

In order to reduce the impact of combustion and exhaust emissions on ambient air, the following mitigation measures are recommended to be adopted and implemented by the awarded Contractor:

- Ensure well designed, maintained, and operated equipment/vehicles. Precautionary control measures for emissions reduction could include proper engine fuel mixtures, regularly serviced exhaust emission systems, suitable engine tuning, and use of low sulfur content diesel, whenever available;
- Use environmentally friendly equipment whenever possible (machinery with higher fuel efficiency or equipped with air pollution control devices to minimize exhaust emissions);
- Keep a record of maintenance for all machinery, vehicles, and generators on site;
- Report and monitor monthly fuel consumption records to keep track of consumption levels and identify overuse;
- Avoid unnecessary idling of vehicles and equipment engines; and
- Ensure that an effective Maintenance Plan and Schedule is in place for employed site machinery, vehicles, and power generators.

By applying the above mitigation measures, the impacts from exhaust and combustion emissions will be reduced to **Minor Consequence (2)** with **High Likelihood (3)**, resulting in a **Medium Significance (2H=6)** on the overall air quality within the Project Area.

5.4.2.2 *Dust Emissions*

The sources of airborne particulates during the construction phase include the following:

- Site clearance, trenching, excavation, backfilling, grading, and compaction works;
- Handling of construction materials and other general construction activities;
- Operation of heavy machinery, equipment, and power generators; and
- Transportation of site labor and construction materials/wastes from and to the Project location.

Dust emissions would vary on a daily basis depending on the level of activity and the prevailing weather conditions. Under normal meteorological conditions, dust impacts will be limited within several tens to hundred meters from the disturbance area, i.e. construction site. The main environmental and health concerns associated with dust generation include:

- Potential nuisance impacts on nearby stationary receptors (residential, commercial, religious buildings, agricultural lands), and mobile receptors (pedestrians and motorists on nearby streets); and
- Occupational health risks to construction workers from inhaling dust-laden air that might irritate respiratory pathways.

The duration of main earth disturbance activities (i.e., land clearance, excavation, backfilling, grading, and compaction works) is limited to several months overall and the surrounding roads that lead to the sites are not all paved, which increases the potential for dust emissions and is expected to impact the nearby receptors if not mitigated properly.

Dust emissions from construction activities are expected to have a **Moderate Consequence (3)** of a **High Likelihood (3)**. Accordingly, with no mitigation measures in place, dust emissions are likely to have **Medium Significance (3H=9)**.

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

- Set physical barriers at site boundaries;
- Ensure site roads are kept regularly damped down and compacted to minimize dust emissions;
- Schedule deliveries of raw materials efficiently;
- Wheel-washing of vehicles before departure from construction site;
- Cover incoming and outgoing trucks with proper canopies;
- Limit vehicular speed onsite to 20 km/h;
- Maintain material stockpiles at minimum heights and adequate slopes and ensure that they are covered;
- Surround the construction areas with scaffolding nets to control debris and dust from dispersing beyond the construction sites; and
- Inform sensitive receptors of the scheduled construction works, ahead of time in conjunction with the concerned municipalities, especially for dust-generating activities.

With the above recommendations, the potential impacts from dust generation during construction activities of the additional sewer lines and pumping stations are expected to have **Minor Consequence (2)** and a **Moderate Likelihood (2)** resulting in a **Medium Significance (2M=4)**.

5.4.3 Impacts during Operation

Table 5-10 below provides rating of potential ambient air quality impacts during the operation phase before and after applying mitigation measures, respectively.

Table 5-10 Consequence Assessment of Ambient Air Quality Impacts during Operation Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Combustion and exhaust emissions	Before Mitigation	N/D	L	L	L	O	R	2. Minor
	After Mitigation	N/D	L	L	L	O	R	2. Minor
Foul odor emissions from leaking or overflowing of raw and/or aging wastewater	Before Mitigation	N/D	M	L	L	O	R	3. Moderate
	After Mitigation	N/D	L	L	L	O	R	2. Minor

5.4.3.1 Combustion and Exhaust Emissions

The Project operation will result in additional ambient air pollutants and greenhouse gases emissions, particularly at the level of the pumping stations that are equipped with standby power generator; thus, resulting in direct negative environmental impacts on the overall ambient air quality in the area.

Therefore, the impacts of combustion and exhaust emissions are anticipated to be of **Minor Consequence (2)** and **High Likelihood (3)**, giving an overall **Medium Significance (2H=6)** on ambient air quality.

The following mitigation measures are proposed to be adopted and implemented, namely at the level of wastewater pumping stations, by the awarded Operator:

- Ensure proper operating conditions and regular maintenance of the generators as per manufacturer specifications;
- Ensure that the specifications of the generators are in line with national standards (Decision 8/1 dated 2001) through one of the following:
 - Compliance in terms of air pollutant emissions through regular monitoring; or
 - Ensuring that effective generator stack heights are in place. The formula for determining the stack height is:

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

Where:

- ✓ H = Total stack height in meters
- ✓ h = Height of neighboring building in meters (within 50 m radius)
- ✓ KVA= Total generator capacity of the set in kVA = kW, i.e. the total capacity which is determined by the maximum fuel (energy) input

If the proposed mitigation measures are applied, the impacts on ambient air quality from combustion and exhaust emissions will have **Minor Consequences (2)** and **Moderate Likelihood (2)**, resulting in a **Medium Significance (2M=4)**.

5.4.3.2 Foul Odor Emissions

Normal operating and maintenance conditions of pumping stations are not expected to result in considerable odiferous emissions, and every station will be equipped with a fan and a ceiling extract diffuser. Nevertheless, due to improper operating and maintenance practices, or due to sudden or accidental malfunctioning or downtime due to power outages, incoming raw wastewater might overflow while wastewater detained in the stations' wet wells will start to age and result in septic conditions.

The impacts of odor emissions are expected to be of **Moderate Consequence (3)** and **Moderate Likelihood (2)**, resulting in an overall **Medium Significance (3M=6)** on ambient air quality.

To reduce odor emissions, the following can be implemented:

- Ensure proper engineering design of the pumping stations (sizing of wet wells, pump-sets, and provision of a wastewater overflow emergency/bypass line);

- Ensure prompt repair of pumping stations in case of failure to minimize the resulting impact, and prevent power outages to keep the stations operational;
- Provide adequate ventilation with a carbon filter to control odors. The ventilation pipes must be extended above the highest point of the station building by three (3) meters;
- Ensure that a regular inspection and maintenance schedule is in place for the stations; and
- Establish an odor complaint grievance mechanism as a measure to allow implementation of timely and effective actions to minimize impacts from odors on downwind receptors.

With the above mitigation measures in place, odor emissions will be reduced, resulting in **Minor Consequences (2)** and **Low Likelihood (1)**, having **Low Significance (2L=2)** on ambient air quality.

5.5 POTENTIAL IMPACTS ON NOISE

5.5.1 Sources of Potential Impacts

The primary sources of noise from the various Project activities are listed in Table 5-11 below.

Table 5-11 Potential Impacts on Noise Levels

Source of Change (Project Activities)	Cumulative Sources of Impact
Construction • Operation of heavy machinery, equipment, vehicles, and on-site generators • Site clearance, trenching, excavation, backfilling, grading, and compaction activities • Heavy machinery and vehicle movement for the transportation of labor, materials and waste Operation • Operation of on-site generators for pumping stations • Operation of pumping stations and maintenance activities	Noise from nearby traffic, existing private power generators, and surrounding construction sites

5.5.2 Impacts during Construction

Table 5-12 below provides rating of potential noise impacts during the construction phase before and after applying mitigation measures, respectively.

Table 5-12 Consequence Assessment of Noise Impacts during Construction Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Noise associated with site preparation, construction activities	Before Mitigation	N/D	M	L	M	C	R	3. Moderate

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
and operation of on-site generators, heavy machinery, equipment and vehicles	After Mitigation	N/D	L	L	M	C	R	2. Minor

Noise impacts during the construction phase are considered temporary in nature. Potential sources comprise of activities caused by the operation of earth moving heavy machinery and equipment (excavators, bulldozers...) during site preparation, general construction activities, and transportation of equipment, materials, waste, and site labor, and the employment of site power generators. Typical sound level pressures recorded from the equipment anticipated to be used at the construction sites are illustrated in Table 5-13 for indicative purposes.

Table 5-13 Typical Sound Pressure Levels Reported from Construction (BS 5228-1 2009)

Equipment/Machinery	Noise Level (dB(A), LA _{eq} at 10 m)
Air compressor	95
Asphalt spreader/paver	75
Backhoe loader	67
Bench Saw	85
Bulldozer	86
Circular Saw	85
Compressor	65
Concrete mixer truck	80
Concrete Pump	67
Drill	85
Dump truck	79
Excavator Truck (Poclain)	82-83
Fuel tanker	79
Grinder	80
Ground excavation dozer	92
Hole Cutter	85
Jack hammer	90
Leveling ground grader	76-84
Mobile Concrete pump	75-80
Mobile Crane	67-70
Pick Up	78
Plate compactor	63
Pneumatic breaker (Breaking hard ground)	87
Rock Breaker (Jack Hammer)	83
Roller compactor	84

Equipment/Machinery	Noise Level (dB(A), LA _{eq} at 10 m)
Shovel Truck	83-91
Tower Crane	76-77
Water tanker	79
Welding machine	73

Noise levels of a range of 63 to 95 dB(A) are expected close to the main activity areas. Nevertheless, these levels would be reduced as the distance from the point source of noise increases. Noise levels will only affect potential receptors (the closest residences) for a relatively short period of time and intermittently. Noise insulation at a typical residential dwelling can result in 25-35 dB(A) noise reduction (BS 8233: 1999), only in the case where all windows are closed. If a window is left partially open, noise will be reduced by 10-15 dB(A) (BS 8233: 1999). As such, noise will be less audible to the local residents when indoor.

Therefore, noise emissions during the construction phase will have **Moderate consequences (3)** and **High likelihood (3)**, resulting in **Medium Significance (3H=9)**.

Mitigation measures to reduce works-associated noise levels include:

- Fit all machinery, equipment, and vehicles with exhaust silencers where possible;
- Ensure proper inspection and maintenance of machinery, vehicles and generators;
- Avoid idling and switch off engines when not in use;
- Place noisy equipment away from sensitive receptors, behind stockpiles to provide acoustic barriers;
- Control speed limits of vehicle movement on site and in the surrounding area;
- Plan deliveries to and from the site during day time hours;
- Respect scheduled working hours (7:00 am- 6:00pm) and avoid night-time work;
- Avoid construction works on Sundays and public holidays;
- Inform site staff and workers on the impact of noise and the applicable regulatory requirements;
- Provide workers with noise protection equipment and enforce their use;
- Conduct regular noise monitoring to ensure that noise emissions are compliant with national standards (Decision 52/1, provided in Appendix D);
- Notify the residents of the plans and expected duration prior to initiating the works, in conjunction with concerned municipalities; and
- Establish a noise complaint grievance mechanism as a measure to allow implementation of timely and effective actions to minimize noise impacts on downwind receptors.

Implementing the aforementioned mitigation measures will result in **Minor Consequences (2)**, of a **High Likelihood (3)**, giving **Medium Significance (2H=6)**.

5.5.3 Impacts during Operation

Table 5-14 below provides rating of potential noise impacts during the operation phase before and after applying mitigation measures, respectively.

Table 5-14 Consequence Assessment of Noise Impacts during Operation Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Noise from standby power generators (at the level of pumping stations)	Before Mitigation	N/D	L	L	L	O	R	2. Minor
	After Mitigation	N/D	L	L	L	O	R	2. Minor
Noise from the normal operation and maintenance of pumping stations and sewage networks	Before Mitigation	N/D	L	L	L	O	R	2. Minor
	After Mitigation	N/D	L	L	L	O	R	1. Negligible

5.5.3.1 Noise from Standby Generators

During the operation stage, standby power generators are likely to generate elevated noise levels, perceptible to nearby receptors. Considering that the generators at each pumping station are enclosed in soundproof canopies, and not at a close proximity to sensitive receptors, noise will not majorly affect visitors, employees and adjacent receptors.

As such, the noise impact from standby power generators operation, at the level of pumping stations, is of **Minor Consequences (2)** and **Moderate Likelihood (2)** of occurrence, resulting in **Medium Significance (2M=4)**.

The following additional mitigation measures are proposed to be adopted and implemented by the appointed Operator:

- Fit generators with exhaust silencers;
- Ensure proper operation and a regular maintenance schedule of generators, as per manufacturer specifications; and
- Conduct regular noise monitoring around pumping stations perimeters and at identified sensitive receptors to ensure that noise emissions are compliant with national standards (Decision 52/1).

If the above measures are applied, noise impact from generators will be of **Minor Consequence (2)** and **Low Likelihood (1)**, resulting in **Low Significance (2L=2)**.

5.5.3.2 Noise from Normal Operation and Maintenance of Pumping Stations and Sewage Networks

Noise is expected to arise from the operation of pumping stations and from the usage of equipment during the maintenance period of the stations and the wastewater network.

Noise impact will be of **Minor Consequence (2)** and **Low Likelihood (1)**, resulting in **Low Significance (2L=2)**.

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

- Design the pumping stations to have properly noise insulated walls;
- Regular maintenance of the stations pump-sets, as per manufacturer specifications;
- Notify nearby residents of the networks maintenance plans and the expected duration prior to initiating the works, in conjunction with the concerned municipalities;
- Avoid idling of equipment and generators when not in use; and
- Equip all internal combustion engine-driven equipment with intake and exhaust mufflers.

Noise impact will be of **Negligible Consequence (1)** and **Low Likelihood (1)**, resulting in **Low Significance (1L=1)**.

5.6 POTENTIAL IMPACTS ON SOIL AND GROUND WATER

5.6.1 Sources of Potential Impacts

The primary sources of impacts on soil and groundwater from the various Project activities are listed in below Table 5-15.

Table 5-15 Potential Impacts on Soil and Groundwater

Source of Change (Project Activities)	Cumulative Sources of Impact
Construction • Site clearance, trenching, excavation, backfilling, grading, and compaction activities • Accidental spills or leaks of fuel and oil from machinery, generators and vehicles during construction and maintenance • Inadequate solid waste management • Inadequate wastewater management Operation • Accidental spills or leaks of fuel from onsite fuel storage and operation and maintenance activities • Potential contamination of soil and groundwater resources from wastewater overflows and/or leakages	Groundwater pollution due to prolonged disposal of untreated sewage into septic tanks/ cesspools in addition to deteriorated wastewater networks causing leakages of raw sewage, as well as industrial and agricultural sources, spills, etc. in the project surrounding

5.6.2 Impacts during Construction

Table 5-37 below provides rating of potential impacts on soil and groundwater during the construction phase before and after applying mitigation measures respectively.

Table 5-16 Consequence Assessment of Soil and Ground Water during Construction Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Temporary or permanent change in topography, soil erosion and collapse from grading, trenching, or excavation works	Before Mitigation	N/I	H	L	L	C	I	4. Major
	After Mitigation	N/I	M	L	L	C	I	3. Moderate
Accidental spills of fuel, oil and chemicals	Before Mitigation	N/D	H	G	L	C	I	5. Critical
	After Mitigation	N/D	L	L	M	C	I	3. Moderate
Inadequate solid waste management	Before Mitigation	N/D	H	L	L	C	R	4. Major
	After Mitigation	N/D	M	L	L	C	R	3. Moderate
Inadequate wastewater management	Before Mitigation	N/D	M	L	M	C	R	3. Moderate
	After Mitigation	N/D	L	L	S	C	R	1. Negligible

5.6.2.1 Temporary or Permanent Change in Topography, Soil Erosion and Collapse from Grading, Trenching, or Excavation

Potential impacts from physical disturbance of underlying soils at work sites include physical compaction, erosion, and reduction in porosity and loss of permeability.

Excavation works at proposed pumping station sites and trenching works for the additional sewer lines will result in direct disturbance of soil including localized alteration of the soil profile within the excavation/trench footprint, and soil compaction in the immediate vicinity as a result of vehicle and construction equipment operations.

Soil compaction is also a vital part of the construction process. It is used for support of the building foundation, roadways, walkways, and retaining walls. The compaction process consists of mechanically densifying a soil by pressing the soil particles together into a close state of contact with air being expelled from the soil mass in the process. When soil particles are forced together by compaction, both the number of voids contained in the soil mass and the size of the individual void spaces are reduced. This change in voids has an obvious effect on the movement of water through the soil. One effect is to reduce the permeability, thus reducing the seepage of water.

Given the impact on soil is long-term and irreversible, the impact is classified as having **Major Consequence (4)** and **High Likelihood (3)** of occurrence; this results in a **High Significance (4H=12)**.

Mitigation measures should be adopted by the site Contractor to reduce the significance of potential impacts; these include:

- Ensure international standards (i.e. ASTM Soil Compaction Standards) are met during any excavation works, compaction and grading activities, in order to minimize expected disturbance during the construction phase;
- Manage fixed routes for equipment movement and avoid multiple routes; and
- Re-use excavated/cut materials as general fill where considered suitable.

If the above mitigation measures are taken into consideration, the potential impacts from excavation and soil compaction would be reduced to **Moderate Consequence (3)** rating with **Moderate Likelihood (2)**, as such the significance level will then be a **Medium Significance (3M=6)**.

5.6.2.2 *Impacts from Accidental Spills of Fuel, Oil and Chemicals*

The major potential sources of accidental spills that might be incurred from the construction of the proposed Project include chemicals, diesel supplies, lubricating oils, among others, as part of routine equipment and generators operations and maintenance during the construction phase.

These spills might contain compounds such as benzene, toluene, ethyl-benzene and xylene (BTEX), or compounds of methyl tertiary butyl ether (MTBE). These aromatic hydrocarbons tend to readily evaporate from surface spills and biodegrade under aerobic and anaerobic conditions given their relatively good solubility and volatility, particularly MTBE and benzene. Spills consisting of BTEX; Poly Aromatic Hydrocarbons (PAHs), chlorinated hydrocarbons (CHs), as well as heavy metals such as Nickel, Copper, Chromium and Zinc persist in the receiving environment, and when mixed with soil, they tend to adhere and accumulate due to their low evaporation and biodegradability.

Since excavation will not be close to the groundwater level that is not shallow within the study area, the groundwater will be at moderate levels of risk in case of any spill.

The impact of potential spills will be long-term, with a **Critical Consequence (5)** and **Low Likelihood (1)** of occurrence, thus resulting in a **Medium Significance (5L=5)**.

There are several mitigation measures that should be incorporated during the construction stage to minimize impacts from potential spills and leaks, and even prevent them from occurring. Below is a minimum list of required mitigation measures:

- Good housekeeping practices through handling and storage of chemicals, oil, fuels and lubricants within containment facilities (e.g. bonded areas, leak-proof trays) designed to prevent the release of spills/leaks to the soil and groundwater environment;
- Maintenance schedule should be in place as part of the inspection procedures of all equipment/ generators/ machinery for risk minimization;
- Maintenance of machines and equipment should take place off-site or onsite in a well-contained area with impermeable concrete pavement and drainage for vehicle washing and maintenance;
- Oil spill response kits should be available wherever oils are being used/stored;
- Promote awareness among workers on how to handle oil/lubricants;
- Train workers how to clean up small-scale spills;

- Ensure drip trays are present when re-fuelling;
- Prepare a Spill Emergency Plan specific for the Project; and
- In case of spill:
 - Immediately incident reporting to the concerned authorities;
 - Contain the source of spill (close valve, seal pipe, seal hole or as appropriate);
 - Check for hazardous flammable materials on site;
 - Prompt clean-up of the spill by removing affected top soil layer by trained employees who should be equipped with appropriate tools and Personal Protective Equipment (PPE);
 - Treat and contain the removed soil as hazardous waste; and
 - Adopt, to the extent possible, dry cleaning techniques to decrease resulting wastewater, and to avoid flushing of spills to deeper soil layers.

Once the above is applied, the impacts of leaks/spills will become of **Moderate consequence (3)** and **Low Likelihood (1)** of occurrence; resulting in a **Low Significance (3L=3)**.

5.6.2.3 *Impacts from Inadequate Solid Waste Management*

As mentioned in previous sections, construction activities are likely to generate considerable volumes of solid wastes of various types. Inappropriate waste handling and disposal practices may potentially result in soil and groundwater contamination due to leaching and runoffs.

Poor Waste Management will have a **Major consequence (4)** with **Moderate Likelihood (2)** if no mitigation measures are in place, resulting in a **Medium Significance (4M=8)**.

The potential impact resulting from poor waste management should be reduced by implementing the following measures:

- Segregate at source domestic-like wastes and construction wastes that can be reused onsite from those that need to be transferred for treatment or disposal;
- Sort excavation waste resulting from construction activities into different types (bulky aggregates, fine aggregates, etc.);
- Reuse part of the excavation waste in backfilling; and dispose of the rest (if any) in an adopted/authorized construction and demolition waste dump;
- Material stockpiles should be of certain heights, slopes and be well covered and contained;
- Schedule the works during dry season, when possible;
- Progressively carry out rehabilitation of disturbed areas following completion of works at all construction sites (rehabilitation will include reinstatement of soil, surface leveling, re-vegetation and mulching, where applicable); and
- Ensure that standards of “good housekeeping” are maintained (i.e., avoid littering, prevent storage of combustible waste for more than 24 hours to prevent attraction of pests and flies).

Once the above are applied, the impact will be reduced to **Moderate Consequence (3)** with **Low likelihood (1)** resulting in a **Low Significance (3L=3)**.

5.6.2.4 *Impacts from Inadequate Wastewater Management*

If inappropriate sanitary facilities for construction site labor are not provided and no strict rules of sanitation are maintained, domestic wastewater may find its way into the underlying soils and eventually, groundwater. If septic tanks used for sanitary facilities are not leak-proof, leakages may result in gradual pollution of groundwater resources given the Project area is found to be partially on a karstic aquifer (C4-C5 geological formation).

Based on the above, the impact from inadequate storage and disposal of wastewater during construction is considered to have a **Moderate consequence** with **High likelihood**, resulting in a **Medium Significance (3M=9)**.

To ensure that no groundwater contamination results from poor wastewater management, the below should be taken into consideration by the awarded Contractor:

- Ensure all connections are inspected and are not leaking through the regular inspection of septic/ holding tanks (if any) and connections to the wastewater sewage network;
- Obtain a permit from the Municipality or the relevant Water Establishment to transport and discharge the domestic wastewater to an operating treatment facility; and
- Restrict vehicle washing to contained maintenance areas offsite or onsite with impermeable concrete pavement and proper drainage.

With the above measures being implemented, the impact will become of **Negligible Consequence (1)** with **Low Likelihood (1)**, resulting in a **Low Significance (1L=1)**.

5.6.3 *Impacts during Operation*

Table 5-17 below provides rating of potential impacts on soil and groundwater during the operation phase before and after applying mitigation measures respectively.

Table 5-17 Consequence Assessment of Soil and Groundwater during Operation Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Accidental Spills of Fuel, Oil and Chemicals	Before Mitigation	N/D	H	G	L	O	I	5. Critical
	After Mitigation	N/D	L	L	M	O	R	2. Minor
Potential contamination from wastewater overflows and/or leakages	Before Mitigation	N/D	H	L	M	O	R	4. Major
	After Mitigation	N/D	M	L	M	O	R	3. Moderate

5.6.3.1 Accidental Spills or Leaks of Fuel from Onsite Fuel Storage and Operation and Maintenance Activities

The major potential sources of accidental spills include the refueling of diesel supplies and lubricating oils, as part of routine generators operation and maintenance, during the operation phase. Private generators will be located in an allocated area along with the fuel tanks. It is planned to have the fuel tanks in a bunded area.

The likelihood of the impact occurring is classified of a **Critical Consequence (5)** and of **Low Likelihood (1)** resulting in a **Medium Significance (5L=5)**.

Accidental spills and leaks should be further minimized if the below is taken into consideration:

- No storage tank should be used for the storage of fuel, oil or chemicals unless its material and construction are compatible with the type of materials to be stored and storage conditions (e.g. pressure and temperature);
- Drip trays should be installed underneath diesel generators and fuel storage tanks to intercept leakages;
- Recordkeeping of all fuel, oil, chemicals, and diesel quantities used onsite;
- Reduce the frequency of refueling activity by filling the tanks to the maximal capacity during each refueling operation;
- Ensure that the maintenance schedule and checklist already prepared is being efficiently used;
- Check tank levels prior to delivery to prevent overfilling through side glass or manually by dipstick logs;
- Establish a Spill Response Plan in place;
- Ensure a supply of suitable absorbent materials is available at re-fueling points for use in dealing with minor spills. If a leak or spill occurs during loading or offloading operations, the operations will be stopped and the spill will be contained, cleaned up and collected based on the Spill Response Plan; and
- Ensure that personnel assigned to handle chemicals/oil/fuel are well aware of the requirements. They should be trained prior to commencing their duties.

With the proper mitigation measures in place, the impact is characterized as having **Minor Consequence (2)** with **Low Likelihood (1)**, resulting in a **Low Significance (2L=2)**.

5.6.3.2 Potential Contamination from Wastewater Overflows and/or Leakages

During the operation phase of the wastewater networks and pumping stations, sudden malfunctioning or downtime are expected to take place. Prolonged power outages and improper operation and maintenance of operating systems might lead to a relatively higher frequency of malfunctions. These all result in possible overflows of raw wastewater and/or leakages from the networks into underlying soils and eventually, groundwater.

Based on the above, the impact from inadequate storage and disposal of wastewater during construction is considered to have a **Major consequence (4)** with **High likelihood (3)**, resulting in a **High Significance (4H=12)**.

Measures should be adopted to eliminate and/or reduce soil, groundwater and indirect impacts on water resources from sudden overflows or leakages of raw wastewater due to technical malfunctions and/or prolonged power outages. These include:

- Ensure proper engineering design of the pumping stations (sizing of wet wells, pump-sets, and provision of a wastewater overflow emergency/bypass line);
- Ensure prompt repair of pumping stations in case of failure to minimize the resulting impact on soil and water resources;
- Proper operation and maintenance procedures for all operating components (networks and pumping stations);
- Continuous monitoring of any signs of leakages or overflows;
- Maintain continuous supply of power (for pumping stations) to prevent possible overflows and downtime; and
- Ensure sewage network manholes are closed with proper lids to prevent blockages from fallen bulky objects.

If proper implementation of the above measures is ensured, the predicted impacts will become a **Moderate Consequence (3)** with a **Moderate Likelihood (2)**, resulting in a **Medium Significance (3M=6)**.

5.7 POTENTIAL IMPACTS ON BIOLOGICAL ENVIRONMENT

5.7.1 Sources of Potential Impacts

The primary sources of impacts on the biological environment from the various Project activities are listed in Table 5-18 below.

Table 5-18 Potential Impacts on the Biological Environment

Source of Change (Project Activities)	Cumulative Sources of Impact
Construction Damage to biological environment from: • Site clearance, excavation and construction activities • Elevated noise levels from works and employed machinery and equipment • Increased traffic • Transportation of building material, equipment and waste • Inadequate disposal of solid waste and wastewater	Inadequate disposal of solid waste (open dumps) and untreated wastewater in the surrounding area
Operation Damage to biological environment from: • Elevated noise levels from the operation of generators and pumping stations • Leakage of wastewater	

5.7.2 Impacts during Construction

Table 5-19 below provides rating of potential impacts on the biological environment during the construction phase before and after applying mitigation measures respectively.

Table 5-19 Consequence Assessment of Impacts on the Biological Environment during Construction Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Excavation and construction activities and associated traffic and waste disposal	Before mitigation	N/D	L	L	M	C	R	2.Minor
	After mitigation	P/D	-	-	-	-	-	Beneficial

Potential negative impacts on biodiversity during plant construction are summarized in Table 5-20.

Table 5-20 Potential Negative Impacts on Biodiversity

Impact	Cause
Loss or destruction of trees and plants	Construction works
Altered abiotic/site factors	Soil compaction, erosion
Mortality of individuals	Destruction of vegetation
Disturbance to wildlife	Construction noise, traffic, or presence of people, and disposal of waste

Based on the description of the biological environment, the anticipated project will not lead to significant negative impacts on biodiversity except for the removal of some trees at the pumping stations sites PS-2 and PS-6, and disturbance to wildlife including birds living or crossing near the Qaraoun Lake. The main construction activities having negative results on biodiversity are earth-moving activities, generation and inadequate disposal of domestic and construction waste material and wastewater effluent discharges.

The potential impact of construction activities on biodiversity is considered to have **Minor Consequence (3)** and **High Likelihood (3)**, resulting in **Medium Significance (2H=6)**.

Recommended mitigation measures to minimize or eliminate construction impacts on biodiversity at the proposed location include:

- Minimize disturbance of natural land by excavating and constructing necessary areas of land only;
- Prohibition of unnecessary cutting or damaging of wild plants and trees, specifically the wild species;

- Since a number of trees will be removed, native trees should be planted in areas surrounding the sites or in landscaped areas within the sites;
- Reforestation of areas surrounding the sites should be executed in cooperation with reforestation organizations;
- Native trees, shrubs and herbs (available at native nursery) to adopt in the landscape plan in order to enhance the visual aspect of the facilities and play a role of reintroduction of native plant species to the area include:
 - *Cedrus Libani*
 - *Juniperus excels*
 - *Juniperus oxycedrus*
 - *Juniperus drupacea*
 - *Pinus pinea*
 - *Acer hermoneum*
 - *Acer syriacum*
 - *Laurus nobilis* (good for hedges)
 - *Ostrya carpinifolia*
 - *Quercus calliprinos*
 - *Crateagus azarolus* or *monogyna*
 - *Malus trilobata*
 - *Prunus ursine*
 - *Pirus syriaca*
 - *Rosa canina*
 - *Lonicera etrusca* (climber)
 - *Origanum syriacum*
- Avoid construction works during the bird migration seasons;
- Proper disposal of domestic and construction waste at designated sites;
- Enclosing all fine earth materials during transportation to and from the site to prevent spillage and dusting; and
- Proper storage and prompt transportation of construction material to prevent them from being washed away during rainfall or carried by wind.

With these mitigation measures in place, the potential impact of construction activities on biodiversity becomes **Beneficial (+)** with **Moderate Likelihood (2)**, leading to an overall **Beneficial Significance (B++)**.

5.7.3 Impacts during Operation

Table 5-21 below provides rating of potential impacts on the biological environment during the operation phase before and after applying mitigation measures respectively.

Table 5-21 Consequence Assessment of the Biological Environment during Operation Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Normal operation of networks, pumping stations and generators	Before mitigation	N/D	L	L	L	O	R	2. Minor
	After mitigation	P/I	-	-	-	-	-	Beneficial

The main impacts during operation are summarized in Table 5-22.

Table 5-22 Potential Negative Impacts on Biodiversity

Impact	Cause
Increased human intervention	Operation and maintenance works
Air and Soil pollution	Improper disposal of liquid and solid waste
Water pollution	Leakage of wastewater
Disturbance to fauna	Operation noise, traffic, or presence of people
Threat to planted native species	By weeds and invasive species

The potential impact of the proposed project's operation is considered of **Minor Consequence (2)** and **Low Likelihood (1)**, resulting in a **Low Significance (2L=2)**.

Recommended mitigation measures to minimize the impacts on biodiversity at the proposed locations include:

- Include native species in the landscape plan;
- Management of landscaping plan to prevent growth of weeds and exotic species, allow propagation and survival of native species and replanting trees to replace the ones that are removed or die;
- Proper management of liquid and solid waste generated by the project;
- Prevention of littering in the area;
- Control hunting within the project area.

With these mitigation measures in place, the potential impact of project operation on biodiversity becomes of **Beneficial Consequence (+)** with **Moderate Likelihood (2)**, leading to an overall **Beneficial Significance (B++)**, especially at the level of the Litani River and Qaraoun Lake that will be protected from wastewater pollution, thus reducing impacts on their living environment and species.

5.8 POTENTIAL IMPACTS ON TRAFFIC

5.8.1 Sources of Potential Impacts

The primary sources of traffic impacts from the Project activities are listed in Table 5-23.

Table 5-23 Potential Impacts on Traffic

Source of Change (Project Activities)	Cumulative Sources of Impact
Construction Increase in traffic during construction (mainly at the level of sewage networks and pumping stations adjacent to the public roads) for the transport of materials and waste to the sites	Existing traffic
Operation Increase in traffic during maintenance works (mainly at the level of sewage networks and pumping stations adjacent to the public roads)	

5.8.2 Impacts during Construction

Table 5-24 below provides rating of potential traffic impacts during the construction phase before and after applying mitigation measures, respectively.

Table 5-24 Consequence Assessment of Traffic during Construction Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Increase in traffic during construction (mainly at the level of sewage networks and pumping stations adjacent to the public roads)	Before Mitigation	N/D	M	L	M	C	R	3. Moderate
	After Mitigation	N/D	L	L	M	C	R	2. Minor

The construction phase requires the transport of heavy machinery and equipment, construction materials and wastes, in addition to the workforce. Vehicles transporting materials and wastes may need several trips to the construction sites per day, which may increase the traffic volume on the roads leading to these sites, namely during peak hours. Areas in the direct vicinity of the Project construction sites will experience an increase in traffic volume due to the deployment of construction vehicles, transport vehicles and equipment. All roads adjacent to the additional sewer pipelines installation works will be subject to partial or total closure for the duration of the construction period and may cause increased travel times for commuters traveling through the Project area because of lengthy detours or diversions.

The impact on traffic during the construction phase is considered to be of **Moderate Consequence (3)** and **High Likelihood (3)**, resulting in a **Medium Significance (3H=9)**.

Recommended mitigation measures to be taken by the awarded Contractor to reduce impacts on traffic include:

- Limit speed on the construction sites to 20 km/h unless otherwise advised, and adopt careful logistical and route planning;
- Position any necessary traffic diversion signs and devices correctly. Signs and devices should be clearly displayed in the Arabic and English languages. Temporary traffic signals and signs should be employed to warn of hazards and provide directions, especially on narrow one-lane roads;
- Coordinate with the concerned municipalities with respect to the planned road blockages, detours or diversion, and the scheduling of the construction works including material delivery, waste transfer, truck movement and other machinery operations in order to limit the disruption to the neighborhood from traffic inconveniences and traffic flow and to minimize noise and dust generation;
- Follow a specific schedule for transport to avoid interference with peak traffic hours and minimize disturbance/delay to commuters at rush hours on the roads leading to the Project construction sites; and
- Fill up all holes and trenches, and level all mounds and heaps of earth, and exposed surface reinstatement, which have been excavated or made in connection with the works immediately upon completion of any part of the works.

Once the above recommendations are in place, the impact will become of **Minor Consequence (2)** and **Moderate Likelihood (1)**, resulting in a **Medium Significance (2M=4)**.

5.8.3 Impacts during Operation

Table 5-25 below provides rating of potential traffic impacts during the operation phase before and after applying mitigation measures, respectively.

Table 5-25 Consequence Assessment of Traffic during Operation Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Increase in traffic during maintenance works (mainly at the level of sewage networks and pumping stations adjacent to the public roads)	Before Mitigation	N/D	L	L	S	O	R	2. Minor
	After Mitigation	N/D	L	L	S	O	R	1. Negligible

During the operation phase, malfunctioning/failures of the pumping stations and sewage networks, in addition to sudden breakages and overflows, are expected. Maintenance

activities, namely at the level of the sewage networks, are likely to generate traffic disturbances from the road blockages and the development of temporary detours and deviations along public roads.

According to the above, the impact on traffic during operation is considered to be of **Minor Consequence (2)** and **Low Likelihood (1)**, resulting in a **Low Significance (3L=3)**.

To ensure that the maintenance activities do not lead to road congestion in the areas of works, the following is suggested to be implemented by the awarded Contractor:

- Avoid maintenance works during peak traffic hours;
- Display temporary traffic signals and signs to warn of hazards and provide directions especially on narrow one-lane roads; and
- Coordinate with municipal police in case of need for road closure and rerouting to be able to carry out specific maintenance activities, preferably ahead of time.

With the above measures in place, the impact on traffic during operation will become of **Negligible Consequence (1)** and **Low Likelihood (1)**, resulting in a **Low Significance (1L=1)**.

5.9 POTENTIAL IMPACTS ON WATER RESOURCES CONSUMPTION

5.9.1 Sources of Potential Impacts

The primary sources of impacts on water resources from the various Project activities are listed in Table 5-26 below.

Table 5-26 Potential Impacts on Water Resources

Source of Change (Project Activities)	Cumulative Sources of Impact
Construction Water for construction activities and workforce uses	Water consumption from nearby facilities and daily socio-economic activities (residential, commercial, agricultural, industrial, etc.)
Operation Water for housekeeping uses at pumping stations	

5.9.2 Impacts during Construction

Table 5-27 below provides rating of potential impacts on water resources during the construction phase before and after applying mitigation measures, respectively.

Table 5-27 Consequence Assessment on Water Resources Consumption during Construction Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Water for construction activities and domestic use	Before Mitigation	N/D	L	L	S	C	R	1. Negligible
	After Mitigation	N/D	L	L	S	C	R	1. Negligible

In general, water consumption is inevitable at any project site. Generally, water is used for concrete mixing (in case of an onsite mixing), dust suppression using wet techniques, hydro-testing for installed pipelines, and for site labor domestic activities. Particular to concrete mixing, ready-mix concrete will be outsourced from a nearby batching plant and will not take place at the construction sites. Estimations of water demand for construction-related activities are not available at this stage. As for water demand for site workforce, an average of 53 L/capita/d will be needed, assuming no site lodging, compared to the national daily domestic water consumption rate in Lebanon that is around 160 L/capita/d (MoEW, 2010). Nevertheless, as mentioned earlier, there is currently no labor forecast for the construction phase of the proposed Project.

Therefore, the impact on water resources during the construction phase will have **Negligible Consequences (1)** and **High Likelihood (3)**, resulting in a **Low Significance (1H=3)**.

To further limit these impacts during construction, the awarded Contractor should adopt a water saving plan during the construction phase and limit the amount of water used for workforce daily uses.

As such, the impact on water resources during the construction phase will have **Negligible Consequence (1)** and **Moderate likelihood (2)**, resulting in a **Low Significance (1M=2)**.

5.9.3 Impacts during Operation

As mentioned earlier in Section 3.4.2 above, water supply is needed for routine housekeeping activities at the stations premises during the operation of the wastewater pumping stations. No water consumption is expected to be needed for the operation of the wastewater networks, unless occasionally when needed during maintenance works, namely for hydro-testing of newly-replaced pipelines. Thus, water consumption during operation is negligible.

5.10 POTENTIAL IMPACTS ON ENERGY RESOURCES

5.10.1 Sources of Potential Impacts

The primary sources of impacts on energy resources from the various Project activities are listed in Table 5-28 below.

Table 5-28 Potential Impacts on Energy Resources

Source of Change (Project Activities)	Cumulative Sources of Impact
Construction Energy consumption during construction activities (fuel for generators, equipment and vehicles)	Energy consumption from nearby facilities and ongoing daily socio-economic activities (residential, commercial, industrial, etc.)
Operation Energy consumption during operation and maintenance activities (fuel for generators)	

5.10.2 Impacts during Construction

Table 5-29 below provides rating of potential impacts on energy resources during the construction phase before and after applying mitigation measures respectively.

Table 5-29 Consequence Assessment of Energy Resources Use during Construction Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Energy (fuel) consumption during construction activities	Before Mitigation	N/D	M	L	M	C	R	3. Moderate
	After Mitigation	N/D	L	L	M	C	R	2. Minor

The electricity needed during the construction phase will be supplied by EDL public grid (if possible) and will be backed up by onsite power generators, provided by the Contractor, during grid outages. Fuel-fired generators will be equipped with an onsite temporary fuel storage tank. In addition, fuel will be needed to operate machinery, equipment and vehicles that will be operated during the construction stage. Estimations on energy demand in the form of electricity (if electricity from EDL was supplied) and/or fuel are not available at this stage.

The impact on energy resources during construction is expected to be of **Moderate Consequence (3)** and **High Likelihood (3)**, resulting in a **Medium Significance (3M=9)**.

The awarded Contractor should implement an energy saving plan at each work site that includes:

- Use equipment with higher fuel efficiency
- Adopt a periodic inspection and maintenance schedule for power generators and equipment engines, as per manufacturer specifications, and maintain maintenance logs;
- Report and monitor monthly fuel and energy consumption records to keep track of consumption levels and identify overuse;
- Avoid unnecessary idling of vehicles and equipment engines.

With the above measures in place, the impact on energy resources will become of **Minor Consequence (2)** and **High Likelihood (3)**, resulting in a **Medium Significance (2H=6)**.

5.10.3 Impacts during Operation

Table 5-30 below provides rating of potential impacts on energy resources during the operation phase before and after applying mitigation measures, respectively.

Table 5-30 Consequence Assessment of Energy Resources Use during Operation Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Energy consumption during operation	Before Mitigation	N/D	L	L	L	O	R	2. Minor
	After Mitigation	N/D	L	L	L	O	R	2. Minor

The electricity needed for the operation of the pumping stations will be supplied by EDL and will be backed up by private generators during the operation phase.

The impact on energy resources during operation is considered to be of **Minor Consequence (2)**, with **High Likelihood (3)**, resulting in a **Medium Significance (2H=6)**.

To reduce impacts on energy resources, the following mitigation measures can be applied:

- Adopt a periodic maintenance schedule of power generators, as per manufacturer specifications, and maintain maintenance logs;
- Perform regular inspections and maintenance of pumping stations and generators;
- Report and monitor monthly fuel and energy consumption records to keep track of consumption levels and identify overuse;
- Upgrade machines/equipment and generators to more energy efficient technology when rehabilitation or upgrade is considered for the purpose of reducing consumption – consider the installation of solar PV panels for the operation of pumping stations; and
- Switch off all machines/ equipment or any other energy consuming appliances when not in use.

The impact on energy resources during operation following the implementation of mitigation measures is considered to be of **Minor Consequence (2)** and **Moderate Likelihood (2)**, resulting in a **Medium Significance (2M=4)**.

5.11 POTENTIAL IMPACTS ON WASTE GENERATION

5.11.1 Sources of Potential Impacts

The primary sources of impacts of waste generation from the various Project activities are listed in Table 5-31 below.

Table 5-31 Potential Impacts from Waste Generation

Source of Change (Project Activities)	Cumulative Sources of Impact
Construction Construction-related solid and liquid wastes generation	Inadequate solid waste and wastewater management in the Project area
Operation Operation- and maintenance-related solid and liquid wastes generation	

5.11.2 Impacts during Construction

Table 5-32 below provides rating of potential impacts of waste generation during the construction phase before and after applying mitigation measures respectively.

Table 5-32 Consequence Assessment of Waste Generation during Construction Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Construction-related solid and liquid wastes generation	Before Mitigation	N/D	M	L	M	C	R	3. Moderate
	After Mitigation	N/D	L	L	M	C	R	2. Minor

Potential sources of solid and liquid wastes during construction are:

- Construction waste and spoil;
- Surplus materials;
- Machinery, generator and vehicle mechanical spare parts;
- Empty containers;
- Domestic-like solid waste;
- Domestic-like wastewater from site laborers;
- Hydro-test water; and
- Concrete wash-off (cleaning of ready-mix concrete trucks).

As described previously in sections 3.3.7 and 3.3.8, wastewater will be either collected and discharged at the nearest existing manhole connected to the sewage network, or collected into an onsite temporary septic tank that will be regularly emptied by service providers in the area, while every solid waste stream will be collected and handled separately.

The impact on waste generation during construction is considered to be of **Moderate Consequence (3)**, with **High Likelihood (3)**, resulting in a **Medium Significance (3H=9)**.

The potential impacts could be minimized by the following mitigation measures:

- All construction workers and personnel should be responsible for ensuring that standards of "good housekeeping" are maintained. This will include:
 - Clear all rubbish and work associated debris;
 - Sort domestic and general waste into combustible (paper, food, cardboard, and wood) and non-combustible waste (metals, glass, rubble) streams at source by means of suitably labeled containers for safe collection, segregation and handling of all waste streams generated; and
 - Avoid storage of combustible waste for more than 24 hours to prevent attraction of pests and flies.

- Regularly inspect garbage bins;
- Sort and collect hazardous wastes separately from domestic waste. All hazardous waste bags should be properly labeled and stored so as to prevent occupational health hazards;
- Compile log sheets of hazardous wastes, including type, amount and disposal method, to track final destinations and identify opportunities for improvement;
- Transport excavation and construction wastes in covered/closed trucks;
- Regularly inspect and maintain septic tanks (if any) to detect and prevent leaks;
- Ensure that the quality of the hydro-test water is compliant with decision 8/1 for the discharge of wastewater into sewage network or surface water bodies; and
- Collect the concrete wash water in a designated tank and allow for water to evaporate and the concrete to harden to dispose it off with construction waste.

With the suggested mitigation measures, the impact on waste generation during construction is considered to become of **Minor Consequence (2)**, with **High Likelihood (3)**, resulting in a **Medium Significance (2H=6)**.

5.11.3 Impacts during Operation

Table 5-33 below provides rating of potential impacts of waste generation during the operation phase before and after applying mitigation measures respectively.

Table 5-33 Consequence Assessment of Waste Generation during Operation Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Operation-and maintenance-related solid and liquid wastes generation	Before Mitigation	N/D	M	L	L	O	R	3. Moderate
	After Mitigation	N/D	L	L	L	O	R	2. Minor

Potential sources of solid and liquid wastes during construction are:

- Solid wastes from the maintenance of networks and pumping stations;
- Screenings from the cleaning of pumping stations wells; and
- Minimal wastewater from housekeeping practices for the pumping stations.

The impact on waste generation during operation is considered to be of **Moderate Consequence (3)**, with **Moderate Likelihood (2)**, resulting in a **Medium Significance (3M=6)**.

To reduce the impact of waste generation, the following mitigation measures should be implemented:

- Implement the measures suggested in section 5.6.3.1 during maintenance activities;
- Collect the screenings generated from cleaning the wells of the pumping stations and dispose them in a designated dump in coordination and approval of MoE; and
- Provide low toxic or environment-friendly (biodegradable) detergents for general cleaning purposes.

After implementing the suggested mitigation measures, the impact on waste generation during operation is considered to become of **Minor Consequence (2)** and **Moderate Likelihood (2)**, resulting in a **Medium Significance (2M=4)**.

5.12 POTENTIAL IMPACTS ON ARCHAEOLOGY

5.12.1 Sources of Potential Impacts

The primary sources of impacts on archaeology from the various Project activities are listed in Table 5-34 below.

Table 5-34 Potential Impacts on Archaeology

Source of Change (Project Activities)	Cumulative Sources of Impact
Construction Excavation works.	• Uncovered archaeological features in the area.
Operation None	• Unearthed Prehistorical occupation evidence

5.12.2 Impacts during Construction

Table 5-35 below provides rating of potential impacts on archaeology during the construction phase before and after applying mitigation measures respectively.

Table 5-35 Consequence Assessment of Archaeology during Construction Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Potential damage to undiscovered archaeological features during excavation	Before Mitigation	N/D	H	L	M	C	I	4. Major
	After Mitigation	N/D	L	L	M	C	I	2. Minor

The main potential impacts to uncovered Prehistorical occupation and archaeological features will be through potential physical disturbance. Those impacts are considered to be permanent and irreversible.

Assuming no mitigation measures are taken, the impact will have a **Major Consequence (4)** and **High Likelihood (3)** of occurrence, resulting in **High Significance (4H=12)**.

The different components of the Project being located in an area where before present occupation has been identified and that is of a high interest, and since archaeological features of other periods, especially the Byzantine one, might be encountered, it is highly recommended to apply the below mitigation measures in order to reduce impacts on prehistory, archaeology and culture:

- Coordinate with DGA for a survey to be conducted prior to the initiation of works, allowing to identify any possible prehistorical and archaeological remains on the different locations of the Project; and
- Ensure that all crew members and site engineers are made aware of the laws and regulations related to archaeological findings and are capable of identifying any if encountered.

If any material were to be found during the survey, DGA is the only authority to determine the required operations and to give the approval to commence construction works.

During construction, excavation and/or leveling works, the following measures should be applied if any chance finding were to occur:

- Stop construction activities;
- Secure the site to prevent any damage or loss of removable objects;
- Notify the responsible foreman/archaeologist who in turn should notify the DGA (within less than 24 hours);
- DGA will evaluate the find and determine the needed measures to protect it; and
- Construction works could resume only when permission is given from the DGA after the decision concerning the safeguard of the heritage is fully executed.

With proper implementation of mitigation, the impact on archaeology and culture will be reduced to **Minor Consequence (2)** and **Moderate Likelihood (2)** of occurrence, resulting in **Medium Significance (2M=4)**.

5.12.3 Impacts during Operation

No potential impacts on archaeology are anticipated during the project's operation phase.

5.13 POTENTIAL IMPACTS ON SOCIO-ECONOMY

5.13.1 Sources of Potential Impacts

The primary sources of potential impacts on the socio-economic conditions within the Project area from the various Project activities are listed in Table 5-36 below.

Table 5-36 Potential Impacts on Socio-Economy

Source of Change (Project Activities)	Cumulative Sources of Impact
Construction - Creation of new job opportunities - Potential damage to the existing infrastructure - Disturbances from noise and dust generation and traffic - Increased pressure on existing infrastructure (solid waste and wastewater management facilities) Operation - Improvement of overall socioeconomic and environmental conditions of serviced communities and receiving environment from containment of wastewater for ultimate treatment prior to discharge into the environment	- Existing socio-economic activities - Existing pressure on solid waste and wastewater infrastructure

5.13.2 Impacts during Construction

Table 5-37 below provides rating of potential socio-economic impacts during the construction phase before and after applying mitigation measures respectively.

Table 5-37 Consequence Assessment of Socio-Economic Impacts during Construction Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Creation of new job opportunities	Before Mitigation	P/D	H	G	M	C	-	Beneficial
	After Mitigation	-	-	-	-	-	-	-
Damage to the existing infrastructure	Before Mitigation	N/D	H	L	S	C	R	4. Major
	After Mitigation	N/D	M	L	S	C	R	3. Moderate
Disturbances from noise and dust generation and traffic	Before Mitigation	N/D	M	L	S	C	R	3. Moderate
	After Mitigation	N/D	L	L	S	C	R	1. Negligible
Increased pressure on existing infrastructure (solid waste and wastewater management facilities)	Before Mitigation	N/D	M	L	S	C	R	3. Moderate
	After Mitigation	N/D	L	L	S	C	R	1. Negligible

5.13.2.1 Creation of New Job Opportunities

The construction phase will lead to the creation of temporary job opportunities and an increase in the purchase of construction materials and services, resulting in beneficial socio-economic impacts in the region.

As a result, the project will have a positive socio-economic impact having a **Beneficial Consequence (+)** with **High Likelihood (3)**, leading to an overall **Beneficial Significance (B+++)**.

5.13.2.2 *Damage to the Existing Infrastructure*

The network pipelines will be installed along the roads and connected to existing wastewater networks. Potential damage might take place to underlying water supply pipelines, electricity power cables, and telecommunication lines during excavation and trenching works, namely due to faulty construction site practices or lack of coordination with relevant authorities prior to the initiation of works regarding the existence of infrastructure.

With no mitigation measures in place, the impact on existing infrastructure is of **Major Consequence (4)**, with **Moderate Likelihood (2)**, resulting in **Medium Significance (4M=8)**.

Mitigation measures that should be implemented include:

- Trial pits should be executed along the network route to locate the existing infrastructure components;
- Sewer lines should be installed at least² 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-listed mitigation measures in place, the potential impact on existing infrastructure is of **Moderate Consequence (3)**, with **Low Likelihood (1)**, resulting in a **Low Significance (3L=3)**.

5.13.2.3 *Disturbances from Noise and Dust Generation*

As previously noted in sections 5.4.2, 5.5.2, and 5.8.2 above, dust emissions, elevated noise levels, and traffic generated during construction can cause nuisance to the nearby receptors and commuters.

Therefore, disturbances from noise and dust generation and traffic during the construction phase will have **Moderate consequences (3)** and **High likelihood (3)**, resulting in **Medium Significance (3H=9)**.

Nevertheless, if the proposed mitigation measures for dust and noise emissions and traffic impacts are properly implemented, the significance of this impact will be reduced.

Upon implementation of proposed mitigation measures, the impact will become of **Negligible Consequence (1)** and **Moderate Likelihood (2)**, resulting in an overall **Low Significance (1M=2)**.

²Separation distances specified should be measured from the nearest outside edges of the facilities.

5.13.2.4 Increased Pressure on the Existing Infrastructure (Solid Waste and Wastewater Management Facilities)

Excavated material and construction waste that is not recyclable or reusable will be disposed of in permitted dumps in coordination with the Municipality. Domestic-like solid waste generated by construction workers will be disposed of in the nearest curbside waste barrels to be collected by contractors appointed by the Municipality. Wastewater will be collected in temporary septic tanks, which will be emptied as needed, in a location approved by the Municipality.

The increase in pressure on the existing infrastructure during construction is considered to have a **Moderate Consequence (3)** of **High Likelihood (3)**, resulting in a **Medium Significance (3H=9)**.

In order to mitigate the above mentioned impacts, the Project implementing agency – CDR – should ensure the compliance of the awarded Contractor with the proposed waste management plan (refer to Section 5.11.2 above).

Upon implementation of proposed mitigation measures, the impact will become of **Negligible Consequences (1)** and a **Moderate Likelihood (2)**, resulting in an overall **Low Significance (1M=2)**.

5.13.3 Impacts during Operation

Table 5-38 below provides rating of potential impacts on the prevailing socio-economic conditions during the operation phase before and after applying mitigation measures, respectively.

Table 5-38 Consequence Assessment of Socio-Economic Impacts during Operation Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Improvement of overall socioeconomic and environmental conditions of serviced communities and receiving environment from containment of wastewater	Before Mitigation	P/I	H	L	L	O	-	Beneficial
	After Mitigation	-	-	-	-	-	-	-

With reference to the Project needs and objectives presented in section 1.5.2 above, the implementation of the Project will result in an overall positive impact on the area through the construction of new additional sewer lines and wastewater pumping stations, as per of the overall Aitanit Wastewater System.

The project is expected to have a **Beneficial Consequence (+)** with **High Likelihood (3)**, leading to an overall **Beneficial Significance (B+++)**.

5.14 POTENTIAL IMPACTS ON OCCUPATIONAL AND PUBLIC HEALTH AND SAFETY

5.14.1 Sources of Potential Impacts

The primary sources of occupational and public health impacts from the various Project activities are listed in Table 5-39 below.

Table 5-39 Potential Impacts on Occupational and Public Health

Source of Change (Project Activities)	Cumulative Sources of Impact
Construction - Potential risks to general health and safety of the sites' workers, nearby residents, commuters, and pedestrians Operation - Potential occupational health and safety risks to operation and maintenance workers and to nearby receptors, pedestrians, and commuters during maintenance works or from sudden overflows or leakages - Improved public health conditions from the proper management of wastewater	Public health conditions associated with the mismanagement of wastewater

5.14.2 Impacts during Construction

Table 5-40 below provides rating of occupational and public health impacts during the construction phase before and after applying mitigation measures respectively.

Table 5-40 Consequence Assessment of Occupational and Public Health Impacts during Construction Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Potential risks to general health and safety of the sites' workers, nearby residents, commuters, and pedestrians	Before Mitigation	N/D	M	L	M	C	R	3. Moderate
	After Mitigation	N/D	L	L	M	C	R	2. Minor

Working on a construction project entails several health and safety risks that need to be addressed ahead of commencing the construction works. The main sources of health and safety risks include physical injuries and exposure to dust and noise. According to the World Health Organization (WHO), prolonged or excessive exposure to noise can cause hearing impairment; similarly, exposure to dust will have respiratory impacts.

The impact on occupational and public health and safety during construction is considered to have a **Moderate Consequence (3)** and a **Moderate Likelihood (2)**, resulting in a **Medium Significance (3M=6)**.

In order to further ensure that workers' and potential site visitors'/ pedestrians' health and safety are not affected, it is recommended to:

- Surround the construction areas with scaffolding nets;
- Provide sufficient lighting;
- Prohibit keeping trenches unnecessarily open and install barriers to avoid falling and tripping;
- Fence off all construction sites to prevent unauthorized access;
- Keep machinery and vehicles passages clear;
- Implement a speed limit of 20 km/h for vehicles arriving to and leaving the construction sites;
- Provide workers with the appropriate PPE (goggles, dust masks, helmets, hearing protection equipment, proper clothing, safety boots, etc.) and enforce their use;
- Maintain the PPE (cleaning when dirty and replacement when damaged or worn out);
- Ensure the availability of adequate loading and unloading space;
- Prohibit smoking and littering;
- Ensure that an easily accessible first-aid station is provided on-site;
- Post adequate signs at visible locations throughout the construction area indicating type of operation, potential risks, and appropriate medical/emergency action response;
- Perform staff training about the fundamentals of occupational health and safety procedures, and about handling hazardous material containers and related wastes; and
- Implement the required air emissions and noise mitigation measures listed in sections 5.5.2 and 5.4.2 respectively.

After implementing the above mentioned mitigation measures, the impact on occupational and public health and safety is considered to become of a **Minor Consequence (2)** and a **Low Likelihood (1)** of occurrence, resulting in a **Low Significance (2L=2)**.

5.14.3 Impacts during Operation

Table 5-41 below provides rating of occupational and public health impacts during the operation phase before and after applying mitigation measures respectively.

Table 5-41 Consequence Assessment of Occupational and Public Health Impacts during Operation Before and After Applying Mitigation Measures

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Potential health and safety risks to operation and maintenance workers and nearby receptors, pedestrians, and commuters from maintenance works or from sudden overflows or leakages	Before Mitigation	N/D	M	L	S	O	R	3. Moderate
	After Mitigation	N/D	L	L	S	O	R	1. Negligible

Impact/Source		Nature	Magnitude	Extent	Timing	Duration	Reversibility	Consequence Rating
Improved public health conditions from the proper management of wastewater	Before Mitigation	P/I	H	L	L	O	-	Beneficial
	After Mitigation	-	-	-	-	-	-	-

5.14.3.1 Potential Health and Safety Risks to Workers and Nearby Receptors, Pedestrians, and Commuters from Maintenance Works or from Sudden Overflows or Leakages

During the operation phase, malfunctions of the pumping stations or damage to the pipelines are possible. The workers in charge of the maintenance of the stations and the networks will be exposed to odors, hazards and potential injuries.

The impact on occupational and public health and safety during operation is of a **Moderate Consequence (3)** and a **Low Likelihood (1)**, resulting in a **Low Significance (3L=3)**.

The awarded Contractor should implement the following site occupational health and safety measures at each work site that includes:

- Provide workers with the appropriate PPE (goggles, dust masks, helmets, hearing protection equipment, proper clothing, safety boots, etc.) and enforce their use;
- Post adequate signs at visible locations throughout the maintenance area indicating type of operation, potential risks, and appropriate medical/emergency action response;
- Prohibit keeping trenches unnecessarily open and install barriers to avoid falling and tripping;
- Fence all maintenance sites to prevent unauthorized access;
- Store and handle chemicals (if any) as directed by their material safety data sheets and use the required PPEs;
- Conduct regular training for workers about health and safety requirements; and
- Implement the required ambient air emissions and noise mitigation measures above listed in sections 5.4.3 and 5.5.3 respectively.

After implementing the above mentioned mitigation measures, the impact on occupational and public health and safety is considered to become of a **Negligible Consequence (1)** and a **Low Likelihood (1)** of occurrence, resulting in a **Low Significance (1L=1)**.

5.14.3.2 Improved Public Health Conditions from the Proper Management of Wastewater

Proper implementation of the Project and sound operation and maintenance practices of its various components are expected to promote improvement in the public health conditions of communities potentially affected by the prevailing unsanitary management of wastewater.

The Project is expected to have a **Beneficial Consequence (+)** with **High Likelihood (3)**, leading to an overall **Beneficial Significance (B+++)**.

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

A summary of environmental impacts before and after implementation of mitigation measures is provided in Table 5-42 and Table 5-43.

Table 5-42 Impact Summary before Mitigation

Activity / Source of the impact	Receptors									
	Ambient Air Quality	Noise	Soil and Ground Water Resources	Biological Environment	Traffic	Water Resources	Energy Resources	Archaeology	Socio-economy	Occupational and Public Health and Safety
Construction Phase										
Site clearance, excavation, backfilling, and construction activities	9	9	12	6	9	3	9	12	9	6
Operation of equipment and generators	9	9					9		9	6
Accidental spills (fuels/chemicals) and material wash-off			5							
Waste Generation									9	
Inadequate Solid Waste Management			8						9	
Inadequate Wastewater Management			9						9	
Job creation									+++	
Operation Phase										
Operation of pumping stations and networks	6	4		2			6		+++	+++
Malfunctioning, accidental downtime of sewage network and/or pumping stations resulting in raw wastewater overflow	6		12						6	3
Maintenance activities		2	5		3				6	

Table 5-43 Impact Summary after Mitigation

Activity / Source of the impact	Receptors									
	Ambient Air Quality	Noise	Soil and Ground Water Resources	Biological Environment	Traffic	Water Resources	Energy Resources	Archaeology	Socio-economy	Occupational and Public Health and Safety
Construction Phase										
Site clearance, excavation, backfilling, and construction activities	4	6	4	++	4	2	6	4	2	2
Operation of equipment and generators	6	6					6		2	2
Accidental spills (fuels/chemicals) and material wash-off			3							
Waste Generation									6	
Inadequate Solid Waste Management			3						2	
Inadequate Wastewater Management			1						2	
Job creation									+++	
Operation Phase										
Operation of pumping stations and networks	4	2		++			4		+++	+++
Malfunctioning, accidental downtime of sewage network and/or pumping stations resulting in raw wastewater overflow	2		6						4	1
Maintenance activities		1	2		1				4	

6. PUBLIC CONSULTATION

According to existing laws and regulations, international conventions and good practice, including the World Bank's Operational Policy OP 4.01, the public has the right to be properly and timely informed about any type of project that can cause an impact on the environment. In this context, a public announcement (Appendix E) stamped and signed by the concerned Municipalities was posted at Baaloul and Qaraoun Municipalities.

A consultation meeting was held on December 18, 2017 in the quarters of Qaraoun municipality to discuss the findings of the ESMP. Photos from the meeting at the Qaraoun Municipality are provided in Figure 6-1. The consultation presentation is provided in Appendix G.



Figure 6-1 Images from the Consultation Meeting

Around 36 participants representing the following affiliations attended the meeting; the list of participants is available in Appendix F:

- CDR
- Municipalities (Baaloul and Qaraoun)
- MoPH
- The Litani River Authority
- DGA (MoC)
- Bureau Technique pour le Développement (BTD)
- Islamic Charitable Society
- Muslim Scout
- Civil Society
- Al Waleed Trading and Contracting Establishment

In general, the attendees welcomed the Project and acknowledged its positive impacts on the environment as a whole. Below is a summary of the main issues of concern raised during the public participation meeting, summarized in Table 6-1.

Table 6-1 Concerns Raised during the Public Consultation Meeting

Comment/Question	Answer
The construction of additional networks and pumping stations is very essential for the area; however, their operation and regular maintenance are the main issues. The municipalities do not have the required skills or the financial resources to handle the operation and maintenance of such projects; however, they are obliged to fix any damage when the operator of the project does not, even though BWE collects money for O&M of wastewater infrastructure.	• BWE is the operator of the project and responsible for the regular maintenance of the networks and pumping stations. • Regular coordination between the concerned municipalities and BWE should be conducted to ensure proper operation and maintenance of the system. Municipalities are responsible for ensuring the proper arrangements to achieve this (e.g., subcontracting by BWE to the private sector).
The project should take into consideration future increase in population and wastewater generation when estimating the required diameter of wastewater pipes.	The design of the project takes into consideration the increase of wastewater generation for 25 years.
The plots for PS-5 and PS-6 in Baaloul are locations where people go for a walk and they are potential plots for implementing an Environmental Center project. Potential wastewater overflow and odor and noise generation can negatively affect the project.	• Regular maintenance of the pumping stations will be conducted to avoid any disturbances to regular visitors of the site. • Design of the structures and stations and their textural finishes will be selected to be easily integrated and compatible with the surrounding areas.
Baaloul village needs the addition of around 10 km networks and another pumping station.	The project design is taking into consideration the addition of more networks.
The existing pipelines are old and incapable of accommodating the current wastewater quantities and thus, will not be able to accommodate for the additional quantities with the extension of the networks.	According to the design, the networks will be able to accommodate for the additional wastewater quantities.
DGA: the DGA needs to be informed of the plots numbers and the depth of excavation prior to the initiation of works. An official letter should be addressed to DGA by CDR in this respect, and DGA should conduct initial investigations on site, followed by supervision of works during the works.	CDR will ensure proper coordination with DGA at early stages of the project.

7. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

This section presents the proposed Environmental and Social Management Plan (ESMP) for the Project. The ESMP 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;
- 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 ESMP are to:

- 1) Ensure the Project's compliance with Lebanese legislation;
- 2) Provide a basis to carry out monitoring activities and compliance inspection programs; and
- 3) Support the Contractors and relevant stakeholders in the implementation of mitigation and monitoring plans.

The ESMP may be subject to updates and modifications throughout the Project lifetime.

7.1 ENVIRONMENTAL MANAGEMENT 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 mitigation measures for construction and operation impacts are summarized in Table 7-1 and Table 7-2.

Table 7-1 Construction Phase Environmental and Management Plan

Source of Impact	Project Activities	Evaluation of Impact								Mitigation Measures	Residual Impacts	Institutional Responsibility	Cost Estimation
		N	M	E	T	D	R	L	S				
Emissions													
Air Emissions	Combustion exhaust emissions and	N/D	M	L	S	C	R	H	M	- Ensure well designed, maintained, and operated equipment/vehicles. Precautionary control measures for emissions reduction could include proper engine fuel mixtures, regularly serviced exhaust emission systems, suitable engine tuning, and use of low sulfur content diesel, whenever available; - Use environmentally friendly equipment whenever possible (machinery with higher fuel efficiency or equipped with air pollution control devices to minimize exhaust emissions); - Keep a record of maintenance for all machinery, vehicles, and generators on site; - Report and monitor monthly fuel consumption records to keep track of consumption levels and identify overuse; - Avoid unnecessary idling of vehicles and equipment engines; and - Ensure that an effective Maintenance Plan and Schedule is in place for employed site machinery, vehicles, and power generators.	Medium	Implementation: Contractor Supervision: CDR	Part of construction activities cost
	Dust emissions	N/D	M	L	S	C	R	H	M	- Set physical barriers at site boundaries; - Ensure site roads are kept regularly damped down and compacted to minimize dust emissions; - Schedule deliveries of raw materials efficiently; - Wheel-washing of vehicles before departure from construction site; - Cover incoming and outgoing trucks with proper canopies; - Limit vehicular speed onsite to 20 km/h; - Maintain material stockpiles at minimum heights and adequate slopes and ensure that they are covered; - Surround the construction areas with scaffolding nets to control debris and dust from dispersing beyond the construction sites; and - Inform sensitive receptors of the scheduled construction works, ahead of time in conjunction with the concerned municipalities, especially for dust-generating activities.	Medium	Implementation: Contractor Supervision: CDR	Part of construction activities cost
Noise	Noise associated with site preparation, construction activities and operation of on-site generators, heavy machinery, equipment and vehicles	N/D	M	L	M	C	R	H	M	- Fit all machinery, equipment, and vehicles with exhaust silencers where possible; - Ensure proper inspection and maintenance of machinery, vehicles and generators; - Avoid idling and switch off engines when not in use; - Place noisy equipment away from sensitive receptors, behind stockpiles to provide acoustic barriers; - Control speed limits of vehicle movement on site and in the surrounding area; - Plan deliveries to and from the site during day time hours; - Respect scheduled working hours (7:00 am- 6:00pm) and avoid night-time work; - Avoid construction works on Sundays and public holidays; - Inform site staff and workers on the impact of noise and the applicable regulatory requirements; - Provide workers with noise protection equipment and enforce their use; - Conduct regular noise monitoring to ensure that noise emissions are compliant with national standards (Decision 52/1, provided in Appendix D); - Notify the residents of the plans and expected duration prior to initiating the works, in conjunction with concerned municipalities; and - Establish a noise complaint grievance mechanism as a measure to allow implementation of timely and effective actions to minimize noise impacts on downwind receptors.	Medium	Implementation: Contractor Supervision: CDR	- Noise PPEs: Washable and reusable ear plugs: ~1.5 USD/piece or Ear Muffs: ~28 USD/piece - Noise monitoring: 400 USD/Event
Soil and Ground Water Resources	Temporary or permanent change in topography, soil erosion and collapse from grading, trenching, or excavation works	N/I	H	L	L	C	I	H	H	- Ensure international standards (i.e. ASTM Soil Compaction Standards) are met during any excavation works, compaction and grading activities, in order to minimize expected disturbance during the construction phase; - Manage fixed routes for equipment movement and avoid multiple routes; and - Re-use excavated/cut materials as general fill where considered suitable.	Medium	Implementation: Contractor Supervision: CDR	Part of construction activities cost

Source of Impact	Project Activities	Evaluation of Impact								Mitigation Measures	Residual Impacts	Institutional Responsibility	Cost Estimation
		N	M	E	T	D	R	L	S				
	Accidental spills of fuel, oil and chemicals	N/D	H	G	L	C	I	L	M	- Good housekeeping practices through handling and storage of chemicals, oil, fuels and lubricants within containment facilities (e.g. bonded areas, leak-proof trays) designed to prevent the release of spills/leaks to the soil and groundwater environment; - Maintenance schedule should be in place as part of the inspection procedures of all equipment/ generators/ machinery for risk minimization; - Maintenance of machines and equipment should take place off-site or onsite in a well-contained area with impermeable concrete pavement and drainage for vehicle washing and maintenance; - Oil spill response kits should be available wherever oils are being used/stored; - Promote awareness among workers on how to handle oil/lubricants; - Train workers how to clean up small-scale spills; - Ensure drip trays are present when re-fuelling; - Prepare a Spill Emergency Plan specific for the Project; and - In case of spill: - Immediately incident reporting to the concerned authorities; - Contain the source of spill (close valve, seal pipe, seal hole or as appropriate); - Check for hazardous flammable materials on site; - Prompt clean-up of the spill by removing affected top soil layer by trained employees who should be equipped with appropriate tools and Personal Protective Equipment (PPE); - Treat and contain the removed soil as hazardous waste; and - Adopt, to the extent possible, dry cleaning techniques to decrease resulting wastewater, and to avoid flushing of spills to deeper soil layers.	Low	Implementation: Contractor Supervision: CDR	Oil spill response: 80 USD Drip trays: 65 USD
	Inadequate solid waste management	N/D	H	L	L	C	R	M	M	- Segregate at source domestic-like wastes and construction wastes that can be reused onsite from those that need to be transferred for treatment or disposal; - Sort excavation waste resulting from construction activities into different types (bulky aggregates, fine aggregates, etc.); - Reuse part of the excavation waste in backfilling; and dispose of the rest (if any) in an adopted/authorized construction and demolition waste dump; - Material stockpiles should be of certain heights, slopes and be well covered and contained; - Schedule the works during dry season, when possible; - Progressively carry out rehabilitation of disturbed areas following completion of works at all construction sites (rehabilitation will include reinstatement of soil, surface leveling, re-vegetation and mulching, where applicable); and - Ensure that standards of "good housekeeping" are maintained (i.e., avoid littering, prevent storage of combustible waste for more than 24 hours to prevent attraction of pests and flies).	Low	Implementation: Contractor Supervision: CDR	Part of construction activities cost
	Inadequate wastewater management	N/D	M	L	M	C	R	H	M	- Ensure all connections are inspected and are not leaking through the regular inspection of septic/ holding tanks (if any) and connections to the wastewater sewage network; - Obtain a permit from the Municipality or the relevant Water Establishment to transport and discharge the domestic wastewater to an operating treatment facility; and - Restrict vehicle washing to contained maintenance areas offsite or onsite with impermeable concrete pavement and proper drainage.	Low	Implementation: Contractor Supervision: CDR	Part of construction activities cost

Source of Impact	Project Activities	Evaluation of Impact									Mitigation Measures	Residual Impacts	Institutional Responsibility	Cost Estimation
		N	M	E	T	D	R	L	S					
Waste Generation	Construction-related solid and liquid wastes generation	N/D	M	L	M	C	R	H	M	- All construction workers and personnel should be responsible for ensuring that standards of "good housekeeping" are maintained. This will include: - Clear all rubbish and work associated debris; - Sort domestic and general waste into combustible (paper, food, cardboard, and wood) and non-combustible waste (metals, glass, rubble) streams at source by means of suitably labeled containers for safe collection, segregation and handling of all waste streams generated; and - Avoid storage of combustible waste for more than 24 hours to prevent attraction of pests and flies. - Regularly inspect garbage bins; - Sort and collect hazardous wastes separately from domestic waste. All hazardous waste bags should be properly labeled and stored so as to prevent occupational health hazards; - Compile log sheets of hazardous wastes, including type, amount and disposal method, to track final destinations and identify opportunities for improvement; - Transport excavation and construction wastes in covered/closed trucks; - Regularly inspect and maintain septic tanks (if any) to detect and prevent leaks; - Ensure that the quality of the hydro-test water is compliant with decision 8/1 for the discharge of wastewater into sewage network or surface water bodies; and - Collect the concrete wash water in a designated tank and allow for water to evaporate and the concrete to harden to dispose it off with construction waste.	Medium	Implementation: Contractor Supervision: CDR	Part of construction activities cost	
Depletion of Resources														
Biological Resources	Excavation and construction activities	N/D	L	L	M	C	R	H	M	- Minimize disturbance of natural land by excavating and constructing necessary areas of land only; - Prohibition of unnecessary cutting or damaging of wild plants and trees, specifically the wild species; - Since a number of trees will be removed, native trees should be planted in areas surrounding the sites or in landscaped areas within the sites; - Reforestation of areas surrounding the sites should be executed in cooperation with reforestation organizations; - Native trees, shrubs and herbs (available at native nursery) to adopt in the landscape plan in order to enhance the visual aspect of the facilities and play a role of reintroduction of native plant species to the area include: - Cedrus Libani - Juniperus excels - Juniperus oxycedrus - Juniperus drupacea - Pinus pinea - Acer hermoneum - Acer syriacum - Laurus nobilis (good for hedges) - Ostrya carpinifolia - Quercus calliprinos - Crateagus azarolus or monogyna - Malus trilobata - Prunus ursine - Pirus syriaca - Rosa canina - Lonicera etrusca (climber) - Origanum syriacum - Avoid construction works during the bird migration seasons; - Proper disposal of domestic and construction waste at designated sites; - Enclosing all fine earth materials during transportation to and from the site to prevent spillage and dusting; and - Proper storage and prompt transportation of construction material to prevent them from being washed away during rainfall or carried by wind.	Beneficial	Implementation: Contractor Supervision: CDR	Part of construction activities cost	

Source of Impact	Project Activities	Evaluation of Impact								Mitigation Measures	Residual Impacts	Institutional Responsibility	Cost Estimation
		N	M	E	T	D	R	L	S				
Water Resources	Water for construction activities and domestic use	N/D	L	L	S	C	R	H	L	Adopt a water saving plan during the construction phase and limit the amount of water used for workforce daily uses.	Low	Implementation: Contractor Supervision: CDR	Part of construction activities cost
Energy Resources	Energy consumption during construction activities	N/D	M	L	M	C	R	M	M	- Use equipment with higher fuel efficiency - Adopt a periodic inspection and maintenance schedule for power generators and equipment engines, as per manufacturer specifications, and maintain maintenance logs; - Report and monitor monthly fuel and energy consumption records to keep track of consumption levels and identify overuse; - Avoid unnecessary idling of vehicles and equipment engines.	Medium	Implementation: Contractor Supervision: CDR	Part of construction activities cost
Other Impacts													
Traffic	Increase in traffic during construction	N/D	M	L	M	C	R	H	M	- Limit speed on the construction sites to 20 km/h unless otherwise advised, and adopt careful logistical and route planning; - Position any necessary traffic diversion signs and devices correctly. Signs and devices should be clearly displayed in the Arabic and English languages. Temporary traffic signals and signs should be employed to warn of hazards and provide directions, especially on narrow one-lane roads; - Coordinate with the concerned municipalities with respect to the planned road blockages, detours or diversion, and the scheduling of the construction works including material delivery, waste transfer, truck movement and other machinery operations in order to limit the disruption to the neighborhood from traffic inconveniences and traffic flow and to minimize noise and dust generation; - Follow a specific schedule for transport to avoid interference with peak traffic hours and minimize disturbance/delay to commuters at rush hours on the roads leading to the Project construction sites; and - Fill up all holes and trenches, and level all mounds and heaps of earth, and exposed surface reinstatement, which have been excavated or made in connection with the works immediately upon completion of any part of the works.	Medium	Implementation: Contractor Supervision: CDR	Part of construction activities cost
Archaeology	Potential damage to undiscovered archaeological features during excavation	N/D	H	L	M	C	I	H	H	- Coordinate with DGA for a survey to be conducted prior to the initiation of works, allowing to identify any possible prehistorical and archaeological remains on the different locations of the Project; and - Ensure that all crew members and site engineers are made aware of the laws and regulations related to archaeological findings and are capable of identifying any if encountered. - If any material were to be found during the survey, DGA is the only authority to determine the required operations and to give the approval to commence construction works. - During construction, excavation and/or leveling works, the following measures should be applied if any chance finding were to occur: - Stop construction activities; - Secure the site to prevent any damage or loss of removable objects; - Notify the responsible foreman/archaeologist who in turn should notify the DGA (within less than 24 hours); - DGA will evaluate the find and determine the needed measures to protect it; and - Construction works could resume only when permission is given from the DGA after the decision concerning the safeguard of the heritage is fully executed.	Medium	Implementation: Contractor Supervision: CDR, DGA	Part of construction activities cost
Socio-economic	Creation of new job opportunities	P/D	H	G	M	C	-	H	B	-	-	-	-

Source of Impact	Project Activities	Evaluation of Impact									Mitigation Measures	Residual Impacts	Institutional Responsibility	Cost Estimation
		N	M	E	T	D	R	L	S					
	Damage to the existing infrastructure	N/D	H	L	S	C	R	M	M	- Trial pits should be executed along the network route to locate the existing infrastructure components; - Sewer lines should be installed at least³ 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.	Low	Implementation: Contractor Supervision: CDR	Part of construction activities cost	
	Disturbances from noise and dust generation and traffic	N/D	M	L	S	C	R	H	M	Properly implement the mitigation measures proposed for dust and noise emissions and traffic.	Low	Implementation: Contractor Supervision: CDR	Part of construction activities cost	
	Increased pressure on existing infrastructure	N/D	M	L	S	C	R	H	M	The Project implementing agency – CDR - will ensure the compliance of the awarded Contractor with the proposed waste management plan (refer to Section 5.11.2 above.	Low	Implementation: Contractor Supervision: CDR	Part of construction activities cost	
Health and Safety Hazards	Potential risks to general health and safety of the sites’ workers, nearby residents, commuters, and pedestrians	N/D	M	L	M	C	R	M	M	- Surround the construction areas with scaffolding nets; - Provide sufficient lighting; - Prohibit keeping trenches unnecessarily open and install barriers to avoid falling and tripping; - Fence off all construction sites to prevent unauthorized access; - Keep machinery and vehicles passages clear; - Implement a speed limit of 20 km/h for vehicles arriving to and leaving the construction sites; - Provide workers with the appropriate PPE (goggles, dust masks, helmets, hearing protection equipment, proper clothing, safety boots, etc.) and enforce their use; - Maintain the PPE (cleaning when dirty and replacement when damaged or worn out); - Ensure the availability of adequate loading and unloading space; - Prohibit smoking and littering; - Ensure that an easily accessible first-aid station is provided on-site; - Post adequate signs at visible locations throughout the construction area indicating type of operation, potential risks, and appropriate medical/emergency action response; - Perform staff training about the fundamentals of occupational health and safety procedures, and about handling hazardous material containers and related wastes; and - Implement the required air emissions and noise mitigation measures listed in sections 5.5.2 and 5.4.2 respectively.	Low	Implementation: Contractor Supervision: CDR	PPEs Prices/ person: Overall ~12 USD Boots ~100 USD Helmet ~ 5 USD PVC Gloves ~2 USD Welding Gloves ~ 4USD Goggles ~ 3 USD Mask ~8 USD Reusable ear plugs ~1.5 USD Ear Muffs ~28 USD First Aid Kit (for 100 workers) ~200 USD	

³Separation distances specified should be measured from the nearest outside edges of the facilities.

Table 7-2 Operation Phase Environmental and Social Management Plan

Source of Impact	Project Activities	Evaluation of Impact								Mitigation Measures	Residual Impacts	Institutional Responsibility	Cost Estimation
		N	M	E	T	D	R	L	S				
Emissions													
Air Emissions	Combustion and exhaust emissions	N/D	L	L	L	O	R	H	M	- Ensure proper operating conditions and regular maintenance of the generators as per manufacturer specifications; - Ensure that the specifications of the generators are in line with national standards (Decision 8/1 dated 2001) through one of the following: - Compliance in terms of air pollutant emissions through regular monitoring; or - Ensuring that effective generator stack heights are in place. The formula for determining the stack height is: H= h + 0.2 √KVA Where: ✓ H = Total stack height in meters ✓ h = Height of neighboring building in meters (within 50 m radius) ✓ KVA= Total generator capacity of the set in kVA = kW, i.e. the total capacity which is determined by the maximum fuel (energy) input	Medium	BWE and concerned Municipalities	Generators emissions: 500 USD/Event
	Foul odor emissions	N/D	M	L	L	O	R	M	M	- Ensure proper engineering design of the pumping stations (sizing of wet wells, pump-sets, and provision of a wastewater overflow emergency/bypass line); - Ensure prompt repair of pumping stations in case of failure to minimize the resulting impact on soil and water resources; - Provide adequate ventilation with a carbon filter to control odors. The ventilation pipes must be extended above the highest point of the station building by three (3) meters; - Ensure that a regular inspection and maintenance schedule is in place for the stations; and - Establish an odor complaint grievance mechanism as a measure to allow implementation of timely and effective actions to minimize impacts from odors on downwind receptors.	Low	BWE and concerned Municipalities	Activated carbon filter: 2,000 USD
Noise	Noise from standby power generators	N/D	L	L	L	O	R	M	M	- Fit generators with exhaust silencers; - Ensure proper operation and a regular maintenance schedule of generators, as per manufacturer specifications; and - Conduct regular noise monitoring around pumping stations perimeters and at identified sensitive receptors to ensure that noise emissions are compliant with national standards (Decision 52/1).	Low	BWE and concerned Municipalities	Part of operations activities cost
	Noise from the normal operation and maintenance activities	N/D	L	L	L	O	R	L	L	- Design the pumping stations to have properly noise insulated walls; - Regular maintenance of the stations pump-sets, as per manufacturer specifications; - Notify nearby residents of the networks maintenance plans and the expected duration prior to initiating the works, in conjunction with the concerned municipalities; - Avoid idling of equipment and generators when not in use; and - Equip all internal combustion engine-driven equipment with intake and exhaust mufflers.	Low	BWE and concerned Municipalities	Part of operations activities cost

Source of Impact	Project Activities	Evaluation of Impact								Mitigation Measures	Residual Impacts	Institutional Responsibility	Cost Estimation
		N	M	E	T	D	R	L	S				
Soil and Ground Water Resources	Accidental Spills of Fuel, Oil and Chemicals	N/D	H	G	L	O	I	L	M	- No storage tank should be used for the storage of fuel, oil or chemicals unless its material and construction are compatible with the type of materials to be stored and storage conditions (e.g. pressure and temperature); - Drip trays should be installed underneath diesel generators and fuel storage tanks to intercept leakages; - Recordkeeping of all fuel, oil, chemicals, and diesel quantities used onsite; - Reduce the frequency of refueling activity by filling the tanks to the maximal capacity during each refueling operation; - Ensure that the maintenance schedule and checklist already prepared is being efficiently used; - Check tank levels prior to delivery to prevent overfilling through side glass or manually by dipstick logs; - Establish a Spill Response Plan in place; - Ensure a supply of suitable absorbent materials is available at re-fueling points for use in dealing with minor spills. If a leak or spill occurs during loading or offloading operations, the operations will be stopped and the spill will be contained, cleaned up and collected based on the Spill Response Plan; and - Ensure that personnel assigned to handle chemicals/oil/fuel are well aware of the requirements. They should be trained prior to commencing their duties.	Low	BWE and concerned Municipalities	Oil spill response: 80 USD Drip trays: 65 USD
	Potential contamination from wastewater overflows and/or leakages	N/D	H	L	M	O	R	H	H	- Ensure proper engineering design of the pumping stations (sizing of wet wells, pump-sets, and provision of a wastewater overflow emergency/bypass line); - Ensure prompt repair of pumping stations in case of failure to minimize the resulting impact on soil and water resources; - Proper operation and maintenance procedures for all operating components (networks and pumping stations); - Continuous monitoring of any signs of leakages or overflows; - Maintain continuous supply of power (for pumping stations) to prevent possible overflows and downtime; and - Ensure sewage network manholes are closed with proper lids to prevent blockages from fallen bulky objects.	Medium	BWE and concerned Municipalities	Part of operations activities cost
Waste Generation	Operation-and maintenance-related solid and liquid wastes generation	N/D	M	L	L	O	R	M	M	- Implement the measures suggested in section 5.6.3.1 during maintenance activities; - Collect the screenings generated from cleaning the wells of the pumping stations and dispose them in a designated dump in coordination and approval of MoE; and - Provide low toxic or environment-friendly (biodegradable) detergents for general cleaning purposes.	Medium	BWE and concerned Municipalities	Part of operations activities cost
Depletion of Resources													
Biological Resources	Normal operation	N/D	L	L	L	O	R	L	L	- Include native species in the landscape plan; - Management of landscaping plan to prevent growth of weeds and exotic species, allow propagation and survival of native species and replanting trees to replace the ones that are removed or die; - Proper management of liquid and solid waste generated by the project; - Prevention of littering in the area; - Control hunting within the project area.	Beneficial	BWE and concerned Municipalities	Part of operations activities cost

Source of Impact	Project Activities	Evaluation of Impact								Mitigation Measures	Residual Impacts	Institutional Responsibility	Cost Estimation
		N	M	E	T	D	R	L	S				
Energy Resources	Energy consumption during operation	N/D	L	L	L	O	R	H	M	- Adopt a periodic maintenance schedule of power generators, as per manufacturer specifications, and maintain maintenance logs; - Perform regular inspections and maintenance of pumping stations and generators; - Report and monitor monthly fuel and energy consumption records to keep track of consumption levels and identify overuse; - Upgrade machines/equipment and generators to more energy efficient technology when rehabilitation or upgrade is considered for the purpose of reducing consumption – consider the installation of solar PV panels for the operation of pumping stations; and - Switch off all machines/ equipment or any other energy consuming appliances when not in use.	Medium	BWE and concerned Municipalities	Part of operations activities cost
Other Impacts													
Traffic	Increase in traffic during maintenance works	N/D	L	L	S	O	R	L	L	- Avoid maintenance works during peak traffic hours; - Display temporary traffic signals and signs to warn of hazards and provide directions especially on narrow one-lane roads; and - Coordinate with municipal police in case of need for road closure and rerouting to be able to carry out specific maintenance activities, preferably ahead of time.	Low	BWE and concerned Municipalities	Part of operations activities cost
Socio-economic	Improvement of overall socioeconomic and environmental conditions of serviced communities and receiving environment from containment of wastewater	P/I	H	L	L	O	-	H	B	-	-	-	-
Health and Safety Hazards	Potential health and safety risks to operation and maintenance workers and nearby receptors, pedestrians, and commuters from maintenance works or from sudden overflows or leakages	N/D	M	L	S	O	R	L	L	- Provide workers with the appropriate PPE (goggles, dust masks, helmets, hearing protection equipment, proper clothing, safety boots, etc.) and enforce their use; - Post adequate signs at visible locations throughout the maintenance area indicating type of operation, potential risks, and appropriate medical/emergency action response; - Prohibit keeping trenches unnecessarily open and install barriers to avoid falling and tripping; - Fence all maintenance sites to prevent unauthorized access; - Store and handle chemicals (if any) as directed by their material safety data sheets and use the required PPEs; - Conduct regular training for workers about health and safety requirements; and - Implement the required ambient air emissions and noise mitigation measures above listed in sections 5.4.3 and 5.5.3 respectively.	Low	BWE and concerned Municipalities	PPEs Prices/ person: Overall ~12 USD Boots ~100 USD Helmet ~ 5 USD PVC Gloves ~2 USD Welding Gloves ~ 4USD Goggles ~ 3 USD Mask ~8 USD Reusable ear plugs ~1.5 USD Ear Muffs ~28 USD First Aid Kit (for 100 workers) ~200 USD
	Improved public health conditions from the proper management of wastewater	P/I	H	L	L	O	-	H	B	-	-	-	-

7.2 IMPLEMENTATION OF THE ESMP

Implementation of the ESMP requires a clear distribution of roles among concerned stakeholders, as well as an environmental monitoring plan to verify the effectiveness of mitigation measures, a capacity building plan and a well-defined auditing and reporting scheme.

7.2.1 Roles and Responsibilities

Roles and responsibilities of different institutions involved in the construction and operation of the project with respect to the implementation of the ESMP are summarized in Table 7-3.

Table 7-3 ESMP 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 ESMP.
MoE	• Reviews and approves CEMP prepared by contractor • Ultimately approve EMP implementation reports • Conduct site audits as needed to check implementation of ESMP during construction and operation phases of the project
MoEW/BWE	• Overall responsibility over the EMP Implementation during operation
Litani River Authority	• General oversight of implementation and operation of the project
World Bank	• Review and approval of ESMP implementation reports
Contractor	• Prepare a Construction Environmental Management Plan (CEMP) that details how the Contractor shall implement the provisions of the 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 ESMP 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 ESMP implementation; • Identify training needs of concerned parties to ensure ESMP and monitoring plan requirements are well-understood and can be implemented.
Municipalities	• Follow up on the ESMP implementation during construction and operation phases

7.2.2 *Capacity Building Needs*

7.2.2.1 Training Needs during Site Preparation Phase

In order to ensure a proper and effective implementation of the ESMP, it is particularly important to undertake a training program for the contractors that will be in charge of the works regarding its preparation and implementation. Training sessions for the contractors should be conducted prior to the commencement of the construction works and should focus on the following topics:

- General environmental and health awareness for all employees;
- ESMP study key findings and recommendations;
- Implementation of the proposed ESMP;
- Air pollution control;
- Control of leakages;
- Wastewater management;
- Water consumption;
- Solid waste management;
- Hazardous waste management;
- Oil spill management plan;
- Occupational health and safety issues; and
- Emergency plan.

7.2.2.2 Training Needs during Operation Phase

It is recommended to train the maintenance workers on the following:

- Training to ensure that the ESMP is well-understood;
- Efficient energy, impacts from generators and water use;
- Occupational health and safety;
- Noise and air pollution;
- Pumping stations and wastewater networks inspection and maintenance; and
- Emergency plan.

7.2.3 *Record Keeping and Reporting*

All data collected as part of the ESMP should be well recorded and documented as part of the Environmental Monitoring Report (EMP) submitted to the MoE on an annual basis. Within the EMP report, all data should be presented and analyzed to eventually evaluate the performance of the pumping stations and networks and the effectiveness of the mitigation measures put in place. The EMP report gives all concerned parties a clear picture of the projects' activities and its environmental performance.

7.3 ENVIRONMENTAL MONITORING PLAN

Compliance monitoring should be conducted to ensure the environmental soundness of the project. It should be the responsibility of the designated site HSE Officer during the Construction phase, and the BWE and Municipalities during the operation phase. The proposed monitoring plan for the project is summarized in Table 7-4.

Table 7-4 Environmental Monitoring Plan during Project Construction and Operation

Phase	Impact	Parameters to Monitor	Frequency	Monitoring Location	Number of Samples/Monitoring Points	Standards/Guidelines National/International	Institutional Responsibility	MoE Ref.
Construction	Emissions							
	Air Pollutants	- Recorded respiratory health problems among workers - Color of fumes from equipment and construction generators - Emissions of Generators' and construction equipment	- Workers' respiratory problems: monthly - Color of fumes from equipment and generators: weekly - Generators' and equipment's emissions: before starting construction works and monthly afterward	- Workers' respiratory problems: workers' health records - Color of fumes from equipment and generators: stacks - Generators' and equipment's emissions: stacks	- Generators and equipment stacks for color of fumes - Emissions at generators and equipment stacks for air emissions, and ambient air quality at nearest receptors	- MoE Decision 8/1, dated 2001 (National Standards for Environmental Quality (NSEQ)- Appendix 2-9 for stack emissions - MoE Decision 52/1 – Section 14 for ambient air quality (at receptors)	Site HSE officer	Construction Manager/ Contractors
	Noise	Leq, Lmax, Lmin, L90 dB(A)	- Three times daily during grading and excavation - Once daily during concrete pouring and pipes laying	Near sensitive receptors	Depending on number of receptors	MoE Decision No. 52/1 (Section 10 (Noise Standards))	Site HSE officer	Construction Manager/ Contractors
	Wastewater Generation	Leakages	Weekly	Networks and septic tanks (labor camp)	Visual inspection	Decree No. 2761of 1933 (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)	Site HSE officer	Construction Manager/ Contractors
	Solid Waste Generation	- Waste types - Waste generation rates (kg or tons/day) - Waste reused - Waste transported for offsite reuse/recycling - Waste disposed of - Method and location of disposal	Daily	Construction site (waste storage)	Daily records	Law No. 973 dated 1974 (Related to solid waste pollution; followed by the application of Decree No. 8735)	Site HSE officer	Construction Manager/ Contractors
	Depletion of Resources							
	Energy Resources	Fuel bills and fuel quantities consumption follow up	- Daily records - Monthly report	Construction site	Fuel and electricity bills	-	Contractor	Construction Manager/ Contractors
	Water Resources	Water consumption (m ³ /day) (install water meters to calculate volume consumed per week if applicable)	- Daily records - Monthly report	Construction site	Water bills	-	Contractor	Construction Manager/ Contractors
	Other Impacts							
	Socio-economic	Number/ percentage of local workers	Before and during commencement of construction works (monthly)	-	Employee records	-	Contractor	Contractors
	Health and Safety Hazards	- Proper PPE use - Good housekeeping practices - Number, type and cause of accidents and injuries	Continuous	Construction site	Accidents records	National Decree No. 11802 dated 2004 (Organizing prevention, public safety and occupational health in all institutions, as per the Labor Law)	Site HSE Officer	Contractors

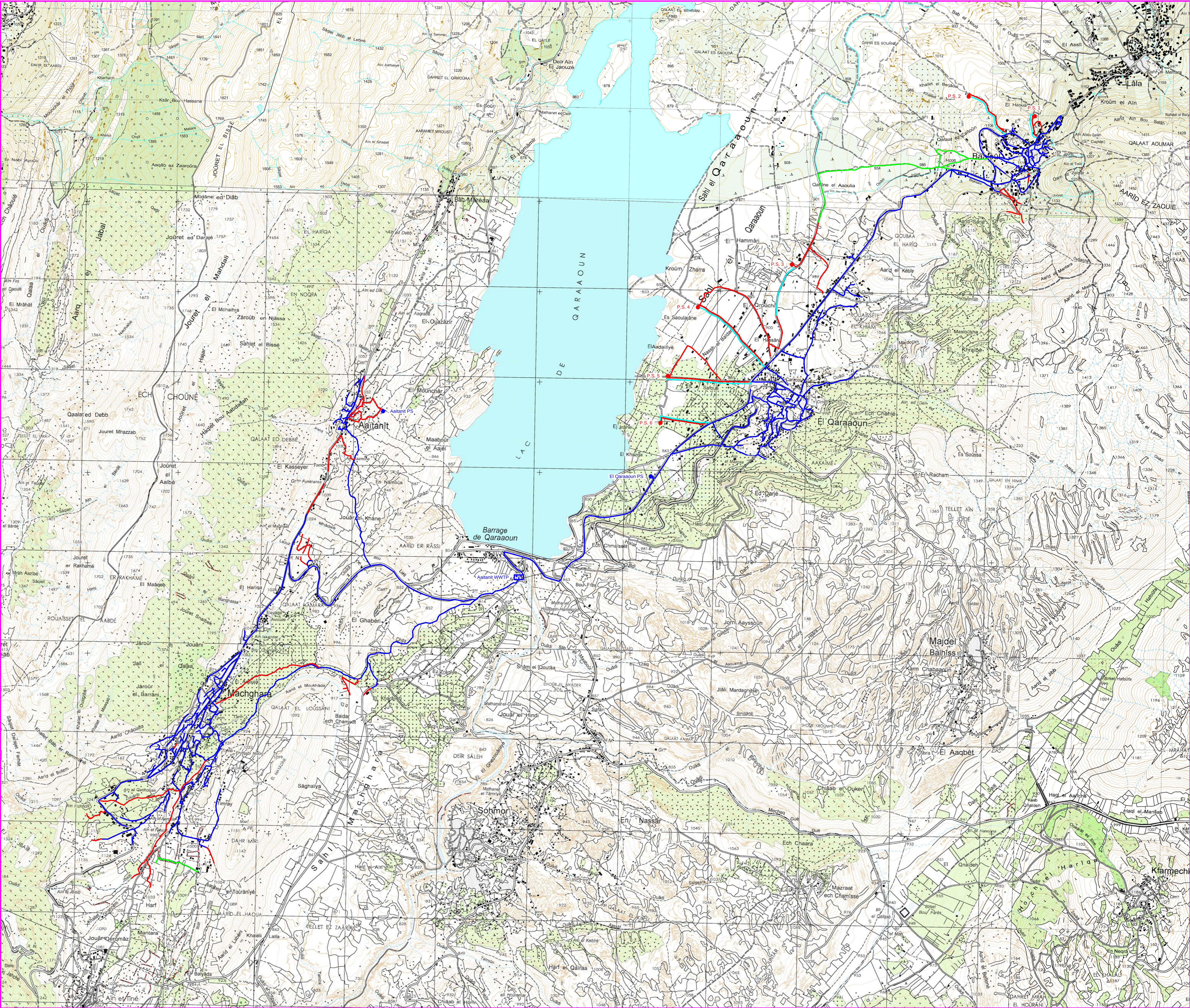
Phase	Impact	Parameters to Monitor	Frequency	Monitoring Location	Number of Samples/Monitoring Points	Standards/Guidelines National/International	Institutional Responsibility	MoE Ref.
	Archaeology	Monuments found during the works	Daily	Construction site	Visual inspection	National Decree No. 3057 dated 2016 which defines and regulates the procedures followed by the DGA for preventive and rescue excavations.	Workers, Site HSE Officer, and Contractor	Contractors
Operation	Emissions							
	Air Emissions (Generators' stack emissions)	Stack height, SO ₂ , NO ₂ , CO, PM ₁₀	Bi-annually	Generators' stacks	Six (1 sample at each stack)	MoE Decision 8/1, dated 2001 – Appendix 2-9 (National Standards for Environmental Quality (NSEQ))	Operator	Operator
	Noise	Leq, L _{max} , L _{min} , L ₉₀ dB(A)	Bi-annually	1 m next to generators	1 sample next to each generator and near sensitive receptors	MoE Decision No. 52/1 (Section 10 (Noise Standards))	Operator	Operator
	Wastewater Generation	Leakages and overflow	Weekly	Networks and pumping stations	Visual inspection	Decree No. 2761 of 1933 (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)	Operator	Operator
	Solid Waste Generation	- Waste types, sorted, reused and their quantities - Waste generation rates (kg or tons/day) - Waste transported for offsite reuse/recycling - Waste disposed of - Method of disposal	During maintenance activities	Maintenance locations	Records of waste generation and management	Law No. 973 dated 1974 (Related to solid waste pollution; followed by the application of Decree No. 8735) MoE Memo 8/1 (2015) on ISWM.	Operator	Operator
	Accidental Releases from fuel tanks	Visual inspection of spills and leaks	When refueling	Fuel tanks	Records of refueling and spills	Law No. 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)	Operator	Operator
	Depletion of Resources							
	Energy Resources	Fuel and electricity bills and fuel quantities consumption follow up	Monthly	Pumping Stations	Monthly records	-	Operator	Operator
	Water Resources	Water consumption (m ³ /month) (install water Meters) Inspection and maintenance of water fixtures	Monthly (consumption) Weekly (fixtures inspection)	Pumping Stations	Monthly records	-	Operator	Operator
	Other Impacts							
	Public health and safety	Number and cause of accidents during maintenance works	During maintenance activities	Maintenance locations	Accidents records	National Decree No. 11802 dated 2004 (Organizing prevention, public safety and occupational health in all institutions, as per the Labor Law)	Operator	Operator

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9. APPENDICES

APPENDIX A-MASTER PLAN



ORIGINAL DRAWING SIZE A1

LEGEND

EXISTING SEWER LINE

PROPOSED GRAVITY SEWER LINE

PROPOSED SEWER FORCE MAIN

ELIMINATED SEWER LINE

EXISTING WASTEWATER TREATMENT PLANT

EXISTING SEWAGE PUMPING STATION

PROPOSED SEWAGE PUMPING STATION

Rev.	Date	Dsgn	Drwn	Chk'd	App'r'd

REPUBLIC OF LEBANON

MINISTRY OF ENERGY AND WATER

COUNCIL FOR DEVELOPMENT AND RECONSTRUCTION

ED

BUREAU TECHNIQUE POUR LE DEVELOPPEMENT

JALL ED DIB - HAJAL Bldg TEL:(04) 712157 / 712158
P.O.BOX:70492 - ANTELIAS FAX: (04) 712159

CONSTRUCTION OF ADDITIONAL SEWER LINES
AND SEWAGE PUMPING STATIONS IN BAALOUL
AND EL QARAOUN - WEST BEQAA CAZA

ALL VILLAGES

GENERAL PLAN

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-06GP-01	R. YAACOUB	R. YAACOUB	R. YAACOUB

DATE	SCALE	SHEET No.	DRAWING No.
APRIL 2017	1:20000	1/1	462-06GP-01

APPENDIX B-BAALOUL PLOTS

رقم الطلب : ١٨٠٦

امانة السجل العقاري في زحلة

بتاريخ ٢٠١٦-١١-١٥

بناء على الطلب المقدم من : طارق الرفاعي

و لدى مراجعة قيود السجل العقاري اعطيت هذه الإفادة الشاملة

المحلة : خلة الشيخ

العقار : ٢٥٨٧ المنطقة العقارية : بعلول

مساحة العقار/القسم (م) : ٣١٥

النوع الشرعي للعقار : اميري

محتويات و وصف العقار و الحقوق العينية و الوقوعات

المرجع في السجل اليومي

الرقم التاريخ

وصف العقار : ارض بعل صخرية غير مستعملة.

دعوى-حكم-قرار : تدعي بلدية بعلول ان هذا العقار وسواه متروك مرفق ويعود حق استعمالها واستثمارها والانتفاع بها لمصلحتها ولمصلحة اهالي بعلول بملف ٢٦

المرجع في السجل اليومي

الرقم التاريخ

الملكية - التصرف

الحصة

نوع الحق خلاصة العقود

اسماء المالكين

سهم

٢٤٠٠

الجمهورية اللبنانية (اميري)

اساس الملكية (ملكية، تصرف، قرار قاضي) : بموجب قرار القاضي الصادر بتاريخ ١٩٦١ / ٧ / ٢٦



زحلة في ٢٠١٦-١١-١٥

استوفي الرسم بموجب لصق تمغة على الطلب

هذا ما تم تسجيله على الصحيفة العقارية حتى تاريخه أعلاه

الموقع المقترح لمحطة ضخ مياه الصرف الصحي في بعلول P.S. 1

مقياس ١ / ١٠٠٠

مصطلحات

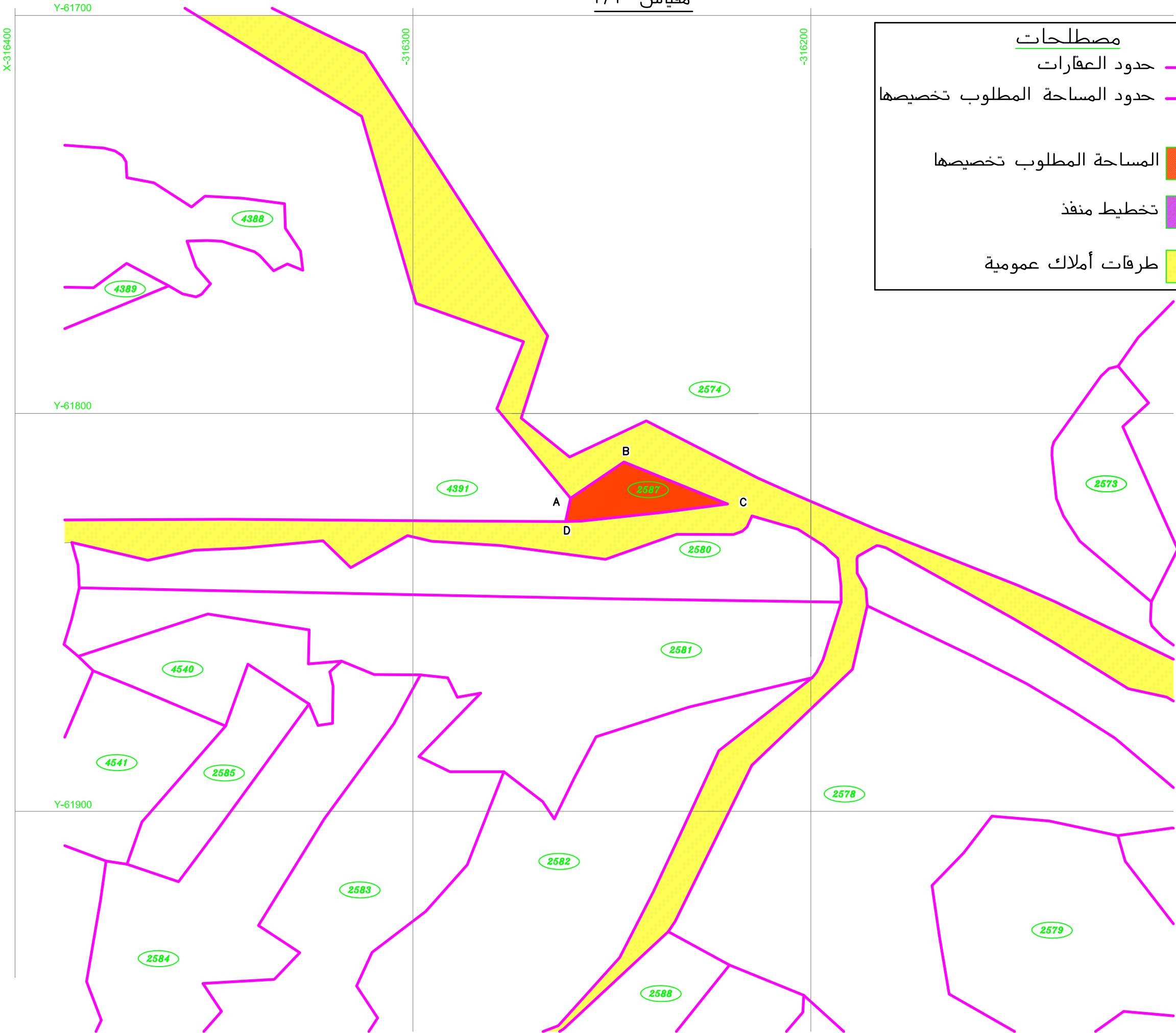
حدود المقارات

حدود المساحة المطلوب تخصيصها

المساحة المطلوب تخصيصها

تخطيط منفذ

طرقات أملاك عمومية



رقم الطلب : ١٥٢٥

امانة السجل العقاري في زحلة

بتاريخ ٢٠١٦-١١-٠١

بناء على الطلب المقدم من : قاسم دله

ولدى مراجعة قيود السجل العقاري اعطيت هذه الإفادة الشاملة

المحلة : وادي الحجلية

العقار : ٢٢٨٣ المنطقة العقارية : بعلول

مساحة العقار/القسم (م) : ١٢٧٠

النوع الشرعي للعقار : اميري

محتويات و وصف العقار و الحقوق العينية و الوقوعات

المرجع في السجل اليومي

الرقم التاريخ

وصف العقار : ارض بعل صخرية غير مستعملة.

دعوى-حكم-قرار : تدعي بلدية بعلول ان هذا العقار وسواه متروك مرفق ويعود حق استعمالها واستثمارها والانتفاع بها لمصلحتها ولمصلحة اهالي بعلول بملف ٢٦

١٤١ ١٩٦٢-٠٣-٠١

الملكية - التصرف

المرجع في السجل اليومي

الرقم التاريخ

نوع الحق خلاصة العقود

اسماء المالكين

الحصة

سهم

٢٤٠٠

الجمهورية اللبنانية (اميري)

اساس الملكية (ملكية، تصرف، قرار قاضي) : بموجب قرار القاضي الصادر بتاريخ ٢٦ - ٧ - ١٩٦١.



زحلة في ٢٠١٦-١١-٠١

استوفي الرسم بموجب لصق تمغة على الطلب

هذا ما تم تسجيله على الصحيفة العقارية حتى تاريخه أعلاه