as a result of construction and operation activities.

The evaluation approach implemented in this study is a Receptor-Specific Analysis approach addressing the various sources of impacts from the Project's different implementation phases.

The identified impacts are assessed in terms of their significance, reversibility, likelihood of occurrence and geographical and temporal extents. They are classified based on various types of impacts as outlined in Table 5-2.

Table 5-2 Impact Classification

Direct impacts	Those that arise from activities that form an integral part of the project (e.g. new infrastructure)
Indirect/ Secondary Impacts	Those that arise from activities not explicitly forming part of the Project (e.g. impacts on nearby residents resulting from a deterioration of water quality due to the operation of the project)
Cumulative Impacts	Those that result from the incremental impact of an action added to other actions
Short Term Impacts	Those that last over a relatively brief period
Long Term Impacts	Those that occur over a fairly prolonged period
Residual Impacts	Those that will continue to occur even after the implementation of suitable mitigation measures
Temporary Impacts	Those that persist for a limited period only (reversible), due for example to particular site preparation activities (e.g. noise from excavation works)
Permanent Impacts	Those that result from an irreversible change to the baseline environment (e.g. land-take for facility operation) or which persist for the foreseeable future (e.g. air emissions from process units operation)
Positive Impacts	Those that have a beneficial influence
Negative Impacts	Those that have a minor, moderate or major negative influence

5.1.3 Impact Assessment Criteria

Consequence criteria are ranked into six levels of significance as listed in Table 5-3. The likelihood of the occurrence of the impact is then rated according to the criteria outlined in Table 5-4. Based on the level of significance and likelihood of occurrence, the significant risks (impact severities) are identified.

Table 5-3 Consequence Rating Criteria

Criteria	Consequence Rating
• Changes that result in a net positive effect to an ecosystem, environment or population	6. Beneficial
• Effect leading to regulatory/high level government intervention; • Negative Direction; • High magnitude: Severe effect on ecosystem or human receptors; • Massive effect over a large area; destruction of sensitive environmental features; • Long-term or permanent effect: measurable effect on the livelihood of those using a resource over a period of years; • Irreversible effect resulting in extensive, potentially irreparable damage to an environmental or socio-economic component or a site of social or cultural importance.	5. Catastrophic
• Effect likely to result in regulatory intervention/action; • Negative Direction; • High magnitude: area of effect is extensive and/or encompasses an area that supports a statistically significant proportion of a population or ecosystem; • Impact of regional significance on sensitive environmental features; • Long-term or continuous effect resulting in substantial adverse changes in an environmental or socio-economic component well outside the range of natural variation; has a measurable effect on the livelihood of those using a resource over a period of months; • Reversible; however unassisted recovery could be protracted. Significant damage/ effect to a site of social or cultural importance.	4. Major
• Effect leading to regulatory investigation; • Negative Direction; • Moderate magnitude: Moderate adverse changes in a Component or area that supports a population. Changes may exceed the range of natural variation though potential for recovery within a few years without intervention is good; • Area of effect encompasses an area that supports either a moderate or minor proportion of a population or ecosystem; • Long-term (1 to 3 years) changes over an area which is not considered to be a component relevant to the assessment; has a measurable effect on the livelihood of those using a resource over a period of weeks; Short-term effect on sensitive environmental features; • Reversible, moderate damage to a site of social or cultural importance.	3. Moderate
• Immediate regulatory notification required; • Negative Direction; • Low magnitude: Minor adverse changes in an environmental or socio-economic component. Changes will be noticeable but fall within the range of normal variation and be typically short-lived, with unassisted recovery possible in the near term. However, it is recognized that a low level of effect may remain. Effect on flora, fauna or habitat but no negative effects on ecosystem; • Medium term effect (up to 1 year) in an area that does not encompass a component relevant to the assessment or whose effect is highly localized within a component. Long-term effect over a discrete, small area which does not support a component relevant to the assessment; May be noticed but does not affect the livelihood of those utilizing a resource; • Reversible minor effect to a site of social or cultural importance.	2. Minor

Criteria	Consequence Rating
• Incident reporting according to routine protocols; • Negative Direction; • Low magnitude: Negligible effect on flora, fauna, habitat, aquatic ecosystem or water resources; • Area of effect is restricted to the immediate vicinity of the source; • Short-term changes in an ecosystem that are unlikely to be noticeable (i.e. fall within the scope of natural variation); has no discernible effect on the environmental resource as a whole and is likely to go unnoticed by those who already use it; • Reversible negligible effect to a site of social or cultural importance.	1. Negligible

Table 5-4 Likelihood Evaluation Criteria

Likelihood to Occur	Category	Score
Impact is highly likely or certain to occur under normal conditions	High	C
Impact may possibly occur under normal conditions	Medium	B
Impact is unlikely to occur under normal conditions but may occur in exceptional circumstances	Low	A

The scoring of impact severity is conducted by different methods: (1) round table scoring exercise by a team of experts, (2) results from analyses and calculations, and (3) scientific predictions based on experience in the field and from similar projects. Impact rating scores are assigned according to the Likelihood of Occurrence (A. High, B. Medium and C. Low) cross-tabulated with the Consequence Rating Criteria including the consequence and significance levels. The scale illustrated in Table 5-5 is used during the assessment.

Table 5-5 Environmental Impact Assessment Management Matrix

(Consequence and Significance versus Likelihood of Occurrence)

		Likelihood Rating		
		A	**B**	**C**
Consequence Rating	**1**	1A	1B	1C
	2	2A	2B	2C
	3	3A	3B	3C
	4	4A	4B	4C
	5	5A	5B	5C
	6	6A	6B	6C

LEGEND

Consequences		**Likelihood**	**Acceptability**
1 – Negligible	4 – Major	A – Low	Beneficial
2 – Minor	5 – Catastrophic	B – Medium	Negligible with minor mitigation
3 – Moderate	6– Beneficial	C – High	Acceptable with EMS in place
			Unacceptable

5.2 PRE-SCREENING OF POTENTIAL ENVIRONMENTAL IMPACT AND PATHWAYS

Based on the methodology described above, the various impacts of the project were pre-screened according to the phase of the project activity as well as the pathway of the impact.

The results of the pre-screening process are summarized in Table 5-6. The preliminary findings are representative of the potential adverse and beneficial environmental and socio-economic impacts that could result from the Project.

Table 5-6 Summary of Pre-Screened Potential Environmental & Socio-Economic Impacts

Receptor / Media	Phase	Potential Impact
Air Quality	Construction	• Increase in air pollutants due to vehicle and truck movement during mobilization and procurement; in addition to the operation of diesel-operated construction machinery (i.e. power generator, loader, bulldozer, dump trucks); • Dust emissions from excavation and backfilling activities and movement of vehicles on unpaved roads, which may impact local ambient air quality.
	Operation	• No significant impacts are anticipated during operation
Noise Quality	Construction	Increase in ambient noise levels from: • Mobilization, site clearance, grading and excavation activities; • Movement of vehicles to transport people and materials; and • Operation of equipment and machinery on-site.
	Operation	• Increased noise levels due to usage of equipment during the maintenance period of the wastewater network. This will depend on the type of work needed and the extent of the network damage. Excavation to expose the damaged pipe is expected in addition to the backfilling, compaction and reinstatement of the excavated road
Soil and Groundwater	Construction	• Temporary or permanent change in topography, soil erosion and collapse from grading, trenching, or excavation; • Change in soil and groundwater quality from: - Improper management and storage of fuel, lubrication oil, gear oil and transmission oil and bitumen material used for asphalting activities; - Improper solid wastes and wastewater management; - Spills of potentially contaminating materials such as glues, solvents, or lubricants that are used or stored onsite for pipes installation; and - Accidental spills from refueling operation;
	Operation	• Temporary change in topography, soil erosion and collapse from excavation activities during maintenance; • Change in soil and groundwater quality from: - Spills of potentially contaminating materials such as glues, solvents, or lubricants that are used onsite for pipes maintenance;

Receptor / Media	Phase	Potential Impact
		- Potential spills of raw wastewater from pipelines.
Surface Water	Construction	• Change in surface water and sediments quality from: - Possible leakage of fuel/ oil/ chemicals. - Inadequate storage and disposal of wastewater, solid waste (domestic waste and construction waste) and hazardous waste that will be generated from the construction activities.
	Operation	Change in surface water and sediments quality from: • Wastewater leakage along all the pipeline route; • • Network maintenance activities;
Ecology	Construction	Habitat loss or destruction, altered abiotic/site factors, mortality of individuals, habitat fragmentation, disturbance, and vegetation loss due to: • Excavation for pipes in the valleys; • Accidental spills (fuels/chemicals) during construction; and • Inadequate disposal of solid waste and surplus material
	Operation	Habitat loss or destruction, altered abiotic/site factors, mortality of individuals, habitat fragmentation, disturbance, and vegetation loss due toWastewater leakage along all the pipeline route in the valleys.
Traffic	Construction	• Increase in traffic volume due to the deployment of construction vehicles, transport vehicles and equipment; and • Increased travel times for drivers passing through the Project area due to partial or total closure of the roads adjacent to the installed pipelines.
	Operation	• Traffic disturbance from maintenance activities
Socio-Economy	Construction	• Land acquisition for pipelines installation
	Operation	• Beneficial Impact of providing new sewer networks and rehabilitation of old network parts
Occupational and Public Health and Safety	Construction	Injuries to the public and workers from: • Open trenches, openly stored or moving construction materials, moving construction equipment and redirected traffic; and • General and construction and pipes installation activities that will increase the workers and public exposed to noise, dust and occupational hazards which will increase the potential accidents
	Operation	• Increased health and safety risks due to traffic related accidents and open trenches during pipes repair and spill management.

5.3 SOURCES OF CUMULATIVE IMPACTS

Potential cumulative sources of impacts around the Project Site include the following:

- Existing traffic and related vehicular air and noise emissions along adjacent roads;
- Air pollutant emissions from existing generators in the area;
- Dust and air pollutants emissions from existing nearby construction sites; and
- Existing industrial effluents in the project area whereby all wastewater are disposed into the Berdawni and Litani Rivers.

Whenever applicable, the effect of these potential cumulative impacts on the different receptors will be taken into consideration as part of the sub-sequent assessment of project-related impacts.

5.4 IMPACTS ON AMBIENT AIR QUALITY

5.4.1 Sources of Potential Impact

The primary sources of air pollutants from the various Project activities are listed in Table 5-7.

Table 5-7 Potential Air Quality Impacts

Source of Change (Project Activities)	Cumulative Sources of Impact
CONSTRUCTION • Increase in air pollutants due to vehicle and truck movement during mobilization and procurement; in addition to the operation of diesel-operated construction machinery (i.e. power generator, loader, bulldozer, dump trucks); • Dust emissions from excavation and backfilling activities, temporary storage of excavated soil near the construction **OPERATION** • No significant impacts are expected during operation phase	• Exhaust emissions from vehicles passing nearby

5.4.2 Impacts during the Construction Phase

5.4.2.1 Combustion and Exhaust Emissions

Vehicle and truck movement during mobilization and procurement, in addition to the operation of diesel-operated construction machinery (i.e. power generator, loader, bulldozer, dump trucks), shall generate exhaust emissions. Diesel emissions count about 40 hazardous air pollutants (HAP) as reported by the Environmental Protection Agency (EPA) (2002). However, the main air pollutants likely to be associated with these emission sources include: Oxides of Nitrogen (NO_x), Sulfur Dioxide (SO_2), Carbon Dioxide (CO_2), Carbon Monoxide (CO), and Particulate Matter (PM). The impacts associated with potential air emissions are summarized in Table 5-8.

Table 5-8 Environmental Impacts of Major Air pollutants from Combustion Sources

Emission	Environmental Impact
Oxides of Nitrogen – NO_X	NO_2 is a toxic gas, even at relatively low concentrations. NO_X also contributes to the formation of acidic species, which can be deposited by wet and dry processes. NO_X can also increase the formation of ozone at ground level when mixed with VOCs in the sunlight atmosphere. NO is a relatively innocuous species, but is of interest as a precursor for NO_2.
Sulfur Dioxide – SO_2	SO_2 is a toxic gas, and is known to contribute to acid rain deposition (wet SO_2 and dry), which may impact ecosystems (soil, water bodies…). Direct health effects potentially causing respiratory illness.
Particulates – PM_{10}	Particulate matter is a complex mixture of organic and inorganic substances present in the atmosphere in either solid or liquid form. Particulate matter is inhaled and deposited within the respiratory pathways, leading to a variety of health effects. PM_{10} (i.e. particulate matter with a diameter of less than 10 µm) is able to penetrate deeply into the lungs. An association has been established between elevated concentrations of PM_{10} and excess short term mortality and morbidity rates.
Carbon Monoxide – CO	Carbon monoxide (CO) is a colorless, odorless gas that is slightly less dense than air. When inhaled, the gas is absorbed into the bloodstream and combines with hemoglobin in the blood to form carboxyhemoglobin (COHb). The affinity of hemoglobin for CO is more than 200 times greater than for oxygen. The result is that CO acts as a poison by reducing the amount of O_2 that can combine with hemoglobin.
Carbon Dioxide – CO_2	Carbon dioxide is an odorless and colorless gas of greenhouse effect known to contribute to global warming. Prolonged exposure to moderate concentrations to CO_2 can cause acidosis and adverse effects on calcium phosphorus metabolism resulting in increased calcium deposits in soft tissue. Carbon dioxide is toxic to the heart and causes diminished contractile force.

Exhaust emissions are inevitable during normal operation of combustion sources. However, lack of maintenance, poor quality fuel, unnecessary idling periods, long operation periods and absence of exhaust emission control units will result in the increase of pollutants emissions.

The emissions associated with construction activities and vehicular exhaust are expected to be of a **Minor effect**. This impact is of a **high likelihood**, yet of a medium to short-term duration (restricted to the construction period) and reversible nature. Accordingly, with no mitigation measures in place, this activity is **likely to have a Minor impact (2C)** on the overall air quality within the project area.

Therefore, it is recommended that various mitigation measures be adopted to further reduce the significance of potential impacts; these include:

- Inspect all equipment and vehicles to be used for the project prior to their deployment to the site as well as at regular intervals during the construction sequence to identify any emerging leakage incidents during construction;
- Continually use properly designed, maintained and operated equipment/vehicles by the construction contractor, proper engine fuel mixtures, regularly serviced exhaust emission systems and proper engine tuning. These precautionary measures contribute significantly to a reduction in identified air pollutant emissions;
- Investigate the environmental benefits of employing environmentally friendly equipment by the contractor, such as machinery with higher fuel efficiency or those equipped with air pollution control devices to minimize exhaust emissions;
- Avoid idling vehicles and equipment engines that are left running unnecessarily;
- Maintain and report monthly fuel consumption records to ensure that the vehicles are running properly and leading to excessive gaseous emissions to air.

An implementation of the above mentioned mitigation measures is likely to reduce the effect of exhaust and combustion emissions during site preparation and transport to negligible **with high likelihood of occurrence** (1C) on the overall air quality within the Project Area

5.4.2.2 Dust Emissions

Increase in dust levels is also expected from excavation and backfilling activities, temporary storage of excavated soil near the construction trench as well as from the movement of vehicles on unpaved roads, which may impact local ambient air quality. Under normal meteorological conditions, dust impacts will be limited to within several tens to hundred meters from the disturbance area. The main environmental and health concerns associated with dust generation include:

- Potential nuisance impacts on receptors in close vicinity of the proposed site, which include: the nearby residential houses, agricultural lands and motorists along the nearby street; and
- Occupational health risk and irritation to construction workers.

The duration of main soil disturbance activities (i.e. excavation and land grading works) is relatively short and of limited extent, such that it is unlikely that the dust emissions will be of major concern.

Dust emissions from construction activities are expected to have a **Minor effect**. This impact is expected to be of a high **likelihood**, yet of a **medium to short-term duration** (restricted to the construction period) and reversible nature. Accordingly, with no mitigation measures in place, dust emissions are likely to have a **Minor impact** (2C) on the overall air quality within the project area.

Minimization of dust generation can be further accomplished through dust control/suppression measures, including the following:

- Install sandbags or other erosion control measures to prevent silt runoff to public roadways where applicable;
- Minimize handling of dusty materials and drop heights for materials transfer to lorries;
- Ensure site roads are kept regularly damped down, compacted or suitably surfaced to minimize dust emissions from vehicle use;
- Implement approved water-spraying procedures as needed;
- Enforce a maximum speed limit of 20 km/h throughout the work sites;
- When possible delay compaction activities until the beginning of the wet season or when more water is available;
- Maintain stockpiles (if any) at minimum heights and forming long-term stockpiles into the optimal shape to reduce wind erosion; and
- Cover all incoming and outgoing trucks from the site.

By applying those recommendations, the potential impacts from dust generation during excavation and construction are expected to have **negligible consequence with high likelihood (1C),** and to be of **short-term and reversible nature**.

5.4.3 Impacts during the Operation Phase

No impacts on air quality are expected during the operation phase of the project.

5.5 IMPACTS ON AMBIENT NOISE QUALITY

5.5.1 Sources of Potential Impact

The primary sources of noise from the various project activities are shown in Table 5-9.

Table 5-9 Potential Impacts on Ambient Noise Level

Source of Change (Project Activities)	Cumulative Sources of Impact
CONSTRUCTION Increase in ambient noise levels from: • Mobilization, site clearance, grading and excavation for pipelines activities; • • Movement of vehicles to transport people and materials; and • Operation of equipment and machinery on-site. **OPERATION** • Increased noise levels due to usage of equipment during the maintenance period of the wastewater network. This will depend on the type of work needed and the extent of the network damage. Excavation to expose the damaged pipe is expected in addition to the backfilling, compaction and reinstatement of the excavated road	Existing traffic and nearby construction activities

5.5.2 Impacts during the Construction Phase

Noise impacts during the construction phase are considered temporary in nature. Their sources comprise activities caused by the operation of earth moving and excavation equipment (excavators, bulldozers…) during site levelling and excavation, the transportation of equipment, materials and people and the use of small generators. Typical sound level pressures recorded from the equipment anticipated to be used at the construction site are illustrated in Table 5-10 for indicative purposes.

Table 5-10 Typical Sound Pressure Levels Reported from Construction (BS 5228-1 2009)

Equipment/Machinery	Noise Level (DBA. LA_{eq} at 10 m)
Asphalt saw	91
Excavator	74
Bulldozer	86
Jack hammer	90
Generator for site cabins	74
Air compressor	95
Roller compactor	84
Plate compactor	63
Concrete vibrator	78
Dump truck	79
Water tanker	79

Equipment/Machinery	Noise Level (DBA. LA_{eq} at 10 m)
Fuel tanker	79
Concrete mixer truck	80
Truck mounted concrete pump + boom arm	80
Mobile crane	70
Backhoe loader	67
Skid steer loader	84
Asphalt spreaders/pavers	75
Dumper	79
Pickups with Telescopic crane	79
Pickups/canters	79
Generator for welding	66
Welding machines (for HDPE, Arc Welding for steel…)	73

Noise levels of 63 to 95 dBA are expected close to the main activity areas. However, these levels would be reduced as the distance from the point source of noise increases. Noise levels will only affect potential receptors (especially surrounding agricultural lands and the closest residential units) for a relatively short period of time and intermittently. This may result in people being able to hear noise in their gardens or outdoor space. Noise insulation from a typical residential dwelling will offer in the region of 25-35 dB(A) noise reduction (BS 8233: 1999), this is however with all windows closed, if a window is partially open the level of noise reduction will fall to within the region of 10- 15 dB(A) (BS 8233: 1999). A noise reduction of 10 dB(A) would mean that the noise level would be less audible to the local residents when indoor.

The likelihood for noise impacts to occur is **High**. With no control measures in place, the noise impacts associated with this phase will be short-term and of Moderate effect (3C).

The following measures can be considered in order to control and/ or minimize noise impacts during construction:

- Use the quietest available equipment where possible;
- Equip all internal combustion engine driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment;
- Operate and maintain all equipment to be used in accordance with manufacturer's instructions for low noise operation. Engine covers will be used at all times;
- Switch off engines when not in use;
- Site noisy equipment away from noise sensitive areas and position them behind stockpiles or other barriers to provide acoustic screening;

- Properly plan deliveries to and from the sites to minimize impacts;
- Prior to initiating the works near to noise sensitive receivers, notify residents of the plans, including expected duration;
- Inform staff and workers onsite on the impact of noise and the regulatory requirements; and
- Control the speed of vehicle movement on site and in the surrounding area.

The implementation of the above-proposed mitigation measures would reduce the noise impact to be **Mino**r in consequence with a **medium likelihood** of occurrence **(2B).**

5.5.3 Impacts during the Operation Phase

During the operation phase, the noise will be generated from usage of equipment during the maintenance period of the wastewater network and will depend on the type of work needed and the extent of the network damage. Excavation to expose the damaged pipes is expected in addition to the backfilling, compaction and reinstatement of the excavated road.

The likelihood for increased noise levels due to usage of equipment during the maintenance period of the wastewater network to occur is **Low**. With no control measures in place, the noise impacts associated with this phase will be with **short-term** and of Minor effect **(2A).**

The following mitigation measures shall be adapted to minimize the impacts:

- Prior to initiating the works near to noise sensitive receivers, notify residents of the plans, including expected duration;
- Switch off equipment and generators when not in use; and
- Equip all internal combustion engine driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment.
-

By adopting the above-proposed mitigation measures, the noise impact is expected to become **Negligible** in consequence with a **low likelihood** of occurrence **(1A).**

5.6 IMPACTS ON ECOLOGY

5.6.1 Sources of Potential Impacts

Source of Change (Project Activities)	Cumulative Sources of Impact
CONSTRUCTION • Site clearance, grading, access road preparation in the valleys; • Excavation for pipes and reservoir foundation; • Accidental spills (fuels/chemicals) during construction; and • Inadequate disposal of solid waste and surplus material. **OPERATION** • Potential spills of raw wastewater from pipelines.	• None

5.6.2 Impacts during the Construction Phase

The sources of impact on biological resources during Project construction are:

- Site clearance, grading, access road preparation in the valleys;
- Excavation for pipes;
- Accidental spills (fuels/chemicals) during construction; and
- Inadequate disposal of solid waste and surplus material.

The potential impacts on flora and fauna from those activities may lead to:

- Habitat loss or destruction;
- Altered abiotic/site factors;
- Mortality of individuals;
- Habitat fragmentation;
- Disturbance; and
- Vegetation loss.

Based on the description of the biological environment in Section 4.2.4, the anticipated Project will not lead to significant negative impacts on biological resources. The main construction activities having negative results on biodiversity are the construction of the network in the seasonal streams.

Therefore, the impacts during construction on biodiversity are evaluated as **minor consequence** and **low** likelihood of occurrence **(2A).**

The mitigation measures that are proposed to be applied are:

- Design a landscape plan that enhances the landscape aesthetic value using local and native population flora;
- When detected, sensitive species or habitats should be conserved;
- All waste resulting from construction works, land reclamation, or any other activity should be collected and disposed properly in an allocated disposal site. Littering in the project area and surrounding areas should be avoided; and
- All affected areas must be replanted with indigenous species appropriate to the respective sites, by agreement with ecological experts.

With the above proposed measures in place, the potential impacts during construction are expected to have **negligible consequence and low likelihood (1A)** and hence are of low significance.

5.6.3 Impacts during the Operation phase

The impacts during the operation phase are mainly related to possible leakage from the pipelines installed in the valley.

Therefore, the impacts during operation on the ecological system is evaluated as **short-term**, of **moderate consequence** and **medium** likelihood of occurrence **(3B).**

The mitigation measures that should be applied are:

- Continuous monitoring of visible leaks along the pipelines routes in the valleys; and
- In case of any contamination, stop directly the flow and clean-up the spill/leakage.

With the above proposed measures in place, the potential impacts during operation are expected to have **minor consequence and be of low likelihood (2A).**

5.7 IMPACTS ON SOIL AND GROUNDWATER

5.7.1 Sources of Potential Impact

The potential impacts on Soil and groundwater are shown in Table 5-11.

Table 5-11 Potential Impacts on Soil and Groundwater

Source of Change (Project Activities)	Cumulative Sources of Impact
CONSTRUCTION • Temporary or permanent change in topography, soil erosion and collapse from grading, trenching, or excavation; • Change in soil and groundwater quality from: - leakage of fuel, lubrication oil, gear oil and transmission oil to the exposed and excavated soil unearthed in the excavation process from construction/haulage vehicles and equipment - Inadequate storage and disposal of lubrication oil, gear oil and transmission oil used for equipment maintenance; - Inadequate storage and disposal of bitumen material used for asphalting activities; - Spills of potentially contaminating materials such as glues, solvents, or lubricants that are used or stored onsite for pipes installation. The spills can affect the excavated or exposed soil; - Accidental spills from refueling operation; - Improper disposal of concrete wastes resulting from onsite concrete batching or cleaning of ready-mix concrete vehicles; - Surface run-off water that comes into contact with concrete, onsite stockpiled sand and gravel and open excavated trenches during rainy days; - Discharged hydrotest water that come into contact with excavated soils stockpiled along the trenches; - Inadequate disposal of solid wastes and wastewater generated during construction from workers; and - Leakage from old networks during rehabilitation.	Waste disposal practices and other projects
OPERATION • Temporary change in topography, soil erosion and collapse from excavation activities during maintenance; • Change in soil and groundwater quality from: - leakage of fuel, lubrication oil, gear oil and transmission oil to the exposed and excavated soil unearthed in the excavation process; - Inadequate storage and disposal of bitumen material used for asphalting activities; - Spills of potentially contaminating materials such as glues, solvents, or lubricants that are used onsite for pipes installation. The spills can affect the excavated or exposed soil; and - Potential spills of raw wastewater from pipelines.	

5.7.2 Impacts during the Construction Phase

5.7.2.1 Temporary or permanent change in topography, soil erosion and collapse from grading, trenching, or excavation

Trenching and excavation will be performed to install the project pipes segments and complete house connections. During construction, excavated earth and gravel will be temporarily stored along the trenches and will be used for the backfill after pipe installation. Sand or suitable material will be imported for pipe bedding. This will result in temporary or permanent change to the topography of excavated roads in addition to possible soil erosion and collapse.

Thus the impact is expected to be **long-term** and **irreversible in nature**, **highly likely** to occur under normal conditions, and the impact severity is considered to be **minor (2C)**.

Further mitigation measures can be adopted to reduce the significance of potential impacts; these include:

- Dispose of surplus material at designated waste locations;
- Segregate wastes that can be salvaged and store them temporarily for later use;
- Direct materials that cannot be reclaimed or re-used is to designated dumping areas;
- Place clear markers indicating the limits of the construction trenches and stockpiling area of excavated materials to restrict the equipment and personnel movement limiting the physical disturbance to land and soils in adjacent areas;
- Stabilize the soils in trenches directly after completion of each stage of works where fill should avoid pockets of segregated materials, it should use well-graded materials, and it should be compacted to recognized standards;
- Avoid executing excavation works under aggressive weather conditions; and
- Erect erosion control barriers around work site during site preparation and construction.

By applying these recommendations, the potential impacts from excavation, trenching and grading are expected to have **minor consequence** and **moderate likelihood (2B)**.

5.7.2.2 Change in soil and groundwater quality

The sources of potential contamination to soil and groundwater are:

- Leakage of fuel, lubrication oil, gear oil and transmission oil to the exposed and excavated soil unearthed in the excavation process from construction/haulage vehicles and equipment;
- Inadequate storage and disposal of lubrication oil, gear oil and transmission oil used for equipment maintenance;
- Inadequate storage and disposal of bitumen material used for asphalting activities;
- Spills of potentially contaminating materials such as glues, solvents, or lubricants that are used or stored onsite for pipes installation. The spills can affect the excavated or exposed soil;

- Accidental spills from refueling operation;
- Improper disposal of concrete wastes resulting from onsite concrete batching or cleaning of ready-mix concrete vehicles;
- Surface run-off water that comes into contact with concrete, onsite stockpiled sand and gravel and open excavated trenches during rainy days;
- Discharged hydrotest water that come into contact with excavated soils stockpiled along the trenches;
- Inadequate disposal of solid wastes and wastewater generated during construction from workers; and
- Leakage from old networks during rehabilitation activities.

The identified types of potential sources or contamination are expected to affect mainly the soil since the groundwater table is not shallow in that area and excavations will not exceed 5 meters; however, these impacts are considered minimal in extent of impact. Methods for mitigation and prevention of these risks will be included in the construction phase of the project and ensured by means of contractually obliged precautionary practices to be included in the agreement between CDR and the Contractor.

The impact on soil and groundwater is thus evaluated to be of **moderate consequence** and **medium** likelihood of occurrence **(3B).**

The potential impacts could be minimized, if not prevented, by the following general measures:

- Store and handle hazardous wastes in appropriate storage facilities; (tanks/containers) and sites;
- Prepare procedures for storage and handling of hazardous wastes and raw materials (e.g. batteries, chemicals, fuel) as part of the Contractor's Waste Management Plan;
- Provide collection trays and absorbent material on site in case of accidental spills;
- Carry out maintenance, refueling and cleaning of vehicles and equipment at designated sites with adequate leakage prevention (e.g. impermeable surface);
- In case of any contamination, remove contaminated soil and treat it or disposed of it in a manner appropriate to the type of contamination present;
- Prohibit leaving material stockpiled on-site during the rainy season without being covered;
- Execute concrete batching, if required, in designated place where the wastes are contained and transferred to the proper disposal place;
- Clean concrete ready-mix vehicles on site in special prepared place where the concrete wastes are contained and disposed in the approved places;
- Provide garbage bins on site for workers to dispose their refuse. Wastes shall be collected regularly and disposed of according to the municipalities' requirements;
- Prepare a hydrotest management plan and get it approved prior to start of Hydrotesting;

- Discharge hydrotest water away from the stockpiled excavation or bedding material in a way that will not cause damage to the adjacent locations;
- Contain wastewater generated by workers during the construction period in septic tanks to be pumped and discharged later into the appropriate designated place;
- Conduct routine inspection and maintenance of equipment for risk minimization;
- Store and handle fuels and lubricants within containment facilities (e.g. bunded areas, leak proof trays, etc.) designed to prevent the release of spilled substances to the soil and groundwater environment, and these facilities should be maintained and kept drained of rainwater;
- Ensure the presence of trained employees capable of dealing with small scale spill hazards; and
- Ensure the total diversion of the sewer flow before removing old networks pipelines.

With the above mentioned mitigation measures, the impact is unlikely to occur under normal conditions but may occur in exceptional circumstances. The impact consequence **is minor with low likelihood of occurrence (2A).**

5.7.3 Impacts during the Operation Phase

5.7.3.1 Temporary or permanent change in topography, soil erosion and collapse from grading, trenching, or excavation

During operation, the main activities are the repair of a leaking pipe, where excavation could take place to expose the pipe and fix the leak.

The impact is expected to be **of minor consequence and high likelihood** under normal conditions, and the impact significance is considered to be **(2C)**.

The following mitigation measures shall be applied to minimize the impacts:

- Stabilize the soils in trenches directly after completion of each stage of works where fill should avoid pockets of segregated materials, it should use well-graded materials, and it should be compacted to recognized standards; and
- Avoid executing excavation works under aggressive weather conditions.

By applying these recommendations, the potential impacts from excavation, trenching and grading are expected to have **Minor consequence** and **moderate likelihood (2B)**.

5.7.3.2 Change in soil and groundwater quality

The sources of potential contamination to soil and groundwater during operation are:

- Leakage of raw sewer from pipelines;
-

- Leakage of fuel, lubrication oil, gear oil and transmission oil to the exposed and excavated soil unearthed in the excavation process;
- Inadequate storage and disposal of bitumen material used for asphalting activities; and
- Spills of potentially contaminating materials such as glues, solvents, or lubricants that are used onsite for pipes installation. The spills can affect the excavated or exposed soil.

The impact of is evaluated as **long-term**, of **moderate consequence** and **high** likelihood of occurrence **(3C).**

These impacts can be mitigated by implementing the following measures:

- Continuous monitoring of visible leaks along the pipelines routes;
- In case of any contamination, remove contaminated soil and treat it or disposed of it in a manner appropriate to the type of contamination present; and
- Prohibit leaving material stockpiled on-site during the rainy season without being covered.

With the above mentioned mitigation measures, the impact is unlikely to occur under normal conditions but may occur in exceptional circumstances. Accordingly, the impact consequence **is minor with medium likelihood of occurrence (2B).**

5.8 IMPACTS ON SURFACE WATER

The potential impacts on surface water are shown in Table 5-12.

Table 5-12 Potential Impacts on Surface Water

Source of Change (Project Activities)	Cumulative Sources of Impact
CONSTRUCTION Change in surface water and sediments quality from: • Possible leakage of fuel/ oil/ chemicals from: - Machinery used during construction and haulage; - Generators; and - Refueling operations and routine inspection. • Inadequate storage and disposal of wastewater, solid waste (domestic waste and construction waste) and hazardous waste that will be generated from the construction activities: - Earthworks and construction of access roads in the valleys; - Pipeline Installation / Trenching and backfilling; - Hydrotesting; and - Chemicals disposal during maintenance of machinery, generators and equipment.	• Existing practices of discharging domestic and industrial wastewater to the Berdawni and Litani Rivers
OPERATION Change in surface water and sediments quality from: • Wastewater leakage along all the pipeline route; and • • Network maintenance activities; •	

5.8.1 Impacts during the Construction Phase

The planned network will be placed along paved and non-paved roads and in parallel to the Berdaouni and Litani Rivers, and in some sections the pipelines will be laid in the valleys. The pipes that will run in the valleys will be surrounded by a mass of concrete.

The following activities may result in water pollution and reduction of water availability to downstream users:

- Possible leakage of fuel/ oil/ chemicals;
- Inadequate storage and disposal of wastewater, solid waste (domestic waste and construction waste) and hazardous waste that will be generated from the construction activities;
- Run-off from cleared or disturbed areas into rivers, streams or surface water features;
- Inadequate management of spoil from water body crossings;
- Keeping trenches open;
- Machinery and equipment entering the channel; and
- Inadequate discharge of hydro testing water.

Methods for mitigation and prevention of these risks will be included in the construction and operation phase of the Project and ensured by means of contractually obliged precautionary practices to be included in the agreement between CDR and the Contractor and enforced by the CDR appointed supervising consultant.

The impacts on surface water resources during construction are evaluated as **Moderate**, and of **High likelihood** to occur under normal conditions. Therefore impact significance is rated as **Medium (3C)**.

Minimization of impact on water bodies can be accomplished through the measures described in section 5.7.2.2, in addition to the following:

- Prevent run-off from cleared or disturbed areas into rivers, streams or surface water bodies by using sediment control methods, such as, silt fences, sandbags, hay bales, drop down structures, detention basins, diversion banks, gabions, etc. All erosion and sediment control structures are to be regularly inspected and maintained, whereby the sieving shall be removed and disposed at a designated site;
- Place all spoil from water body crossings in the construction right-of-way at least three (3) meters from the water's edge, or in additional extra work areas. Use sediment barriers to prevent the flow of spoil or heavily silt-laden water into any water body;
- Prohibit leaving trenches through canals that are dry or contain non-moving water at the time of crossing open for more than 24 hours;
- Carry out the pipelines and manholes installation of seasonal streams preferably in the dry season;
- Notify downstream users of water canals of works 10 days prior to the diversion activities if needed;
- Complete streambed and bank stabilization before returning flow to the water body channel; and
- If hydro testing water is to be discharged into water bodies, ensure that the water quality conforms to the applicable guidelines in MoE Decision No. 8/1/2001 (National Standards for Environmental Quality).

By applying these recommendations, the consequence rating can be considered as **Minor** and the likelihood of occurrence as **Medium** – as such the significance rating is reduced to **Medium (2B)**.

5.8.2 Impacts during the Operation phase

During operation, change in surface water and sediments quality could result from:

- Wastewater leakage along all the pipeline route; and
- Wastewater network maintenance activities.
-

The impacts on surface water resources resulting from maintenance activities and pipelines leakage, during operation phase are expected to have a **Minor** consequence, and to be of **Medium** likelihood of occurrence. The significance rating is **Medium (2B).**

Minimization of impact on water bodies can be accomplished through measures, including the following:

- Prevent run-off from cleared or disturbed areas into rivers, streams or surface water bodies by using sediment control methods, such as, silt fences, sandbags, hay bales, drop down structures, detention basins, diversion banks, gabions, etc. All erosion and sediment control structures are to be regularly inspected and maintained, whereby the sieving shall be removed and disposed at a designated site.
- .

With the proposed mitigation measures, the impact is unlikely to occur under normal conditions but may occur in exceptional circumstances. Accordingly, the impact consequence is **Minor** with a **Low** likelihood of occurrence. The impact significance is reduced to **Low (2A).**

5.9 IMPACTS ON SOCIO-ECONOMY

5.9.1 Sources of Potential Impact

The potential sources of socio-economy impacts are listed in Table 5-13.

Table 5-13 Potential sources of socio-economy impacts

Source of Change (Project Activities)	Cumulative Sources of Impact
CONSTRUCTION • Job creation during construction activities • Nuisance to the public due to damage of existing infrastructure components during excavation • Incdreased pressure on the existing infrastructure due solid waste and wastewater generation • Non comfort during land aquisition process for pipelines installation **OPERATION** • Enhancement of sewage collection systems in the area • Stop wastewater pollution caused by the connected villages domestic wastewater discharge into the Berdawni and Litani Rivers	Existing residential area and socio-economic activities

5.9.2 Impacts during the Construction Phase

5.9.2.1 Job Creation

The construction phase will lead to the creation of temporary job opportunities and indirect positive impacts on socio-economy through the increase in purchase of domestic goods and construction material.

The construction of the sewer networks will lead to short-term positive socio-economic impacts with a **High** likelihood and **Beneficial** consequences **(6C)**.

5.9.2.2 Damage to the Existing Infrastructure and Potential Water Pollution

The network pipelines will be installed in the same roads as existing water networks and telephone lines. Potential damage to existing water pipelines, electricity power cables, and telephones lines during construction are possible as a result of inadequate Project Design. Cross contamination of potable water during rehabilitation of the old sewer networks is also a potential impact.

With no mitigation measures in place, the potential cross contamination of water due to inadequate design can be considered to be of **Major** consequence and **Medium** likelihood of occurrence, and therefore the impact significance is rated as Medium (**4B**).

Mitigation measures include:

- Trial pits shall be executed along the network route to locate the existing infrastructure components;
- Sewer lines shall be installed at least[4] 3 meters horizontally from and 0.3 meters lower than existing water main lines;
- Where the separation requirements cannot be met due to topography, inadequate right-of-way easements, or conflicts with other provisions of these regulations, lesser separation is permissible if:
    - The water main and the sewer are located as far apart as feasible within the conditions listed above;
    - The water main and the sewer are not installed within the same trench; and
    - The sewer line is appropriately constructed to prevent contamination of the water in the main by sewer leakage.

- No water main lines should pass through or come into contact with a sewer manhole.

With the above mentioned mitigation measure, the impact consequence is **Major** and its likelihood of occurrence is reduced to **Low** and hence its residual significance can be reduced to **Medium (4A).**

5.9.2.3 Increased Pressure on the Existing Infrastructure

The generation of wastewater and solid waste during the construction phase might lead to an increased pressure on the existing infrastructure.

The wastewater generated by the Project will be collected in a septic tank which will be emptied as needed in a location approved by the Municipality.

The domestic waste generated from the construction activities is negligible when compared to the waste generated by the villages where the project is being executed.

Construction waste and surplus material will be disposed of in a construction and demolition waste dump approved by the municipalities.

Negative impacts of the Project on the existing infrastructure is expected to be of **Minor consequence** and **Low likelihood (2A).**

[4]Separation distances specified shall be measured from the nearest outside edges of the facilities.

5.9.2.4 Land Acquisition for Pipelines Installation

The construction of the sewer networks necessitates the acquisition of private lands to install the pipelines. The impacts of expropriation during construction phase are strongly negative, long-term, and irreversible.

The socio-economy impacts during construction phase are irreversible with a long-term effect and a **high** severity ranking with a **medium likelihood** of occurrence **(4B).**

The mitigation measures to mitigate the impacts will include:

- Preparation of a resettlement policy framework (RPF); and
- Preparation of a resettlement action plan (RAP) to be approved by the CDR and the World Bank before implementation.

After applying the mitigation measures, the consequences of the impacts are expected to become **moderate** with a **medium likelihood of occurrence (3B).**

5.9.3 Impacts during the Operation Phase

The impacts during operation phase are rather positive with a **medium likelihood occurrence (6B)**

5.10 IMPACTS ON TRAFFIC

5.10.1 Sources of Potential Impact

The primary sources of traffic during the various Project activities are shown in **Table 5-14**

Table 5-14 Primary sources of traffic

Source of Change (Project Activities)	Cumulative Sources of Impact
CONSTRUCTION • Movement of vehicles to transport people and materials; • Pipeline crossing through the different villages of the project. **OPERATION** Excavation of the paved roads within the project villages neighborhoods for maintenance purposes	Existing traffic in concerned villages

5.10.2 Impacts during the Construction Phase

The construction phase requires the transport of heavy construction materials in addition to the workforce. Vehicles transporting the materials may need several trips to the site per day, which

shall increase the traffic volume on the road leading to the site. Areas in the direct vicinity of the Project site will experience an increase in traffic volume due to the deployment of construction vehicles, transport vehicles and equipment. All roads adjacent to the installed pipelines will be subject to partial or total closure for the duration of construction period and may cause increased travel times for commuters traveling through the Project area.

The impacts of the construction activities on the traffic are **short-term**, with **moderate** significance and **medium** likelihood of occurrence **(3B)**. These impacts will cease once the construction period is completed.

The proposed mitigation measures to minimize the impacts are:

- Keep all traffic to designated roads;
- Limit speed on the route to 20 km/h unless otherwise advised, and adopt careful logistical and route planning to combine trips;
- Position any necessary traffic diversion signs and devices correctly. Signs and devices shall be positioned laterally and clearly displayed in the Arabic and English language. Temporary traffic signals and signs should be employed to warn of hazards and provide directions to motorists, especially on narrow one-lane roads;
- Coordinate with the municipality the organization and scheduling of the construction works including the material delivery schedule during construction, trucks movement and other machinery operations in order to limit the disruption to the neighborhood and traffic flow and to minimize noise and dust. Timetables and eventual traffic diversion schedules at the Project site must be agreed on;
- Follow a specific schedule for transport of to avoid interference with peak traffic hours and minimise disturbance/delay to commuters at rush hours on the roads leading to the Project;
- Immediately upon completion of any part of the works, fill up all holes and trenches, and level all mounds and heaps of earth which have been excavated or made in connection with the works.

An implementation of the above mentioned mitigation measures is likely to reduce the impacts on traffic during the construction phase to Minor **with low likelihood of occurrence** (2A)

5.10.3 Impacts during the Operation Phase

During the operation phase it is likely that malfunction occurs and leakage of sewage water is expected. Maintenance activities are likely to generate traffic disturbance given that the location of the damage pipeline would have to be excavated for it to be fixed.

However, the works will be limited to a small area and over a **short-term** period. The impacts are expected to have **Minor** Significance and **Low likelihood (2A).**

5.11 IMPACTS ON OCCUPATIONAL AND PUBLIC HEALTH AND SAFETY

5.11.1 Sources of Potential Impact

The potential impacts on occupational hygiene are shown in Table 5-15.

Table 5-15 Potential Impacts on Occupational and Public Health and Safety

Source of Change (Project Activities)	Cumulative Sources of Impact
CONSTRUCTION Injuries to the public and workers from: - Open trenches, openly stored or moving construction materials, moving construction equipment and redirected traffic; and - General and construction and pipes installation activities that will increase the workers and public exposed to noise, dust and occupational hazards which will increase the potential accidents	Other ongoing projects in the villages
OPERATION Increased health and safety risks due to traffic related accidents and open trenches during pipes repair and spill management	

5.11.2 Impacts during the Construction Phase

Working on a construction project entails several health and safety risk factors that need to be addressed ahead of the influx of the construction workers. Risk Hazards include:

- Tripping;
- Vibration exposure;
- Exposure to dust;
- Exposure to noise;
- Other injuries; and
- Deaths.

With no mitigation measures in place, the impacts on the occupational health and safety from the construction phase are of **short term**, mostly **reversible** nature, **moderate** effect and **medium** likelihood of occurrence **(3B).**

Mitigation and prevention of safety hazards will be incorporated into the Project implementation program addressing the following items:

- Prepare an HSE procedure in accordance with the applicable standards;
- Prohibit keeping trenches open till the next working day. If this is deemed necessary, install barriers to avoid falls into the trenches;
- Fence off all construction sites to prevent unauthorized access to hazardous areas;

- Communicate identified hazards to crew members during the site specific orientation at the start of the job and train them on medical emergency response;
- Post adequate signs throughout the Project area, in visible locations, indicating type of operation and other information and appropriate medical / emergency action response. The signs should be in Arabic;
- Keep the site clean and tidy at all times;
- Take appropriate measures for the storage, handling, transportation and disposal of all waste material;
- Provide basic training in construction, health and safety, first aid and the environment to the construction team;
- During construction activities, take all the necessary measures to prevent accidents with awareness training, defining clear procedures and mandating the use of personal protection equipment (PPE), including eye protection, dust masks, hard hats, gloves, high visibility jackets, hearing protection equipment, proper clothing, safety boots, safe ladders, etc.;
- Reinstate all disturbed services and facilities in a time that will cause the least disturbance possible to the community;
- Develop guidelines for site safety where any excavation, material dumps, soil dumps or other obstructions that are likely to cause injury to any person should be suitably fenced off and at night protected by red warning lights;
- Develop guidelines for the safe transportation, use, and storage of construction vehicles and equipment;
- Handle, store, use and process branded materials in accordance with manufacturer's instructions and recommendations;
- Properly maintain PPE, including cleaning it when dirty and replacing damaged or worn-out equipment. Proper use of PPE should be part of the recurrent training programs for employees and laborers; and
- Ensure that qualified first-aid can be provided at all times. Properly equipped first-aid stations should be easily accessible throughout the work sites.

By adopting the above proposed mitigation measures, impacts on occupational health and safety are predicted to become **Minor** with **Low** likelihood of occurrence (**2A**).

5.11.3 Impacts during the Operation Phase

During operation phase it is likely that the pipeline may be damaged and need maintenance by excavating the paved roads covering the damaged pipeline.

The workers who will be in charge of the maintenance of the network will be exposed to gases, odors, and microbiological hazards as well as potential fall or injury.

Adopting the proposed mitigation measures in Section 5.11.2, will reduce the impacts on occupational health and safety to **minor** with **low** likelihood of occurrence **(2A).**

5.12 SUMMARY OF ENVIRONMENTAL IMPACTS BEFORE AND AFTER IMPLEMENTATION OF MITIGATION MEASURES

A summary of environmental impacts before and after implementation of mitigation measures are provided in Table 5-16 and Table 5-17.

Table 5-16 Impact Summary table with No Mitigation Measures in Place

	Receptors							
Activity / source of the impact	**Ambient air quality**	**Sound Quality**	**Ecology**	**Soil and Groundwater**	**Surface Water**	**Socio-Economy**	**Traffic**	**Occupational and Public H&S**
Construction Phase								
General Construction Activities	2C							
Exhaust and dust emissions	2C							
Site Levelling, Excavation and Soil Compaction Activities	2C	3C	2A	2C		4B	3B	
Preparation of access roads in the valleys					3C			
Accidental Spills of Fuel and Oil and Chemicals			2A	3C	3C			
Inadequate storage of wastewater and solid wastes			2A	3C	3C			
Land acquisition for pipelines construction						4B		
Movement of vehicles to transport people and materials pipeline crossing through the different villages of the project							3B	
Job creation						6C		
Increased pressure on existing infrastructure						2A		
Injuries to the public and workers								3B
Operation Phase								
Traffic								
Site Levelling, Excavation, material transportation, and compaction activities		3A				4A		
Change in soil topography				2C				
Accidental Spills of Fuel and Oil and Chemicals				3B	2B			
Leakage from pipelines			3B	3B	2B			
Beneficial impact of providing new sewer networks, and rehabilitation of old network parts						6B		
Excavation of paved roads		3A					2A	
Emissions due to Energy and Fuel Consumption	2A							

	Receptors							
Activity / source of the impact	**Ambient air quality**	**Sound Quality**	**Ecology**	**Soil and Groundwater**	**Surface Water**	**Socio-Economy**	**Traffic**	**Occupational and Public H&S**
Increased health and safety risks due to traffic related accidents and open trenches during pipes repair								3B
Stop wastewater pollution from connected villages						6B		

Table 5-17 Impact Summary table after Mitigation Measures were Put in Place

Activity / source of the impact	Receptors							
	Ambient air quality	Sound Quality	Ecology	Soil And Groundwater	Surface Water	Socio-Economy	Traffic	Occupational and Public H&S
Construction Phase								
General Construction Activities	1C							
Exhaust and dust emissions	1C							
Site Levelling, Excavation, material transportation, and compaction activities	1C	2B	1A	2B			2A	
Preparation of access roads in the valleys					2B			
Accidental Spills of Fuel and Oil and Chemicals			1A	2A	2B			
Inadequate storage of wastewater and solid wastes			1A	2A	2B			
Land acquisition for pipelines construction						3B		
Movement of vehicles to transport people and materials pipeline crossing through the different villages of the project							2A	
Injuries to the public and workers								2A
Operation Phase								
Traffic								
Site Levelling, Excavation and Soil Compaction Activities for maintenance		2A						
Change in soil topography				2B				
Accidental Spills of Fuel and Oil and Chemicals				2B	2A			
Leakage from pipelines			3A	2B	2A			
Emissions due to Energy and Fuel Consumption	1A							
Increased health and safety risks due to traffic related accidents and open trenches during pipes repair								2A

6 ENVIRONMENTAL MANAGEMENT PLAN

This chapter presents the proposed Environmental Management Plan (EMP) for the construction of wastewater networks. The EMP will highlight the main impacts and control measures that were identified in the Environmental Impact Assessment section, particularly:

- Mitigation measures to be implemented during the construction and operation phases;
- Waste Stream Management and disposal methods;
- References to control guidelines and standards;
- Responsibilities for the implementation of the plan;
- Verification, monitoring and training requirements; and
- Record keeping and documentation requirements.

The overall objectives of the EMP are 1) to ensure the Project's compliance with Lebanese legislation; 2) to provide a basis to carry out monitoring activities and compliance inspection programs; and 3) to support the Contractor and relevant stakeholders in the implementation of mitigation and monitoring plans. The EMP may be subject to updates and modifications throughout the Project lifetime.

6.1 ENVIRONMENTAL MITIGATION AND MONITORING PLAN

This section comprises a priority list of the most important measures that the project proponent should adopt to ensure a practical, cost-effective and appropriate approach to impact mitigation.

Proposed mitigations for construction and operation impacts are summarized in Table 6-1 and Table 6-2, respectively.

The cost to implement the EMP is roughly estimated at $100,000

Table 6-1 Construction Phase Environmental Management Plan

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
Air Quality	Exhaust emissions from vehicular transport and construction equipment operation	• Inspect all equipment and vehicles to be used for the project prior to their deployment to the site as well as at regular intervals during the construction sequence to identify any emerging leakage incidents during construction; • Continually use properly designed, maintained and operated equipment/vehicles by the construction contractor, proper engine fuel mixtures, regularly serviced exhaust emission systems and proper engine tuning. These precautionary measures contribute significantly to a reduction in identified air pollutant emissions; • Investigate the environmental benefits of employing environmentally friendly equipment by the contractor, such as machinery with higher fuel efficiency or those equipped with air pollution control devices to minimize exhaust emissions; • Avoid idling vehicles and equipment engines that are left running unnecessarily; and • Maintain and report monthly fuel consumption records to ensure that the vehicles are running properly and leading to excessive gaseous emissions to air.	No additional cost	• Contractor's mechanical engineer and environmental officer • Supervision consultant appointed by CDR • Municipality Engineer
	Dust generation from soil disturbance during site excavation and site preparation	• Install sandbags or other erosion control measures to prevent silt runoff to public roadways where applicable; • Minimize handling of dusty materials and drop heights for materials transfer to lorries; • Ensure site roads are kept regularly damped down, compacted or suitably surfaced to minimize dust emissions from vehicle use; • Implement approved water-spraying procedures as needed; • Enforce a maximum speed limit of 20 km/h throughout the work sites;	5000 USD cost of sheets and water for spraying	• Contractor's civil engineer and environmental officer • Supervision consultant appointed by CDR • Municipality

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
		• When possible delay compaction activities until the beginning of the wet season or when more water is available; • Maintain stockpiles (if any) at minimum heights and forming long-term stockpiles into the optimal shape to reduce wind erosion; and • Cover all incoming and outgoing trucks from the site.		Engineer
Noise	Increase in noise level from construction activities	• Use the quietest available equipment where possible; • Equip all internal combustion engine driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment; • Operate and maintain all equipment to be used in accordance with manufacturer's instructions for low noise operation. Engine covers will be used at all times; • Switch off engines when not in use; • Site noisy equipment away from noise sensitive areas and position them behind stockpiles or other barriers to provide acoustic screening; • Properly plan deliveries to and from the sites to minimize impacts; • Prior to initiating the works near to noise sensitive receivers, notify residents of the plans, including expected duration; • Inform staff and workers onsite on the impact of noise and the regulatory requirements; and • Control the speed of vehicle movement on site and in the surrounding area.	10,000 USD (mufflers)	• Contractor's HSE officer • Supervision consultant appointed by CDR • Municipality Engineer
Ecology	Impacts on biodiversity	• Design a landscape plan that enhances the landscape aesthetic value using local and native population flora; • When detected, sensitive species or habitats should be conserved; • All waste resulting from construction works, land reclamation, or any other activity should be collected and disposed properly in an allocated disposal site. Littering in the project area and surrounding areas should be prevented; and	1000 USD/month (part time ecological expert during	• Contractor's environmental officer • Supervision consultant appointed by

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
		• All affected areas must be replanted with indigenous species appropriate to the respective sites, by agreement with ecological experts.	construction phase)	CDR • Municipality Engineer
Soil and groundwater	Temporary or permanent change in topography, soil erosion and collapse from grading, trenching, or excavation	• Dispose of surplus material at designated waste locations; • Segregate wastes that can be salvaged and store them temporarily for later use; • Direct materials that cannot be reclaimed or re-used is to designated dumping areas; • Place clear markers indicating the limits of the construction trenches and stockpiling area of excavated materials to restrict the equipment and personnel movement limiting the physical disturbance to land and soils in adjacent areas; • Stabilize the soils in trenches directly after completion of each stage of works where fill should avoid pockets of segregated materials, it should use well-graded materials, and it should be compacted to recognized standards; • Avoid executing excavation works under aggressive weather conditions; and • Erect erosion control barriers around work site during site preparation and construction.	--	• Contractor's civil engineer and foreman • Supervision consultant appointed by CDR • Municipality Engineer
	Change in soil and groundwater quality from poor waste management, and accidental spills and leaks of fuel and Oil	• Store and handle hazardous wastes in appropriate storage facilities; (tanks/containers) and sites; • Prepare procedures for storage and handling of hazardous wastes and raw materials (e.g. batteries, chemicals, fuel) as part of the Contractor's Waste Management Plan; • Provide collection trays and absorbent material on site in case of accidental spills; • Carry out maintenance, refueling and cleaning of vehicles and equipment at designated sites with adequate leakage prevention (e.g. impermeable surface);	About 5,000 USD for transportation of wastes to the designated places	• Contractor's civil engineer and environmental officer • Supervision consultant appointed by CDR • Municipality

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
		• In case of any contamination, remove contaminated soil and treat it or disposed of it in a manner appropriate to the type of contamination present; • Prohibit leaving material stockpiled on-site during the rainy season without being covered; • Execute concrete batching, if required, in designated place where the wastes are contained and transferred to the proper disposal place; • Clean concrete ready-mix vehicles on site in special prepared place where the concrete wastes are contained and disposed in the approved places; • Provide garbage bins on site for workers to dispose their refuse. Wastes shall be collected regularly and disposed of according to the municipalities' requirements; • Prepare a hydrotest management plan and get it approved prior to start of Hydrotesting; • Discharge hydrotest water away from the stockpiled excavation or bedding material in a way that will not cause damage to the adjacent locations; • Contain wastewater generated by workers during the construction period in septic tanks to be pumped and discharged later into the appropriate designated place; • Conduct routine inspection and maintenance of equipment for risk minimization; • Store and handle fuels and lubricants within containment facilities (e.g. bunded areas, leak proof trays, etc.) designed to prevent the release of spilled substances to the soil and groundwater environment, and these facilities should be maintained and kept drained of rainwater; • Ensure the presence of trained employees capable of dealing with small scale spill hazards; and • Ensure the total diversion of the sewer flow before removing old networks pipelines.		Engineer

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
Surface water	Change in surface water and sediments quality from possible leakage of fuel/ oil/ chemicals and inadequate storage and disposal of wastewater, solid waste (domestic waste and construction waste) and hazardous waste that will be generated from the construction activities.	• Prevent run-off from cleared or disturbed areas into rivers, streams or surface water bodies by using sediment control methods, such as, silt fences, sandbags, hay bales, drop down structures, detention basins, diversion banks, gabions, etc. All erosion and sediment control structures are to be regularly inspected and maintained, whereby the sieving shall be removed and disposed at a designated site; • Place all spoil from water body crossings in the construction right-of-way at least three (3) meters from the water's edge, or in additional extra work areas. Use sediment barriers to prevent the flow of spoil or heavily silt-laden water into any water body; • Prohibit leaving trenches through canals that are dry or contain non-moving water at the time of crossing open for more than 24 hours; • Carry out the pipelines and manholes installation of seasonal streams preferably in the dry season; • Notify downstream users of water canals of works 10 days prior to the diversion activities if needed; • Complete streambed and bank stabilization before returning flow to the water body channel; and • If hydro testing water is to be discharged into water bodies, ensure that the water quality conforms to the applicable guidelines in MoE Decision No. 8/1/2001 (National Standards for Environmental Quality).	--	• Contractor's civil engineer and environmental officer • Supervision consultant appointed by CDR • Municipality Engineer

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
Socio economic	Damage to the Existing Infrastructure and Potential Water Pollution	• Trial pits shall be executed along the network route to locate the existing infrastructure components; • Sewer lines shall be installed at least 3 meters horizontally from and 0.3 meters lower than existing water main lines; • Where the separation requirements cannot be met due to topography, inadequate right-of-way easements, or conflicts with other provisions of these regulations, lesser separation is permissible if: - The water main and the sewer are located as far apart as feasible within the conditions listed above; - The water main and the sewer are not installed within the same trench; and - The sewer line is appropriately constructed to prevent contamination of the water in the main by sewer leakage. • No water main lines should pass through or come into contact with a sewer manhole	--	• Contractor's civil engineer and environmental officer • Supervision consultant appointed by CDR • Municipality Engineer
	Land Acquisition for Pipelines Installation	• Preparation of a resettlement policy framework (RPF) that: - Sets up the criteria of eligibility for compensation and for the different categories of losses and affected persons, - Describes the methods used for valuing the eligible assets, - Describes institutional arrangements, roles of different institutions involved in resettlement planning, implementation and monitoring, and - Describes the methodology for consulting with Project Affected Persons (PAP) • Preparation of a resettlement action plan (RAP) to be approved by the	20,000 USD 10,000 USD per RAP	• CDR

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
		CDR and the World Bank.		
Traffic	Increase in traffic due to	• Keep traffic to designated roads, position necessary diversion signs, schedule transport of workers and materials to avoid peak hours	--	• Contractor's HSE officer • Supervision consultant appointed by CDR • Municipality Engineer
Occupational and Public Health	Nuisance to workers	• Prepare an HSE procedure in accordance with the applicable standards; • Prohibit keeping trenches open till the next working day. If this is deemed necessary, install barriers to avoid falls into the trenches; • Fence off all construction sites to prevent unauthorized access to hazardous areas; • Communicate identified hazards to crew members during the site specific orientation at the start of the job and train them on medical emergency response; • Post adequate signs throughout the Project area, in visible locations, indicating type of operation and other information and appropriate medical / emergency action response. The signs should be in Arabic; • Keep the site clean and tidy at all times; • Take appropriate measures for the storage, handling, transportation and disposal of all waste material; • Provide basic training in construction, health and safety, first aid and the environment to the construction team;	3,000 USD/month (HSE officer) 15,000 USD (Training of the construction team)	• Contractor's HSE officer • Supervision consultant appointed by CDR • Municipality Engineer

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
		• During construction activities, take all the necessary measures to prevent accidents with awareness training, defining clear procedures and mandating the use of personal protection equipment (PPE), including eye protection, dust masks, hard hats, gloves, high visibility jackets, hearing protection equipment, proper clothing, safety boots, safe ladders, etc.; • Reinstate all disturbed services and facilities in a time that will cause the least disturbance possible to the community; • Develop guidelines for site safety where any excavation, material dumps, soil dumps or other obstructions that are likely to cause injury to any person should be suitably fenced off and at night protected by red warning lights; • Develop guidelines for the safe transportation, use, and storage of construction vehicles and equipment; • Handle, store, use and process branded materials in accordance with manufacturer's instructions and recommendations; • Properly maintain PPE, including cleaning it when dirty and replacing damaged or worn-out equipment. Proper use of PPE should be part of the recurrent training programs for employees and laborers; and • Ensure that qualified first-aid can be provided at all times. Properly equipped first-aid stations should be easily accessible throughout the work sites.		

Table 6-2 Operation Phase Environmental Management Plan

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
Noise	Increase in noise level from maintenance activities	• Prior to initiating the works near to noise sensitive receivers, notify residents of the plans, including expected duration; • Switch off equipment and generators when not in use; and • Equip all internal combustion engine driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment.	No additional cost	• MoEW/BWE representative
Ecology	Impacts on biodiversity from possible leaks in pipelines installed in the valleys	• Continuous monitoring of visible leaks along the pipelines routes in the valleys; and • In case of any contamination, stop directly the flow and manage the spill.	2000 USD /month	• MoEW/BWE representative
Soil and groundwater	Temporary or permanent change in topography, soil erosion and collapse from grading, trenching, or excavation	• Stabilize the soils in trenches directly after completion of each stage of works where fill should avoid pockets of segregated materials, it should use well-graded materials, and it should be compacted to recognized standards; and • Avoid executing excavation works under aggressive weather conditions.	No additional cost	• MoEW/BWE representative

Component	Impact/source	Mitigation Measures	Indicative Cost	Responsibility
	Change in soil and groundwater quality from poor waste management, accidental spills and leaks of fuel and oil, and potential spills of raw wastewater from pipelines.	• Continuous monitoring of visible leaks along the pipelines routes; • In case of any contamination, remove contaminated soil and treat it or disposed of it in a manner appropriate to the type of contamination present; and • Prohibit leaving material stockpiled on-site during the rainy season without being covered.	2000 USD/.month	• MoEW/BWE representative
Surface water	Change in surface water and sediments quality from possible leakage of fuel/ oil/ wastewater.	• Prevent run-off from cleared or disturbed areas into rivers, streams or surface water bodies by using sediment control methods, such as, silt fences, sandbags, hay bales, drop down structures, detention basins, diversion banks, gabions, etc. All erosion and sediment control structures are to be regularly inspected and maintained, whereby the sieving shall be removed and disposed at a designated site.	1000 USD/month	• MoEW/BWE representative

6.2 IMPLEMENTATION OF THE EMP

6.2.1 Roles and Responsibilities

Roles and responsibilities of the different institutions involved in the construction and operation of the project with respect to the implementation of the EMP are summarized in Table 6-3.

Table 6-3 EMP Implementation Plan

Institution/Body	Roles and Responsibilities
CDR	• Overall responsibility over the EMP Implementation during construction • As part of the project bi annual progress report; a section will be dedicated to report on the implementation of the EMP.
MoE	• Reviews and approves CEMP prepared by contractor • Ultimately approve EMP implementation reports • Conduct site audits as needed to check implementation of EMP
MoEW/BWE	• Overall responsibility over the EMP Implementation during operation
Litani River Authority	• General oversight of implementation of the project
World Bank	• Review and approval of EMP implementation reports
Contractor	• Prepare a Construction Environmental Management Plan (CEMP) that details how the contractor shall implement the provisions of the EMP; CEMP • Provide a field HSE officer to ensure implementation of the CEMP • Immediately report to the site HSE Officer in case of accidents, spills or other events which have health, safety or environmental implications (and to MoE and/ or MoPH as applicable) in case of serious accidents, spills or other events). • In case of incidents, the contractor should fill an incident records form, including how the incident is planned to be addressed.
Supervision consultant(s)	• Review CEMP prepared by Contractor; • Review and approve Contractor's EMP implementation reports; • Supervise the Contractor's implementation of CEMP; • Prepare a checklist to be used to supervise Contractor's works; • Coordinate with CDR to ensure appropriate reporting of EMP implementation; • Identify training needs of concerned parties to ensure EMMP requirements are well-understood and can be implemented.
Municipalities	• Follow up on the EMP implementation during construction phase

6.2.2 Capacity Building Needs

6.2.2.1 Training Needs during Construction Phase

In order to ensure a proper and effective implementation of the EMP, It is particularly important to undertake a training program for the contractor regarding its preparation and implementation. Training sessions for the contractor should be conducted prior to the commencement of the construction works and shall focus on the following topics:

- Understanding of contents of EMP and general obligations of the contractor;
- Preparation of a Method Statement for the Implementation of the EMP;
- Reporting requirements as part of EMP implementation.

6.2.2.2 Training Needs during Operation Phase

It is recommended to train the BWE on the following:

- Contents of EMP during operation phase;
- Preparation of an Operation Environmental Management Plan for the project; and
- Reporting requirements.

The total cost estimate for training during construction and operation phase is estimated at US$15,000

6.2.3 Environmental Monitoring Plan

Compliance monitoring should be conducted to ensure the environmental soundness of the project. It shall be the responsibility of the designated site HSE Officer during the Construction phase and the administration of the Project (MoEW/BWE) during the operation phase. The proposed monitoring plan for the project is summarized in Table 6-4.

Table 6-4 Environmental Monitoring Plan during Construction and Operation

Item	Monitoring Purpose	Monitoring Parameters	Existing conditions	Location	Monitoring Frequency	Indicative Monitoring Costs	Responsibility
Construction Phase							
Air quality	Visual identification and elimination of sources of nuisance and pollution (water spraying, working hours, idle equipment, etc.)	Dust Exhaust from vehicles and equipment Traffic Working hours	Cumulative sources shall be identified during the construction period	Construction site	Daily	N.A.	- Contractor's HSE officer
Noise level	Compliance with national ambient noise levels	Leq, Lmax, Lmin, L90 dB(A)	Ambient noise levels are exceeding the national standards	Sensitive receptors	• Three times daily during grading and excavation; • Once daily during concrete pouring, walls construction and exterior wall finishing	Cost of noise meter (USD5,700)	- Contractor's HSE officer
Solid Waste & Wastewater	Ensure proper cleaning, storage and disposal of waste & wastewater	• Waste types • Waste generation rates (kg or tons/day) • Waste reused • Waste transported for offsite reuse/recycle • Waste disposed of • Wastewater collection tanks • Wastewater disposal	Solid wastes are being disposed in Zahle landfill Wastewater is being discharged into the Berdawni and Litani Rivers	Construction site	Daily	N.A.	- Contractor's HSE officer

Item	Monitoring Purpose	Monitoring Parameters	Existing conditions	Location	Monitoring Frequency	Indicative Monitoring Costs	Responsibility
Soil and ground water	Identify possible soil and groundwater pollution sources	• Visual inspection of the excavation activities • Visual inspection to identify soil stains and location of spills, if any • Inspection of soil erosion from the site • Tally of residents' complaints • Tally of municipalities complaints	Public groundwater wells in the study area are being used to supply potable water for the villages in the Project area	Network route	Daily Monthly	N.A	- Contractor's HSE officer
Surface water	Monitoring of changes in surface water and sediments characteristics during the construction activities near Berdawni and Litani Rivers	Surface water and sediments characteristics (physico-chemical parameters, including turbidity, COD, BOD_5, TPH, TDS and heavy metals)	Berdawni and Litani rivers polluted by domestic and industrial wastewater discharges	Berdawni and Litani Rivers sections close to the construction sites	Prior to construction and every 3 months	400 USD per sample	- Contractor's HSE officer
Traffic	Detect traffic disturbances	Speed limit and road safety signs on site roads Compliance with safety standards and the proper positioning of any necessary traffic diversion sign, especially near schools Number of complaints from the municipalities Number of complaints from the residents/schools/commercial premises	Roads in general are accommodating the existing traffic	Construction sites on public roads	Daily	N.A.	- Contractor's HSE officer

Item	Monitoring Purpose	Monitoring Parameters	Existing conditions	Location	Monitoring Frequency	Indicative Monitoring Costs	Responsibility
Health, safety, environment and Hygiene	Identify and eliminate sources of hazards	Proper PPE use Number /cause of accidents	--	Construction site	Continuous	N.A.	Contractor's HSE officer
Operation Phase							
Surface water	Monitoring of changes in surface water characteristics following leakage of pipes near the rivers	• Surface water and sediments characteristics (physico-chemical parameters, including turbidity, COD, BOD_5, TDS and heavy metals); and • River flow	Berdawni and Litani rivers polluted by domestic and industrial wastewater discharges	Berdawni river downstream the discharge location of the overflow pipeline	Following diversion/leakage of raw wastewater to Berdawni River and Litani.	400 USD per water sample	MoEW/BWE
	Monitor the effluent wastewater quality from Zahle WWTP for compliance with the relevant standards	Wastewater characteristics as per the Lebanese decision 8/1 2001 for the discharge of wastewater into surface water bodies	Litani river polluted by domestic and industrial wastewater discharges	Litani downstream of treated wastewater discharge location	Monthly	700 USD per wastewater sample	MoEW/BWE
Soil	Monitor the sludge quality before disposal	Sludge TCLP test (toxicity characteristic leveling procedure) and the Point Filter test	Existing soil in the area may be polluted by solid wastes discharge practices and agricultural activities	Sludge disposal locations	Monthly	1000 USD per sample	MoEW/BWE

Item	Monitoring Purpose	Monitoring Parameters	Existing conditions	Location	Monitoring Frequency	Indicative Monitoring Costs	Responsibility
Public safety	Identify and eliminate sources of hazard	Number /cause of accidents	--	Community susceptible to be affected from maintenance activities	When needed	Maintenance cost	MoEW/BWE

7 CONSULTATION ON THE EMP/IEE

The WB requires also that stakeholder consultations be carried out during planning, implementation and operation phases of the project..

A consultation meeting was held on September 13, 2014 in Chtaura to discuss the findings of the EMP/IEE. Consultation was conducted in accordance with the following international guidance documents:

- IFC Performance Standard 1- Assessment and Management of Environmental and Social Risks and Impacts , 2012;
- IFC, "Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets"; 2007; and
- IFC, "Good Practice Note: Addressing the Social Dimensions of Private Sector Projects", 2003.

A photographic documentation of the meeting is provided in Figure 7-1.

Arrival and registration of the participants

Introductory/welcoming speech

Presentation

Overview of participants

Figure 7-1 Photos from the Public Consultation Meeting

The workshop attendees represented the following main affiliations (the list of workshop participants is available in Appendix C):

- Ministry of Environment
- Council of Development and Reconstruction
- Municipalities (Alkhyara, Ferzol, Kaa El Reem, Bar Elias, and Aanjar)
- Union of Municipalities(Zahle, Plain)
- Bekaa Water Establishment
- Zahle and Bekaa Chamber of Commerce and Industry
- Ministry of Public Health
- Ministry of Interior and Municipalities
- Caritas Lebanon
- Salam Organization
- Université Saint-Joseph
- Lebanese University

Table 7-1 summarizes the proceedings of the meeting.

Table 7-1 Concerns Raised during the Public Consultation Meeting

Name	Party	Comment/Question	Answer	Integration of Comments in the Study
Kassem Mathloom	Alkhyara Municipality and Union of Municipalities of the Plain	Some of the presented impacts on groundwater are negative whereas wastewater projects are known to have positive impacts	The overall project impact on groundwater is positive, however, the impacts mentioned in the presentation were related to construction activities and potential leakage of wastewater during operation	--
Lawyer Toufik Al Hindi	Zahle and Bekaa Chamber of Commerce and Industry	Now, water networks are being implemented and installed on public roads and in the next phase wastewater networks will be implemented and excavations will be executed again on public roads. There should be a coordination mechanism to avoid re-excavating the roads	Projects are implemented based on the financing availability which makes the coordination difficult	--
Lawyer Nathrat Andokian	Anjar Municipality	• The study doesn't mention the mechanism for coordination with municipalities.	• The main aim of this workshop is to coordinate with municipalities, unions, and organizations, to take their comments and opinions and include them in the study.	The report describes the role of municipalities in implementing the environmental and social management and monitoring plan especially during the construction phase of the project (Section **Error! Reference ource not found.**).
Ibrahim Nasrallah	Union of Municipalities of Zahle Caza	There is an area in Ferzol that cannot be connected to Ferzol WWTP due to topographical reasons and could be connected to Zahle WWTP.	The deisgn consultant will visit the area and investigate the possibility of connecting it to Zahle network	The area will be included in the EMP
Melhem Fayez Ghoson	Ferzol Municipality	There is an area in Ferzol that is not connected to Ferzol WWTP, and needs to be connected to Zahle WWTP		
Osama Ibrahim	Al Salam Organization	• Salam Organization has had a lot of activities last year and now through 18 environmental committee of the civil society distributed in	The support of the local NGOs is needed during the implementation of the project and the workshop aim is to involve these	--

Name	Party	Comment/Question	Answer	Integration of Comments in the Study
		the villages (USAID Fund) it is working on environmental files. Therefore the organization would like to be part in this project in promoting awareness	NGOs; however, the legal mechanism that describes the engagement methods during the execution of the project is not available at this stage.	

The general comments received through the distributed evaluation forms are:

- Industrial wastewater and industrial solid wastes must be considered as the main sources of pollution of the Qaraoun Lake and the Litani River. Short and long-term solutions must be suggested to solve this issue.
- Sewer networks must be installed as far as possible from potable water networks.
- The role of the institutions and the organizations of the civil society must be activated in order to raise people's awareness regarding the environment. The Association "Al Salam" created environmental committees that work to reduce pollution and raise awareness in the 18 towns surrounding the Litani River.

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9 APPENDICES

APPENDIX A: LIST OF IEE STURDY PREPARERS

Ricardo KHOURY, M.E.	Project Director Senior Environmental Engineer
Mahmoud Taleb, B.Sc.	Project Manager Environmental Consultant
Marc Beirouthy, PhD.	Biodiversity Specialist
Rachad GHANEM, M.Sc.	Senior Geologist / Hydrogeologist
Shafic GHRAIZI, B.Sc.	Geologist, GIS Specialist
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APPENDIX B: NATIONAL AND INTERNATIONAL STANDARDS RELEVANT TO THE PROJECT

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APPENDIX B1: RELEVANT NATIONAL ENVIRONMENTAL STANDARDS

Ambient Air Quality and Stack Emissions

The maximum allowable limits of atmospheric ambient air pollutants (Decision 52/1) are shown in Table B 1.

Table B 1 Maximum Allowable Limits for Ambient Air Pollutants (MoE Decision 52/1)

Pollutant	Maximum Allowable Concentration (in µg/m³)	Averaging Period
Sulfur Dioxide (SO_2)	350	1 hour
	120	24 hours
	80	1 year
Nitrogen Dioxide (NO_2)	200	1 hour
	150	24 hours
	100	1 year
Ozone (O_3)	150	1 hour
	100	8 hours
Carbon Monoxide (CO)	30,000	1 hour
	10,000	8 hours
Total Suspended Particulate (TSP)	120	24 hours
Particulate Matter (PM-10)	80	24 hours
Lead	1.0	1 year
Benzene	5 ppb	1 year

In addition to the above-mentioned, Decision 8/1 gives specific regulations for stack emissions.. The Environmental Limit Values (ELV) for power generators operated with fuel having a thermal capacity greater than 0.5 MW are presented in Table B 2.

Table B 2 Maximum Limits for Power Generation Emissions (MoE Decision 8/1)

Parameter	ELV for New Facilities	ELV for Existing Facilities	Remark
O_2 correction	5%	5%	
Dust (mg/m³)	20	20	Using soot filter
	150	150	Diesel fuel
	250	250	Other fuel
CO (mg/m³)	800	1,500	

Parameter	ELV for New Facilities	ELV for Existing Facilities	Remark
NO_x (calculated to NO_2) (mg/m^3) <3MW/ > 3MW thermal capacity	4,000 / 2,000	6,000	
SO_x (calculated to SO_2) (mg/m^3) If diesel fuel (European standard) If other type of fuel	- To be determined in later stages	- To be determined in later stages	

According to the Decision 8/1, a minimum stack height has to be kept for the release of exhaust gases in order to ensure the dispersion of pollutants. This method can be used instead of applying the ELVs for generators. This means that an operator of a plant can choose whether he meets the ELVs on one hand or installs a capacity correlated stack height on the other hand to fulfill the demands related to the necessary dilution of the emissions.

The formula required is:

$$H = h + 0.2\sqrt{kVA}$$

Where

H = Total stack height in meters

h = Height of neighboring building in meters

kVA = Total generator capacity of the set in kVA = kW, i.e. the total capacity which is determined by the maximum fuel (energy) input

Noise

The National Maximum allowable noise level and the permissible occupational Noise Exposure standards according to Decision 52/1 are presented in Table B 3 and Table B 4, respectively.

Table B 3 Permissible Ambient Noise Levels in Selected Regions

Region Type	Limit for Noise Level dB(A)		
	Day Time (7 a.m.- 6 p.m.)	Evening Time (6 p.m.- 10 p.m.)	Night Time (10 p.m.- 7a.m.)
Residential areas with some construction sites or commercial activities or located near a road	50-60	45-55	40-50
Urban residential areas	45-55	40-50	35-45

Industrial areas	60-70	55-65	50-60
Rural residential areas	35 – 45	30 – 40	25 – 35

Table B 4 National Occupational Noise Exposure Standards in Work Areas

Duration per Day (hrs)	Sound Level dB(A)
8	90
4	95
2	100
1	105
½	110
¼	115

Wastewater Discharges

New standards for discharge into receiving water bodies are presented in Decision no. 8/1, to update similar standards set by Decision 52/1 (Table B 5).

Table B 5 Maximum Limits for Wastewater Discharge into Receiving Water Bodies (Decision 8/1)

Substance	Maximum Allowable Limits For Receiving Water Bodies		
	Sewerage System	Surface Water	Sea
Color	none	none	none
pH	6-9	6-9	6-9
Temperature	35°C	30 °C	35°C
BOD (5 day, 20°C)	125 mg/l	25 mg/l	25 mg/l
COD (dichromate)	500 mg/l	125 mg/l	125 mg/l
Total Phosphorus	10 mg/l	10 mg/l	10 mg/l
Total Nitrogen[5]	60 mg/l	30 mg/l	30 mg/l
Suspended solids	600 mg/l	60 mg/l	60 mg/l
AOX	5	5	5
Detergents	-	3 mg/l	3 mg/l
Coliform Bacteria 370 C in 100 ml[6]	-	2,000	2,000
Salmonellae	Absence	Absence	Absence
Hydrocarbons	20 mg/l	20 mg/l	20 mg/l
Phenol Index	5 mg/l	0.3 mg/l	0.3 mg/l
Oil and grease	50 mg/l	30 mg/l	30 mg/l
Total Organic Carbon (TOC)	750 mg/l	75 mg/l	75 mg/l
Ammonia (NH_4^+)	-	10 mg/l	10 mg/l
Silver (Ag)	0.1 mg/l	0.1mg/l	0.1 mg/l
Aluminum (Al)	10 mg/l	10 mg/l	10 mg/l
Arsenic (As)	0.1 mg/l	0.1 mg/l	0.1 mg/l
Barium (Ba)	2 mg/l	2 mg/l	2 mg/l
Cadmium (Cd)	0.2 mg/l	0.2 mg/l	0.2 mg/l
Cobalt (Co)	1 mg/l	0.5 mg/l	0.5 mg/l
Chromium total (Cr)	2 mg/l	2 mg/l	2 mg/l

[5] Sum of Kjeldahl-N(organic N + NH3),NO3-N, NO2-N

[6] For discharges in close distance to bathing water, a stricter environmental limit value could be necessary

Substance	Maximum Allowable Limits For Receiving Water Bodies		
	Sewerage System	**Surface Water**	**Sea**
Hexavalent Chromium (Cr^{VI+})	0.2 mg/l	0.2 mg/l	0.2 mg/l
Copper total (Cu)	1 mg/l	0.5 mg/l	1.5 mg/l
Iron total (Fe)	5 mg/l	5 mg/l	5 mg/l
Mercury total (Hg)	0.05 mg/l	0.05 mg/l	0.05 mg/l
Manganese (Mn)	1 mg/l	1 mg/l	1 mg/l
Nickel total (Ni)	2 mg/l	0.5 mg/l	0.5 mg/l
Lead total (Pb)	1 mg/l	0.5 mg/l	0.5 mg/l
Antimony (Sb)	0.3mg/l	0.3mg/l	0.3mg/l
Tin total (Sn)	2 mg/l	2 mg/l	2 mg/l
Zinc total (Zn)	10 mg/l	5 mg/l	5 mg/l
Active (Cl_2)	-	1 mg/l	1 mg/l
Cyanides (CN^-)	1 mg/l	0.1mg/l	0.1mg/l
Fluorides (F)	15 mg/l	25 mg/l	25 mg/l
Nitrate (NO_3^-)	-	90 mg/l	90 mg/l
Phosphate (PO_4^{3-})	-	5 mg/l	5 mg/l
Sulphate (SO_4^{2-})	1,000 mg/l	1,000 mg/l	1,000 mg/l
Sulphide (S^{2-})	1 mg/l	1 mg/l	1 mg/l

APPENDIX B2: INTERNATIONAL ENVIRONMENTAL STANDARDS RELEVANT TO THE PROJECT

The IFC General EHS Guidelines (2007)[7] state that in the absence of applicable national ambient air quality standards, internationally recognized standards should be applied. EU ambient air quality standards[8] are cited in the IFC General EHS Guidance as recognized international standards (Table B 6).

Table B 6 EU Ambient Air Quality Standards

Parameter	Averaging Period	EU Ambient Air Quality Standard (3) (µg/m³)	Permitted Number of Exceedances per Year
Sulphur dioxide (SO_2)	1 hour	350	24
	24 hours	125	3
Carbon monoxide (CO)	8 hours	10,000	N/A
Nitrogen dioxide (NO_2)	1 hour	200	18
	Annual	40	N/A
Ozone (O_3)	8 hours	120	25
PM_{10}[1]	24 hours	50	35
	Annual	40	N/A
$PM_{2.5}$[2]	Annual	25	N/A

Notes:
1: PM_{10} denotes particulate matter of less than 10 microns in diameter
2: $PM_{2.5}$ denotes particulate matter of less than 2.5 microns in diameter
3: EU air quality requirements from Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

The maximum permissible ambient noise levels in the different environmental settings set by the IFC guidelines are presented in Table B 7. The guidelines also state that noise impacts should not result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site (IFC/WB, 2007).

Table B 7 Noise Levels Guidelines (IFC/WB, 2007)

Receptor	One Hour LAeq In dB(A)	
	Day (07:00-22:00)	Night (22:00-07:00)
Residential, institutional, educational	55	45
Industrial, commercial	70	70

[7] International Finance Corporation, (2007), Environmental, Health and Safety Guidelines. General EHS Guidelines, Washington, 2007,pp4.
[8] EU air quality requirements from Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

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