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PALESTINIAN WATER AUTHORITY

Palestinian Water Authority

Gaza Wastewater Management Sustainability Project

Environmental and Social Audit of the Operation and Maintenance Activities of the Northern Gaza Wastewater Treatment Plant and Associated Facilities

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Executive Summary

Background

This report presents the environmental and social audit (ESA) of the operation and maintenance activities and procedures of the main existing facilities of the North Gaza Emergency Sewage Treatment (NGEST) system which is currently used to collect and treat the sewage generated from the Northern part of Gaza. NGEST project comprises five components: (i) Terminal pumping station (TPS) and Pond #7 that is adjacent to the TPS and used to accommodate an overflow from TPS for a 24 hours flow capacity, (ii) Pressurised main pipeline, (iii) North Gaza Wastewater Treatment Plant (NGWWTP), (iv) Infiltration ponds, and (v) Recovery wells and booster system. The NGWWTP and its associated facilities, was funded by the World Bank and other donors including *Agence Francaise de Development* (AFD). This ESA is performed under the *Gaza wastewater management sustainability (WMS) project* for the existing assets (TPS, NGWWTP, Pond 7 and other lakes), and an Environmental and Social Management Plan (ESMP) for the new suggested installations and works (under Components 1.2 and 2). The ESA looked at the different E&S aspects of the current operations, checked on the compliance with the ESIA/ESMP of the NGEST Project and identified areas that needs improvements to meet the ESF requirements during future operations. The key objectives of the WMS project are to mitigate adverse environmental impacts on communities in the northern governorate of Gaza by preventing the collapse of the northern Gaza wastewater treatment system; and to improve managerial capacity and financial resilience of wastewater treatment services in the Gaza strip. The implementation of this project will be initiated in July 2020.

Scope and Purpose of the Audit

This audit is performed, as a requierment for the World Bank funded projets, to verify and assess the compliance of the operation and maintenance (O&M) activities and procedures of the NGWWTP and its associated facilities with the World Bank Environmental and Social Standards and to the provisions and mitigation measures committed in the NGEST project ESIA and its Environmental and Social Management Plan (NGEST/ESMP, 2006) (Annex 1). Moreover, the audit identified the gaps in the compliance of the recent O&M activities and procedures with the NGEST/ESMP requirements and proposed an action plan for compliance corrective measures that includes specific activities, budgets and implementation timelines. The corrective action plan suggested in this ESA report is incorporated in the ESMP for the new suggested installation works (under Components 1.2 and 2 of the WMS project).

Methodology

In order to achieve these objectives, the methodology used included conducting meetings with the relevant entities to gather the available data and documents related to operation and maintenance of the NGWWTP and the TPS; seven meetings

were conducted with the operation staff at these two facilities. Desk review of all relevant project documents was performed to evaluate the gathered documents and studies prepared for the NGWWTP and TPS. Moreover, site visits to the NGWWTP and TPS were conducted on November 25 and December 8, 2019 to check and assess the environmental and social conditions during the operation phase. Finally, the collected information regarding the operation and maintenance activities were analyzed for compliance with the NGEST/ESMP and the World Bank environmental and social standards; gaps between the NGEST/ESMP monitoring requirements and the recent practices were identified; and an action plan for compliance corrective measures was prepared and incorporated into the new ESMP.

Environmental and Social Audit Findings

The audit findings are presented hereafter in two sections: (**A.**) Environmental audit findings, and (**B.**) Social audit findings.

A. Environmental audit findings

The main environmental aspects/issues related to this project are:

- Groundwater quality
- Noise quality
- Emissions and Air quality
- Wastewater discharge
- Sludge and waste disposal
- Hazardous waste management
- Energy conservation
- Organizational capacity and competency

Table ES1 gives the findings of the environmental audit assessment on compliance of the NGWWTP and TPS O&M procedures with the NGEST/ESMP mitigations requirement.

Table ES1: Summary of environmental audit assessment on compliance of the NGWWTP and TPS O&M procedures with the NGEST/ESMP (based on Table 5.1)

No.	Environmental Issue/ Risk	Mitigation Requirements	compliance status and Description
1.	**Groundwater Quality**		
	Aquifer pollution at the infiltration Basin in the ***NGWWTP site***: • expansion of the nitrogen plume • salinity • pathogenic bacteria (Fecal coliform)Increased level of toxic contaminants	• Regular cleaning of the infiltration ponds (scraping, sediment removal)	• **Full compliance:** Regular cleaning of the infiltration ponds (scraping, sediment removal) is performed as required.
		• Comprehensive aquifer water quality and water level monitoring program (Table 4.4, in the ESMP, presented in Annex 1 of this report) - includes testing the treated wastewater quality.	• **Partial compliance** Water quality and levels testing is performed but not as required in terms of testing frequency as per Table 4.4 ESMP-Annex1. The partial compliance is because of lack of funding.
		• Regular infiltration performance check.	• **Partial compliance:** Infiltration performance check is performed but not as required in terms of testing frequency as per the mitigation measures The partial compliance is because of lack of funding.
		• Follow alternate operations plan (short flooding and drying periods)	• **Full compliance:** Alternate operations plan is performed as required.
		• No wells should be operated within a distance of 6 month residence time from the edge of infiltration basins (>150 meters)	• **Full compliance:** No wells are operated within the specified distance as required.
2.	**Noise quality**		
	Noise generation (pumps, generators) at NGWWTP and TPS	• Ensure that noisy activities occur during daytime and not during holidays or late night times. Random checking is required. • The noise producing equipment are enclosed inside buildings and /or has silencers.	• **Full compliance:** All noise producing equipment are enclosed inside buildings and /or have silencers as required.
3.	**Emissions and Air quality**		
	• Air pollutant generated by diesel generators at ***NGWWTP and TPS***. • Bad smell from treatment units in ***NGWWTP*** (H_2S, NH_3, etc....) • Bad smell in the inlet works of the screening building in the ***TPS***	• Control the air pollutants from the power generators emissions in the TPS and NGWWTP	• **NO compliance**: No filters are installed on the diesel generators exhaust line. The odor control system at the inlets works building is malfunctioning. Non-compliance is due to lack of funding.
		• Proper operations of the odor control system in the ***NGWWTP*** site.	• **Full compliance:** The odor control system in the ***NGWWTP*** site is operated properly and the emissions are controlled. No bad smell is detected.
		• Proper operations of the odor control system in the TPS site control system in the TPS site	• **No compliance:** The odor control system at the inlets works building in the TPS is malfunctioning. None compliance is due to lack of funding.
4.	**Wastewater discharge**		

Table ES1: Summary of environmental audit assessment on compliance of the NGWWTP and TPS O&M procedures with the NGEST/ESMP (based on Table 5.1)

No.	Environmental Issue/ Risk	Mitigation Requirements	compliance status and Description
	• Improper disposal of treated wastewater to the infiltration basins at the NGWWTP.	• Comprehensive wastewater quality monitoring program (Table 4.4, in the ESMP, presented in Annex1, this report)	• **Partial compliance** Wastewater quality monitoring is performed but not as required in terms of testing frequency as per Table 4.4 **ESMP- Annex1.** The partial compliance is because of lack of funding.
5.	**Hazardous waste management**		
	• Risk of spill of hazardous waste such as oils, lubricants, polymers. • Risk of storage and handling hazardous materials used in the **NGWWTP** and **TPS** such as polymers.	• Employees should be trained on the hazards, precautions and procedures for safe storage, handling and use of all potentially harmful materials relevant to each employee's task and work area.	• **No compliance** Employees didn't receive training on precautions and procedures for safe storage, handling and use of potentially hazardous and harmful materials. The noncompliance is because of lack of funding.
		• Follow safety instructions, worker should wear proper clothing	• **Partial compliance** The existing staff at the NGWWTP don't have all the required PPEs. The noncompliance is because of lack of funding.
		• A first aid station with trained staff, which is able to coordinate with local hospitals in case of emergencies.	• **Partial compliance** A first aid station exists but lacks some equipment and trained staff. The noncompliance is because of lack of funding.
		• Preparing and implementing spill response and emergency plans to address their accidental release.	• **No compliance** Spill response and emergency plans to address their accidental release is not prepared nor employed.

B. Social audit findings

The main social aspects/issues related to this project are:

- Labor and working conditions including occupational health and safety management.
- Community health and safety.
- Stakeholder engagement and public consultation.

Table ES2 gives a summary of social audit assessment on compliance of the NGWWPT and TPS O&M procedures with the NGEST/ESMP requirements.

Table ES2: Summary of Social Audit Assessment on compliance of the NGWWPT and TPS O&M procedures with the NGEST/ESMP

No.	Social Issue/ Risk	compliance status	Description of compliance status
1.	**Labor working conditions including Occupational Health and Safety**		
	• Risk of Accident, injuries and handling of toxic and hazardous material • Noise generation. • Emissions and air pollution in the work environment.	• Follow safety instructions, worker should wear proper clothing.	• **Partial compliance** The existing staff at the NGWWTP don't have all the required PPEs .The noncompliance is because of lack of funding.
		• A first aid station with trained staff, which is able to coordinate with local hospitals in case of emergencies	• **Partial compliance** A first aid station exists but lacks some equipment and trained staff. The noncompliance is because of lack of funding.
		• Employees will be trained on the hazards, precautions and procedures for safe storage, handling and use of all potentially harmful materials relevant to each employee's task and work area.	• **No compliance:** Employees didn't receive training on precautions and procedures for safe storage, handling and use of potentially hazardous and harmful materials. The noncompliance is because of lack of funding.
		• The work place should have proper ventilation to refresh oxygen and reduce temperature (labs, control rooms, etc.).	• **Partial compliance:** Ventilation equipment are available in NGWWTP and TPS (labs, control rooms, etc.) but need repair/ rehabilitation. The noncompliance is because of lack of funding.
		• Warning signs and instructions should be properly displayed	• **Partial compliance:** Warning signs are available at the **NWWTP** but not in the **TPS**. The noncompliance is because of lack of funding.
		• Proper fencing should be installed around the facility especially the infiltration basin.	• **Full compliance:** Fences are available both sites (**NWWTP** and **TPS)**.
2.	**Community health and safety (CHS)**		
	• Risk of people and/or Livestock (sheep, cows), drowning in the infiltration basins • Risk on community health and safety associated with sludge hauling and disposal.	• Proper fencing should be installed around the facility.	• **Full compliance:** Fences are available at both sites (**NWWTP** and **TPS)**.
		• Proper sludge hauling ad disposal procedures from the NGWWTP and from TPS.	• **No compliance** Sludge hauling ad disposal procedures from the NGWWTP and from TPS are improper in terms of CHS. The noncompliance is because of lack of funding.
3.	**Stakeholder engagement and Public consultation**		
	• Negative publicity and misconceptions	• Public information campaigns during the project operation.	• **Partial compliance:** Limited public information campaigns were conducted during operation phase. The noncompliance is because of lack of funding.

Table ES2: Summary of Social Audit Assessment on compliance of the NGWWPT and TPS O&M procedures with the NGEST/ESMP

No.	Social Issue/ Risk	compliance status	Description of compliance status
		• Establishing appropriate channels of communication to maintain continuous engagement and communicating additional information that may arise at key stages in the project cycle;	

Proposed action plan to bridge compliance gaps

According to the environmental and social audit performed and presented in section 5 of this report, many **gaps** were found in the monitoring practices during the operation phase of the **NGWWTP** and the **TPS** facilities. **Tables** 6.1 and 6.2 presents the action plan that will be implemented by the PWA to **bridge the gaps** compliance gab with the **NGEST/ESMP provisions**. The action plan presented the following:

1. The environmental and/or social aspect to be monitored.
2. The action required to bridge the gap.
3. The time frame of action implementation.
4. The required resources (human, financial, equipment) for actions implementation.

As a general finding, it has been noticed during the audit that the lack of budget was the most important issue that affected the proper operation and maintenance of the previous investment in the NGETS project. Most of the incompliance gaps are a result of the inadequacy or lack of budgets necessary for applying the monitoring activities and the mitigations measures. Thus, for this proposed project, it is necessary to save the required budgets as stated and planned in the project documents.

However, the following is a summary of the key features of the action plan presented in two parts: Environmental and social aspects.

A. Summary of action plan activities to bridge compliance gaps in environmental aspects

The **environmental aspects** covered in the action plan are: Groundwater quality, Emissions and Air quality, Wastewater discharge, Sludge and waste disposal, Hazardous waste management, Energy conservation, and organizational capacity and competency of the implementing agency.

Groundwater Quality monitoring actions

- Comprehensive aquifer water quality and water level monitoring program is to start with the commencement of the WMS project (July 2020) and to be

conducted regularly based on the frequency given in Table 4.4 (Annex 1). The budget needed for the monitoring program is 10000 USD/year.

The previous monitoring of groundwater quality (mainly nitrate concentration in the groundwater within the project area before the operation of the NGWWTP) shows that the nitrate concentration in the plant site and the area to the west of the site is between 50 and 100 mg/l. These high levels of nitrate are due to the infiltration of partially treated wastewater received from the old wastewater treatment plant at Biet Lahia into the infiltration basins before the start of the operation of NGWWTP.

Other parameters were measured in late 2017 to identify the best locations and designs of the monitoring wells around the NGWWTP site. The measured parameters included Ammonia, detergents, and phenols, which can be used as indicators of water pollution with wastewater. The measurement of ammonia concentration indicated high levels of Ammonia in the wells that are close to the infiltration basins, while lower concentrations were recorded in farther wells. The obtained results for detergents ranged from 1.1-7.8 mg/l, which are considered to be high for groundwater wells and indicate an entry of external source of pollution. Relatively high levels of phenol that reached 18 mg/l at some locations were also recorded

- Updating the existing NGEST groundwater model (flow and solute transport) that was prepared to monitor the aquifer underlying the project area. The update is to be performed once each 5years .The budget needed for the model update is 5000 USD/update.

  The model will show the status of the groundwater quality during the operation of the system (NGWWTP, infiltration of treated wastewater and recovery wells) and will predict the pollution plume distribution in case of the failure of the system operation.

Air Quality monitoring actions

- Repairing the odor control system in the screening building in the TPS. The repair should be covered in the construction contract of the WMS project; expected date of this action is July 2020.
- Providing workers with appropriate protecting gear (masks) in case of exceedance of indoor air quality levels. Masks are covered under the general budget of the PPEs that should be included in the WMS project budget.
- Repairing the gas storage system in the NGWWTP to stop air pollution due to gas discharge into the atmosphere. The repair should be covered in the construction contract of the WMS project; expected date of this action is July 2020.

Wastewater discharge monitoring actions:

- Comprehensive wastewater quality is to start with the commencement of the WMS project (July 2020) and to be conducted regularly based on the frequency

given in Table 4.4 (Annex 1). The budget needed for the monitoring program is 10000 USD/year.

- Replacing the malfunctioning equipment in TPS and NGWWTP to avoid raw wastewater flood into the surrounding areas of the TPS site. The budget for equipment replacement cost is to be covered under the WMS project (July 2020).
- Starting the preparation for constructing phase II of the NGWWTP by updating/preparing tender documents to increase the treatment plant capacity and prevent uncontrolled floods of raw wastewater at TPS. The preparation of the tender documents is proposed to be finalized by the end of 2020, so that the beginning of the construction could take place in June 2021, and the operation could be started by 2024. The budget for updating/preparing tender documents cost is to be covered under the WMS project (July 2020).
- Initiate building capacity program for the operational staff to properly operate and maintain different facilities of the NGWWTP. Adequate staff should be secured since the current staff is not enough (a total of 27 staff members as indicated in the LMP) to manage and operate the NGWWTP. The budget for building capacity program is to be covered under the WMS project (July 2020).

Sludge and waste disposal monitoring actions:

- Stop immediately disposing the sludge from NGWWTP to the TPS and develop an agreement between PWA and an authorized landfill to dispose sludge properly. Transfer the accumulated sludge piles from TPS to an authorized landfill .Sludge is creating a habitat for mosquitos and other insects and its leachate during rain storms may pollute soil and may eventually pollute ground water if the recent disposal practice continues. The budget for transfer and disposal cost is to be covered under the WMS project.
- Prepare sludge management plan for the NGWWTP to ensure its safe handling and disposal in an environmentally accepted manner. The plan should include agreement between PWA and Municipality of Gaza for the disposal of the sludge of NGWWTP to Joher El Deek landfill.; expected date of this action is July 2020.

Hazardous waste management monitoring actions:

- Train employees on the hazards, precautions and procedures for safe storage, handling and use of all potentially harmful materials relevant to each employee's task and work area. The training should immediately start upon the commencement of the WMS project (July 2020) and its cost should be covered under the WMS project budget as well.
- Providing workers with appropriate with the appropriate personal protection equipment (PPEs) to deal with hazardous materials. PPEs are covered under the general budget of the PPEs that should be included in the WMS project budget s indicted later; expected date of this action is July 2020.

- Establishing a first aid station with trained staff, which is able to coordinate with local hospitals in case of emergencies. The cost of establishing the first aid station should be covered under the WMS project budget; expected date of this action is July 2020.

Energy conservation actions:

- Using the produced biogas in the NGWWTP for energy production. This requires the repair of the biogas system in the NGWWTP. This point is covered above under the air pollution monitoring activities; expected date of this action is July 2020.
- Using solar energy such as photovoltaic technology (PV). A fund has been saved to construct a PV station in the NGWWTP site vicinity to produce around 5 MW of electricity; expected date of this action is October 2020.

Organizational capacity and competency

- The current environmental and social management system (ESMS) in PWA/PMU is not appropriate and should be strengthened by hiring a professional environmental and social officer (ESO) possessing the competency to lead the ESMS at the PWA/PMU. The budget of this ESO is covered under the Stakeholder Engagement Plan (**SEP)** prepared for the WMS project and should be hired by the commencement of this project; expected date of this action is July 2020.

B. Summary of action plan activities to bridge compliance gaps in social aspects

The **social aspects** covered in the action plan are: Labor and working conditions including Occupational Health and Safety (OHS), Community health and safety, and Stakeholders Engagement and public consultation.

Labor and working conditions including (OHS):

- A complete OHS system should be developed for both facilities (NGWWTP and TPS) for the operation and maintenance period. This will include but not limited to:
  - Immediate provision of PPEs to all relevant plant operators and workers according to their job functions at both sites (NGWWTP and TPS). The budget needed is USD 15000 to be covered under the WMS project.
  - Immediate provision of OHS training to all plant operators and workers as per their job functions. The budget needed is 10000USD to be covered under the WMS project.
  - Establishing a first aid station with trained staff as indicated previously; expected date of this action is July 2020.
  - Organize awareness raising sessions and educate the workers and the community in the Project site on issues of GBV/SEA, legal rights, GRM and referral path for victims of GBV/SEA. The budget needed for this work should be part of the WMS project and estimated at 5000 USD; expected date of this action is July 2020.

Community health and safety:

- Organize awareness raising sessions and educate the community in the Project site vicinity on issues of GBV/SEA, legal rights, GRM and referral path for victims of GBV/SEA. The budget needed for this work is covered in the **SEP** prepared for the WMS project; expected date of this action is July 2020.
- GRM for GBV/SEA should be strengthened and integrated into the project GRM to track complaints related to GBV/SEA, including a feedback system for regular and timely feedback on actions taken to respond to complaints.
- Most of the activities mentioned under the environmental aspect are also considered as actions that protect the community health. Thus, for convenience these common activities are not repeated under this section.

Stakeholders Engagement and public consultation:

A Stakeholder engagement plan (SEP) has been prepared for the WMS project to communicate surrounding community and all stakeholders regarding any issues related to the Plant (NGWWTP) and the TPS operation and any specific needs or measures. SEP is prepared in accordance with the WB standard ESS10. The main issues included in this SEP are:

- Establishing effective information dissemination and consultations procedures,
- Establishing appropriate channels of communication to maintain continuous engagement and communicating additional information that may arise at key stages in the project cycle;
- Training of key players in the project implementation as needed to implement the plan,
- Organize stakeholder consultations at all stages of project cycle
- Establishing project grievance redress mechanism (GRM) that will ensure reception and timely response to any complaints made about the project.

The SEP is prepared in a separate report including detailed activities and timelines. The budget of the SEP to implement the required activities was estimated at 82,830 USD.

1. Introduction

1.1. Background

This report presents the environmental and social audit of the operation and maintenance activities and procedures of the main facilities of the North Gaza Emergency Sewage Treatment (NGEST) system which is currently used to collect and treat the sewage generated from the Northern part of Gaza. NGEST comprises five components: (i) Terminal pumping station (TPS) and Pond #7 that is adjacent to the TPS and used to accommodate an overflow from TPS for a 24 hours flow capacity, (ii) Pressurised main pipeline, (iii) North Gaza Wastewater Treatment Plant (NGWWTP), (iv) Infiltration ponds, and (v) Recovery wells and booster system. Pond #7 and TPS are located in the site of the old wastewater treatment plant at Beit Lahya town (BLWWTP). The NGWWTP and its associated facilities, was funded by the World Bank and other donors including *Agence Francaise de Developpement* (AFD).

This audit is performed under the *Gaza wastewater management sustainability (WMS) project*, to ensure that the NGWWTP and its associated facilities are conforming with the World Bank Environmental and Social Standards (ESSs), as a requierment for the World Bank funded projets. The key objectives of the WMS project are to mitigate adverse environmental impacts on communities in the northern governorate of Gaza by preventing the collapse of the northern gaza wastewater treatment system; and to improve managerial capacity and financial resilience of wastewater treatment services in the Gaza strip. The implementation of this project will be initiated in July 2020.

1.2. Project Overview

1.2.1. Project Location

The different components of the project are located in two main sites in the Northern governorate in the Gaza Strip, namely the NGWWTP site in Jabalia, the TPS and Pond#7 site in Beit Lahia, in addition to the pressure pipeline that connects these two sites (See Figure 1.1).

1.2.2. WMS Project components

A detailed technical audit has been prepared for the NGEST system based on the standard asset management methodology as outlined in international standards. The output of this audit includes the condition of every electromechanical and civil assets includes ranking the equipment according to levels of deterioration (from unserviceable to new or excellent condition). The results of the performance audit informed the specific investments under the WMS project components below.

Component 1: Support the operation of the NG WWTP and associated facilities including rehabilitation and retrofitting. Under this component the Project will finance the PWA's hiring of qualified staff to operate and maintain the NG WWTP to its design capacity, along with the provision of chemical inputs, tools and consumables for operating NGEST facilities for three years (from March 2020 to March 2023). The Palestinian Authority (PA) will finance electricity costs under agreed arrangements. This component will also finance the cost of rehabilitation works of underperforming or environmentally sensitive wastewater pumping and treatment facilities, including: (i) the TPS that has been poorly maintained and is only

working on two out of five pumps; and (ii) a reliable voltage regulation system at the NG WWTP. Specifically, the following works are needed:

I. **For the terminal pumping station:** reparation of two out of five of the pumps; replacing three out of five pumps damaged by the flooding of the dry pit; replacing the variable frequency device VFD for the pumps; replace the current bar screens; adding additional instrumentation that allows for automatic control and remote monitoring; implementing a SCADA system for the pumping station; transmitting the SCADA data to the central control center at the NGWWTP.

II. **For the transmission line:** Instrumentation that monitors the transmission line and its integrity such as flow meters, pressure meters etc.; procurement of spare pipe sections that allow for rapid repairs if the transmission line bursts; rehabilitation and maintenance for the chambers, valves and related fittings along with the ductile iron pressure pipeline.

III. **For the NGWWTP:** Replacing equipment that is damaged beyond repair; repairing equipment with major/minor defects; provide a sustainable solution to the biogas balloon that does not get punctured again – reduce the volume, provide protection and replace the existing balloon; operate the biogas system and cogeneration plant for electricity production; provide technical service to the operators on electromechanical, process and SCADA issues; provision of capacity building including on-site training to the local engineers and technicians; provision of spare parts; provision of chemicals and consumables (excluding fuel and electricity); develop in house capabilities for testing Sodium, Calcium, Magnesium and Boron; provide the salaries for the employees of the NG WWTP; include sludge disposal costs and voltage stabilizer.

Component 2: Limited upgrade of NGEST and TPS facilities to build resiliency and address emergencies. The current design does not provide a sustainable solution of emergency overflows. In an event of an overflow the surrounding areas are flooded with raw sewage causing both environmental damage and a public health crisis. This component will finance:

I. an emergency overflow system for the terminal pumping station (overflow will be discharged into a dedicated emergency overflow);
II. upgrading of the existing pond #7 that is adjacent to the Terminal Pumping Station to a 24 hours flow capacity. This pond should include special lining (e.g. HDPE lining) in order to prevent raw sewage from seeping into the environment and submerged aerators that can aerate the sewage to prevent odor emissions.
III. Construction of a pumping station at the existing pond #7 that enables pumping the wastewater collected in pond #7 and return it to the Terminal Pumping Station

Component 3: Capacity building for sustainability of wastewater services in northern Gaza. Advanced wastewater treatment facilities require highly trained engineers and technicians. In countries where advanced wastewater treatment plants are built there is a time period where technical infusion to the local engineers is required. Again, due to limited access and travel limitations this natural process of technical and knowledge infusion is extremely hindered. Without this operational and maintenance knowledge the wastewater facilities will not operate successfully, and the effluent/sludge quality will not be achieved. To finance: (i) technical assistance to build capacity of the Technical Team for wastewater management within the existing organizational structure, to address the current emergency and for the long

term sustainable operation of the plant; and, (ii) technical assistance to design and implement an enhanced governance and institutional framework, based on a national wastewater strategy for efficient and reliable management of wastewater treatment services in northern Gaza in close coordination with similar efforts that are being conducted in central and south Gaza.

Component 4: Project Management and Implementation Support. To finance: (i) PWA's Project supervision and Project management; and (ii) consulting services for the development of engineering designs and studies.

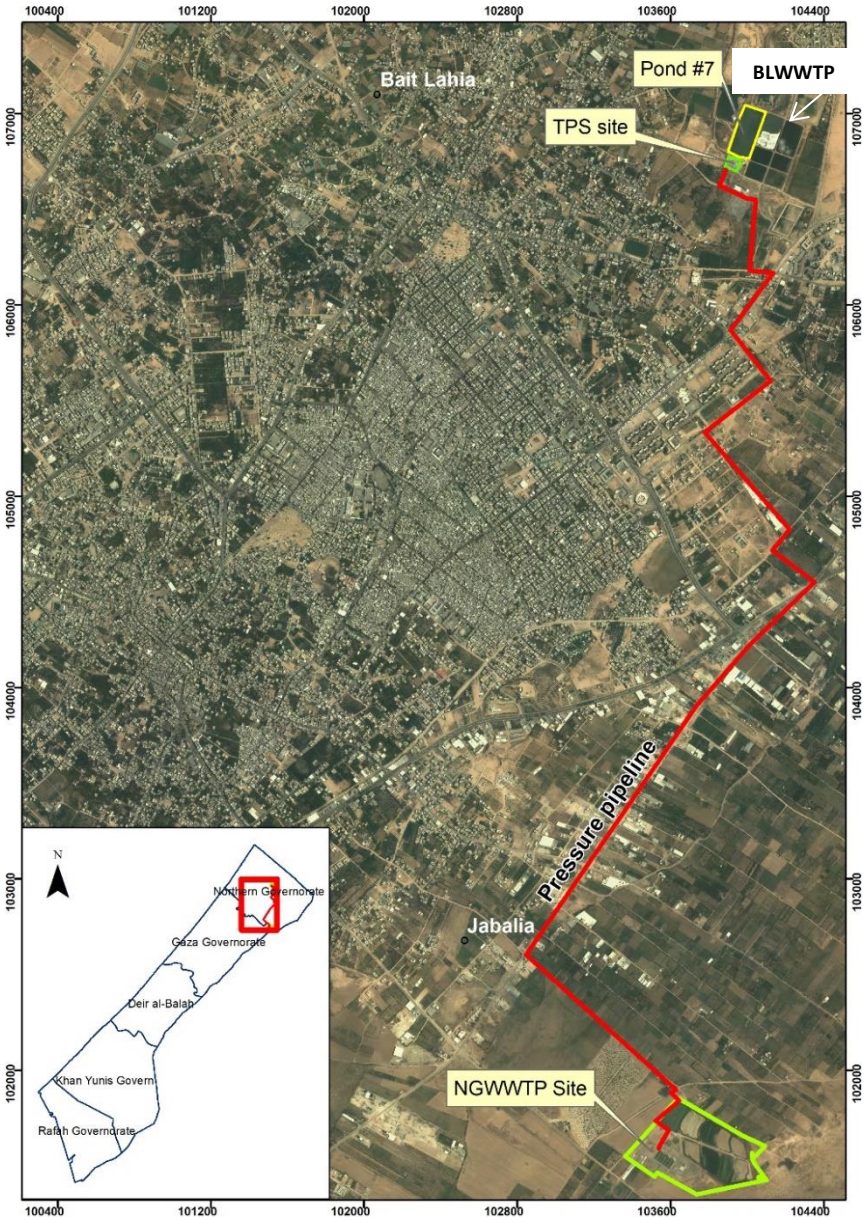


Figure 1.1: Project Location

1.4 Scope of the Audit:

This audit is performed, as a requierment for the World Bank funded projets, to verify and assess the compliance of the operation and maintenance (O&M) activities and procedures of

the NGWWTP and its associated facilities with the World Bank Environmental and Social Standards and to the provisions and mitigation measures committed in the NGEST project ESIA and its Environmental and Social Management Plan (NGEST/ESMP, 2006) (Annex 1). Moreover, the audit identified the gaps in the compliance of the recent O&M activities and procedures with the NGEST/ESMP requirements and proposed an action plan for compliance corrective measures that includes specific activities, budgets and implementation timelines. The corrective action plan suggested in this ESA report is incorporated in the ESMP for the new suggested installation works (under Components 1.2 and 2 of the WMS project).

1.5 Audit Methodology

In order to achieve the audit objectives, the methodology used included conducting meetings with the relevant entities to gather the available data and documents related to operation and maintenance of the NGWWTP and TPs, conducting desk review for the relevant project documents, in addition to conducting a visit to the project components. The Audit was carried by an independent consultant (Dr. Fahid Rabah). The desk review was done to evaluate all the gathered documents and studies prepared for the NGWWTP and TPS.In addition, site visits to the NGWWTP and TPs were conducted on November 25 and December 8, 2019 to check and assess the environmental and social conditions during the operation phase.

The following methods were used to conduct the environmental and social audit:

A. Meetings

The operation staff at the NGWWTP, including the infiltration basins and the TPS, were approached on site to discuss different issues related to the operation and maintenance activities at these facilities. For the NGWWTP, the staff included the plant manager, process engineer, lab technician, and electromechanical engineer. While for the TPS, the staff included the pumping station manager and the pumping station operator. Table 1.1 summarizes the purpose and objective of each meeting as well as the key findings and issues discussed.

Table 1.1: Summary of the meetings with the operation staff at NGWWTP and TPS

Facility	Person	Date	Subject	Findings and issues discussed
NGWWTP	Mazen Abu Samra-Plant Manager	08-12-2019 And 11-12-2019	Existing related environmental and social documents; The current operation and maintenance staff and procedures; Existing health and safety measures; and The activities performed by the operation staff as per the ESMP of the NGWWTP.	• The existing staff lacks the required experience in operating such a sophisticated treatment plant. • The main reference for the environmental monitoring activities for the NGEST project is the EA report that has been prepared in 2006. • Not all necessary PPE is being used by the workers in the plant. • The first aid room lacks the suitable furniture and first aid kits. • There is no trained professional staff on first aid procedures and skills • Recent staff members are not trained on handling chemicals and sludge. • The plant is operating near the design flows and may not operate well in the near future as the flows increase.
	Sami Al Qedra-Process Engineer	08-12-2019	The operation and maintenance procedures at the NGWWTP site; and The main problems encountered;	• The existing bar screens are not working properly and they need to be replaced. • The odor control system is not working properly. • The biogas cannot be stored in the existing storage system, which is mainly a balloon placed within a concrete building with simple roof cover, as it is punctured and needs repair. • The quantity of the produced sludge is relatively high (86 ton/day) and the sludge storage yard is not adequate to store this quantity. Therefore, the generated sludge is transferred out of the NGWWTP site and disposed in an open land adjacent to the TPS site. • Not all air quality monitoring activities are being implemented given that some parameters need special devices that have relatively high costs.

Table 1.1: Summary of the meetings with the operation staff at NGWWTP and TPS

Facility	Person	Date	Subject	Findings and issues discussed
	Mustafa Al Aqqad-Lab Technician	10-12-2019	Current monitoring activities for the discharge water quality and the groundwater quality	• The staff partially applied the testing program for the groundwater and the treated wastewater quality, which has been proposed in the NGEST/ESMP (2006), due to shortage of financial support. • The regular infiltration performance check for the infiltration basins has stopped since August 2019 due to lack in the O&M staff.
	Mohammed Khdair-Electromechanical Engineer	08-12-2019	Existing electrical and mechanical problems;	• The ventilation ducts in the control panel room are and not airtight, which causes damage to the programmable logic controller (PLC) and the electric panels in the room. • The electric voltage from the electricity grid fluctuates leading to malfunctioning of some of the sensitive electric equipment in the plant, such as the blowers. This negatively affects the treatment plant operation.
TPS	Rajab Al Anqah-TPS Manager	08-12-2019	The current operation and maintenance staff and procedures; Existing health and safety measures;	• The existing operation staff in the TPS comprises the TPS manager (Mechanical Engineer); three un-skilled operators (no qualifications); two guards (no qualifications); three un-skilled workers (no qualifications); and an electric technician. • Occupational Health and Safety precautionary measures are not considered during the O&M of the TPS and its associated facilities. • The control room is completely malfunctioned and the SCADA system is dismantled and not working. • The sludge from the NGWWTP is randomly disposed in a 10,000 m^2 land adjacent to Pond #7. • The existing bar screens are not working and in bad conditions and need to be replaced.

Table 1.1: Summary of the meetings with the operation staff at NGWWTP and TPS

Facility	Person	Date	Subject	Findings and issues discussed
				• The screenings screw conveyers are malfunctioning and should either be repaired or replaced. • In a previous incident, the electricity distribution boards were flooded with sewage. • Air quality and ground water quality monitoring activities are not implemented.
	Mohamed Abu Firya-TPS Operator	08-12-2019	The operation and maintenance procedures at the TPS site; and The main problems encountered;	• Pond #7 is full of raw wastewater and accumulated sludge and produce bad smell. • The shoulders of pond #7 are not high enough, which results in the overflow of sewage to the random lakes area creating environmental pollution and threatens the safety and health of the population. • The odor control system in TPS is not operating and in a bad condition and should be repaired and operated.

B. Site visits

Site visits were conducted by the consultant to the NGWWTP on December 8, 2019, the infiltration basins on December 8, 2019, and to the TPS on November 25 and December 8, 2019 to check and assess the environmental and social conditions during the operation phase. During the visits, the following main activities were performed:

- Visual inspection of all the treatment units in the NGWWTP. A description of the recent performance of each treatment unit was made by the process engineer during the tour. A description of the recent status of each equipment was made by the electromechanical engineers.
- Visual inspection of the TPS facility including all its equipment and structures. A description on the recent performance of TPS was made by the station manager during the tour. The tour also included the TPS overflow pond (pond #7) and its surrounding area.
- Inspection of procedures performed by the operation staff as per the ESMP of the NGWWTP and the TPS.

C. Data collection and desk review

In order to collect sufficient and reliable data regarding the NGWWTP and the TPS, an iterative process of information gathering and analysis was conducted. All available relevant documents and materials were reviewed; the main documents that were reviewed are the following:

- Environmental Assessment Report for the North Gaza Emergency Sewage Treatment Plant Project (2006);
- Supplementary Environmental and Social Assessment Report for the North Gaza Emergency Sewage Treatment Plant Project (2013);
- The performance audit report for the North Gaza Emergency Sewage Treatment Plant Project (2019);
- Laboratory reports for NGWWTP inflow and outflow data;
- NGWWTP operation and maintenance manual; and
- Applicable Palestinian laws especially the ones related to operation activities such as Palestinian labor law, as well as applicable World Bank standards that will be considered in the process of reviewing the ESIA and the IFC's General Environmental, Health and Safety Guidelines (EHSG), and the EHSG for Water and Sanitation (See Section 2.1)

Moreover, several site visits were carried out, as discussed in paragraph B of this section, to gather data on the current status of the operation and maintenance activities in the NGWWTP, including the infiltration basins, and the TPS from an environmental and social perspective.

D. Analyzing the operation and maintenance procedures for compliance with the ESMP and the environmental and social safeguards as per the World Bank ESF and standards (ESSs).

E. Identifying gaps between the safeguards requirements and the recent practice and putting an action plan for corrective measures that includes specific activities, budgets and implementation timelines.

2. Legal and institutional framework

The project is guided by the local laws and regulations set by the Palestinian Authority along with the World Bank environmental and social safeguard requirements.

2.1 Laws, Polices, Regulations and Standards

National Palestinian policies, laws and standards as well as the World Bank environmental and social safeguard requirements that are applicable for the project and the environmental and social audit report are summarized as follows:

- Palestinian Environmental Assessment Policy;
- Palestinian Environmental Law (PEL) No. 7 of 1999;
- Palestinian Water Law No. 14;
- Palestinian Public Health Law No. 20;
- Palestinian Law on Agriculture No. 2 of 2003;
- The Palestinian Labor Law No. 07 of 2000;
- Palestinian Ambient Air Quality Standards (PS 801- 2010);
- Outdoor Noise Standards (PS 840- 2005);
- Technical Specifications for the Reuse of Treated Wastewater in Irrigation 34/2012;
- The IFC's General Environmental, Health and Safety Guidelines (EHSG), and Environmental, Health, and Safety Guidelines for Water and Sanitation;
- WHO Air Quality Guidelines (2005);
- WHO Noise Level Guidelines (1999); and
- World Bank Environmental and Social Standards (ESSs).

More information regarding the relevance of each of these laws, policies, and standards to the project is provided in Annex 2.

2.2 Institutional arrangements

The Palestinian Water Authority (PWA) will be responsible for the implementation of the WMS Project. The Project Management Unit in PWA (PMU) will be responsible for Project oversight, monitoring, reporting, facilitation, hiring of consultants, contract awards, and coordination with stakeholders to ensure that the project objective is achieved.

For the first five years of the project operation PWA will be responsible for the operation and maintenance of the NGWWTP, while the CMWU in cooperation with the four municipalities in the northern governorates will still be responsible for the

operation of the TPS. However, after this period of five years, the operation of all facilities will be under the responsibility of the Coastal Municipalities Water Utility (CMWU) and the four municipalities in the northern governorate in the Gaza Strip, namely Beit Lahia, Beit Hanoun, Jabalia, and Um Al Naser.

Other governmental institutions will also be involved in the project monitoring activities, such as the Environment Quality Authority (EQA), the Ministry of Health (MoH), and the Ministry of Agriculture (MoA). These institutions will mainly be involved in monitoring the project compliance with Palestinian legislations and standards.

3. Description of the NGWWTP and the TPS

Currently, North Gaza sewage is collected and treated by Northern Gaza Emergency Sewage Treatment (NGEST) project. The main facilities of the sewage system are the TPS and the NGWWTP. The following is a brief description of these two facilities.

3.1. Terminal Pumping Station - TPS

The terminal pumping station is the main station where North Gaza sewage is collected and pumped to the NGWWTP. Figure 3.1 presents the site general layout of the TPS.

Figure 3.1 General Layout of the terminal pumping station (TPS).

The TPS and its main pressure pipeline were constructed, completed and entered into service by the end of 2009 and early 2010. Since that time, the TPS and the pressure pipeline started to pump and convey the raw sewage generated from North Gaza municipalities (Jabalia, Beit Lahia, Beit Hanoun and Um Al Naser) to infiltration basins at the NGWWTP site. The operation of these components was carried out through staff from the municipalities under technical assistance supported by the CMWU in accordance with memorandum of understanding signed between CMWU, North Gaza municipalities and PWA. The operation of the TPS at this stage aimed at evacuating and drying out the random lake to eliminate the risks of flooding to the surrounding population as well as the environmental contamination of the surrounding area and the groundwater aquifer. The entire temporary operation arrangement of TPS systems had been continued to be applied by all involved parties until March 2018 when the NGWWTP had become on board under testing and commissioning process followed by operation contract signed between PWA and JV contractor, the TPS continued to be separately operated through the same staff during presence of JV contractor.

The TPS includes the following main components:

- Screening building that houses the following:
  -Grit removal chamber
  -Two course bar screens
  - Screenings screw conveyers.
  - Screenings containers.
  - Manual control valves.
- Pumping room that houses the following:
  - Five vertical dry pumps – manufactured by ABS – type FR 250/250-48. The pumping station allows for installation of 3 additional pumps at the second stage.
  - Piping works valves, fittings and manifold.
- Generators Room that houses:
  - Two standby diesel generators.
  - Electric supply synchronizer.
- Electric panels' room.
- Control command room.

3.2. Pressurized main pipeline

From the TPS the sewage is pumped towards the NGWWTP via a 6,974 m rising from 30.75 m.a.s.l. to an inlet water level at the WWTP headworks of 56.70 m.a.s.l. The transmission line is a ductile pipe and has an inner diameter of 800 mm.

3.3. The NGWWTP

The NGWWTP is based on the activated sludge process that includes biological nitrogen and partial phosphorus removal. Primary sedimentation is incorporated. Sludge treatment is based on anaerobic treatment. This configuration is considered the Best Available Technology and allows for obtaining high quality effluent and a stabilized sludge that minimizes environmental and health risks.

After its commission in March 2018, the operation of the NGWWTP has been carried out by the JV contractor (two years O&M contract starting from July 1, 2018). The plant operations performance reports issued by JV contractor under the operation contract, where well-trained international and local staff was involved, showed remarkable achievement in accordance with the effluent quality requirements of BOD5, TSS, TN and specific energy requirements matching with the design figures and compatible for infiltration. The Contract with the JV contractor has been terminated on July 1, 2019 and since then PWA has been trying to fill the gap with limited financial and human resources available. With AFD support through emergency funding, PWA managed to operate and maintain the NGWWTP facilities up to the end of February, 2020. Under the WSM Project, the World Bank will secure additional financial resources to be deployed by July 1, 2020 for the coming three years. This indicates the urgent need for the project. As indicated in the PAD of this project, for the period from the first of March to the first of July , the PWA will be operating the NGWWTP facilities with ***a retroactive*** budget paid by the Palestinian Authority.

Figure 3.2 presents the general layout of the NGWWTP. The plant two treatment processes are incorporated into the plant:

- **Liquid treatment:** based on a biological process, to obtain effluent of a quality suitable for reuse or local use for recreation and landscaping .
- **Sludge treatment:** to obtain a type B sludge that allows for the sludge disposal at an authorized site or for restricted agricultural uses in the area, complying in both cases with the environmental requirements (both in quality and characteristics).

The following is a brief description of the components of the liquid and sludge treatments in the NGWWTP.

3.3.1. Liquid Treatment

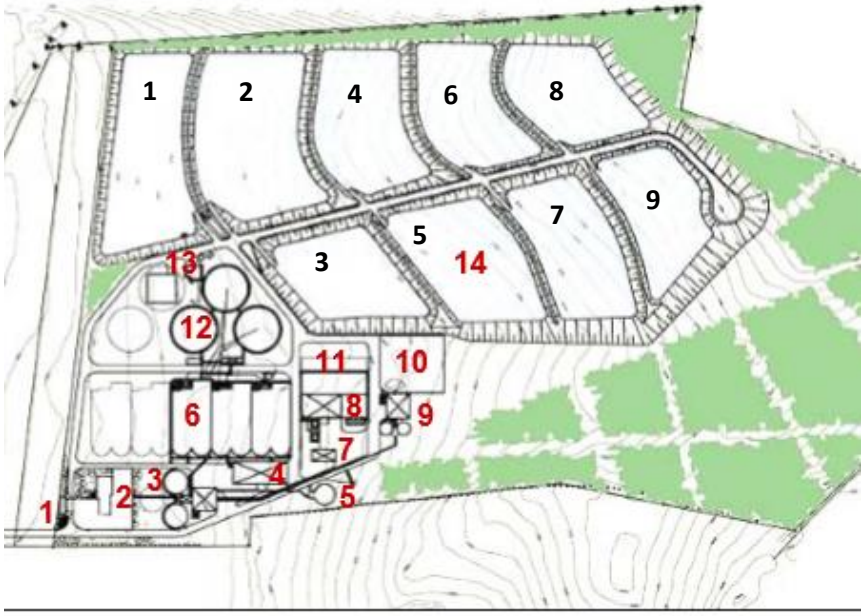
The liquid line treatment comprises of the following main components:

- Pre-aeration system
- Three fine bar screens (including a conveyor and screening compactor)
- Three grit and grease removal systems (including a grit classifiers)
- Three rectangular primary clarifiers
- Three biological treatment reactors
- Three secondary clarifiers
- One RAS/influent sewage pumping station (with three pumps)
- Five turbo blowers.

3.3.2. Sludge Treatment

The sludge treatment consists of the following main components:

- Two mixed primary sludge silos
- Two mixed biological sludge silos



1. Entrance	8. Primary Settling
2. Administration Building	9. Sludge Dewatering
3. Digesters	10. Sludge Storage
4. Energy Building	11. Preliminary Screening
5. Gas Holder	12. Final Clarifiers
6. Activated Sludge	13. Pump Station
7. Odor Treatment	14. Infiltration Basins

Figure 3.2 General Layout of the NGWWTP

- Two Gravity Belt Thickeners – a complete system with pumps and thickeners
- Two polymer makeup and dosing units for thickeners
- Two anaerobic digesters
- Digested sludge pumping station
- Two mixed digested sludge silos
- Two centrifuge decanters for sludge dewatering
- One dewatered sludge storage
- One polymer makeup and dosing units for centrifuges (including four pumps)
- Two heat exchangers
- One cogeneration unit
- One biogas storage system
- One biogas treatment system
- One biogas flare

3.3.3 Infiltration basins

The infiltration area is divided into nine basins with a total effective area of approximately 80,000 m^2 (see Figure 3.2). The infiltration basins are divided into three groups; Basins 1-2-3, Basins 4-5-7; and Basins 6-8-9. The effluent of the NGWWTP is distributed only to one of the three basin groups at a certain time. After flooding for a certain period, 0.5-2 days, the flooded basins are allowed to dry and the water is directed to the next basin group. The upper 5 cm layer of the basins is periodically scraped to remove the accumulated solids to overcome clogging.

4. Field inspection

This section presents the field inspection results of the TPS and NGWWTP sites.

4.1 Inspection findings for the TPS

During the inspection of the ***TPS*** site the following observations were made:

1. <u>The operation staff and operation manual:</u>
   - The existing operation staff in the TPS is composed of the following:
     - TPS manager (Mechanical Engineer)
     - Three operators (no qualifications).
     - Two guards (no qualifications).
     - Three workers (no qualifications)
     - Electric Technician

As indicated, the operation staff is generally unqualified to operate and maintain the pumping station. A capacity building program is needed to train the existing staff on operation and maintenance of the TPS. The lack of qualified staff resulted in the deterioration of the TPS status as mentioned in the coming items (items 2 to 7 of this section). The staff is not equipped with any of the PPEs that are usually used in such pumping stations.

- The TPS has a hard copy operation and maintenance manual that is actually not used by the staff. The operation manual is not user-friendly and needs to be modified and presented in a better form to facilitate its practical use by the staff.

2. <u>The pre-treatment building is not functioning properly:</u>
   - The two existing bar screens are not working and in bad conditions and should be replaced.
   - The screenings screw conveyers are malfunctioning and should either be repaired or replaced.
   - The ventilation and odour control systems are malfunctioning and should be repaired.
   - The floor and the walls of the building are dirty and a proper cleaning program should be maintained.
   - The maintenance control sluice gates are operated manually and the operator complained and requested motorized gates for proper operation of these gates.

The malfunction of the equipment and the poor housekeeping of the pretreatment building are posing environmental pollution and creating health and safety hazards to the operation staff.

3. The main pumps room :
   - Only one pump is working out of the existing 5 pumps. According to a technical annex performed for his project, 3 pumps should be replaced and two pumps should be repaired.
4. Overflow pond(Pond # 7):
   - The pond is full of raw wastewater and accumulated sludge and produce bad smell due to the anaerobic decomposition resulting from the long storage time. The shoulders of the pond are not high enough. This results in the overflow of sewage to the random lakes area creating environmental pollution and threatens the safety and health of the population.
5. Sludge storage area:
   - This area (around 10,000 m^2) lies to the west of pond # 7 and recently used to store the sludge produced from the NGWWTP. The sludge is randomly disposed and the area is not technically prepared to receive sludge. This is creating environmental pollution and threats the health and safety of the surrounding population.
6. Surge tank Accessories:
   - The surge tank installed in the TPS to protect the pressurised pipe that transfer the sewage to the NGWWTP. The surge tank is not working properly due to the malfunctioning of some of its accessories. The malfunctioning is a result of insufficient maintenance of the surge tank and its accompanying equipment .Three air compressors (3 Kw- 10 bar) and the control level sensors should be replaced. The risk of surge tank malfunctioning is the possible burst of the pressurised pipe due to water hammer action that will result in environmental pollution and health and safety hazards to the population and workers.
7. Control room and SCADA station:
   - The control room is completely malfunctioning and the SCAD system is dismantled and not working. SCADA system is important in the system control during normal and emergency cases and allows the operation staff to overcome emergency situations. Thus, the malfunctioning of the SCADA system compromises the automatic control ability and remote monitoring of the TPS.

4.2 Inspection findings for the NGWWTP

During the inspection of the NGWWTP site the following observations were made:

1. The operation staff and operation manual:
   - The existing operation staff in the NGWWTP is composed of the following:
     - Acting plant manager (Civil Engineer)
     - Mechanical Engineer
     - Electrical Engineer
     - One Plant operators
     - Three SCADA operators
     - One Laboratory Chief
     - Electric Technician
     - Mechanic Technician

- Five labours
- One Driver
- One Administrative
- One Secretary

The existing staff has basic qualifications that can be built on to initiate a suitable operation and maintenance team. The staff lacks the required experience in operating such a sophisticated treatment plant. An onsite capacity building program by qualified experts is needed to train the existing staff on the operation and maintenance to avoid the treatment system collapse.

- The staff is equipped with some of the PPEs that are usually used in such treatment plant (Helmets, masks, etc.), however, some PPEs are still missing and should be supplied.
- The NGWWTP has both soft and hard copies of the operation and maintenance manual. However, the staff is facing difficulties in using the operation manual as it is not user-friendly and needs to be modified and presented in a better form to facilitate its practical use.

2. <u>The pretreatment building is not functioning properly:</u>
   - The two existing bar screens are not working and in bad conditions and should be replaced.
   - The ventilation ducts are rusted and not airtight and should be maintained to guarantee proper operation of the odor control system.

The malfunction of the bar screens and the ventilation ducts are posing environmental pollution and health and safety hazards.

3. <u>The biogas storage equipment:</u>
   - The existing biogas membrane storage ball is punctured and needs repair. It also needs more protection from stray ammunition that comes from the nearby troubled boards. The risk of not repairing the storage ball is the loss of the produced gas as a valuable energy source and the air pollution due to releasing the biogas to the environment or burning it using the existing flare.

4. <u>Sludge production and storage:</u>
   - The quantity of the produced sludge is relatively high (86 ton/day) and the sludge storage yard in the NGWWTP is not adequate to store this quantity.
   - The quality of the produced sludge is not meeting the sludge reuse standards for agriculture (as a fertilizer); consequently it is not allowed to use it for this purpose.
   - The sludge is transferred out of the NGWWTP site and disposed in the TPS site on land as indicated in *item 4.1* above and creating health and environmental hazards at that site.

- Generally, the recent sludge management procedures in the NGWWTP is inappropriate and posing health and safety hazards on the operation staff and the community and creating environmental pollution at the TPS site.

5. Availability of treatment chemicals:
   - Polymers are the main chemical required in the NGWWTP. It is used for sludge thickening and dewatering. The shortage in these chemicals hinders the sludge treatment line and within 5 days leads to complete halt of the NGWWTP.
   - The stoppage of the treatment plant leads to sewage floods at the TPS site and consequently causes environmental pollution and threatens the public safety and health of the surrounding communities.
   - The NGWWTP suffered from polymers shortage in September 2019 for few days until a temporary fund was used to supply polymers till the end of February 2020 by the AFD agency. During the shortage period, the treatment plant was not able to receive all the sewage from the TPS and sewage started to accumulate in the overflow pond # 7 with a high risk of flooding; the public safety around the TPS is a high concern. Starting from March first until the first of July when the bank fund will be available, PWA will use a retroactive budget covered by the Palestinian Authority and will be included in the project budget as indicated in the project PAD. Part of this budget will be used to purchase polymers to keep the NGWWTP running and to avoid the reoccurrence of the flooding events from pond #7.

6. Electric voltage fluctuations at the NGWWTP:
   - The electric voltage from the electricity grid fluctuates leading to malfunctioning of some of the sensitive electric equipment in the plant. This negatively affects the treatment plant operation.
   - A voltage stabilizer is needed to protect the electric equipment and consequently prevent the occurrence of unfavorable environmental and safety situations.

7. Recent Treatment capacity of the NGWWTP:
   - The current plant treats an average flow of 34,400 m^3/day while 10% of the time the influent flows exceeds 40,000 m^3/day. The design flows for the plant are 35,600 m^3/day. This means that the plant is operating near the design flows and may not operate well in the near future as the flows increase. The anticipated average daily flows will increase in the coming years to reach the current design capacity in 2021, and about 41,000 m^3/day in 2025. The proposed modifications of Pond 7 will increase the capacity of the plant to

41,400 m^3/day which would be sufficient until more capacity is added to the plant.

- The expected insufficient treatment in the near future means that the NGWWTP will not meet the Palestinian effluent standard. In this situation the treated effluent cannot be pumped to the infiltration basins as that will pose a high risk on the groundwater aquifer and will eventually create high risk on the public safety specially the farmers and their families.
- To avoid such a situation, the preparations for the construction of the second phase of the NGWWTP, which was supposed to start in 2025, should start as soon as possible to increase the plant capacity. It is proposed to start preparation of the tender documents for phase II under the WMS project, so that they could be finalized by the end of 2020, in order to facilitate the fund raising for the construction activities of this phase. The construction activities should start as early as possible (June 2021 is recommended), so as to start the operation of the second phase of the plant by 2024.

5. Environmental and social audit for the O&M procedures of NGWWTP and the TPS

The World Bank environmental and social frame work has outlined a set of environmental and social standards and requirements that should be followed during construction, operation, and maintenance of projects funded by the World Bank. Usually, these standards and requirements are reflected in an environmental and social management plan (**ESMP**) for the project under consideration which is prepared in a separate document and used as a reference for environmental and social (**E&S**) auditing. For this project, the ***ESMP of the NGEST*** project prepared on 2006 (see Annex 1), is used as a reference for the Environmental and social audit presented in this report.

This audit is presented in two sections as the following:

1. Environmental audit of the O&M procedures in the NGWWTP and TPS (**section 5.1**).
2. Social audit of the O&M procedures in the NGWWTP and TPS (**section 5.2**).

5.1 Environmental Audit of the O&M procedures in the NGWWTP and TPS

The ESMP of the NGEST project (called hereafter "NGEST/ESMP") has outlined a set of environmental performance standards/indicators that are supposed to be monitored during operation and maintenance stage. The NGEST/ESMP covers the NGWWTP including the infiltration basins and the TPS. The NGEST/ESMP is presented in Annex 1. Table 5.1 presents the NGEST/ESMP requirements together with the environmental ***audit findings*** for the **NGWWTP** and the **TPS** operation and maintenance procedures**.**

As shown in Table 5.1, the main environmental aspects/issues related to this project are:

- Groundwater quality
- Noise quality
- Emissions and Air quality
- Wastewater discharge
- Sludge and waste disposal
- Hazardous waste management
- Energy conservation
- Organizational capacity and competency

The following items (5.1.1 to 5.1.8) present each of above mentioned environmental aspects together with its audit findings (i.e. gaps and compliance status).

5.1.1 Ground water quality monitoring:

- Based on site inspection and meetings with recent O&M staff, there is a **partial compliance** with the **ESMP** in monitoring the groundwater quality in the aquifer beneath the infiltration basins in the NGWWTP. These infiltration basins are used to infiltrate the treated wastewater to the aquifer. Table 4.4 in the ESMP (Annex 1) presented a specific monitoring program showing the groundwater and the treated wastewater quality parameters to be tested and the testing frequency. The purpose of this testing program is to check the effectiveness of groundwater protection measures from possible pollution in case of the deterioration of treated wastewater quality. The O&M staff in the NGWWTP partially applied the testing program due to shortage of financial support. Table A3.1 in Annex 3 presents sample of the test results for ground water and Table A3.2 in Annex 3 presents sample of the test results for treated wastewater performed by the O&M staff of the NGWWP.
- The previous monitoring of groundwater quality (mainly nitrate concentration in the groundwater within the project area before the operation of the NGWWTP) shows that the nitrate concentration in the plant site and the area to the west of the site is between 50 and 100 mg/l. These high levels of nitrate are due to the infiltration of partially treated wastewater received from BLWWTP into the infiltration basins.
- Other parameters were measured in late 2017 to identify the best locations and designs of the monitoring wells around the NG WWTP site. The measured parameters included Ammonia, detergents, and phenols, which can be used as indicators of water pollution with wastewater. The measurement of ammonia concentration indicated high levels of Ammonia in the wells that are close to the infiltration basins, while lower concentrations were recorded in farther wells. The obtained results for detergents ranged from 1.1-7.8 mg/l, which are considered to be high for groundwater wells and indicate an entry of external source of pollution. Relatively high levels of phenol that reached 18 mg/l at some locations were also recorded
- The monitoring program in the ESIA/ESMP required a regular infiltration performance check in the infiltration basin. The O&M staff **complied partially**

to this requirement in terms of the test frequency. Due to the lack of staff this test has stopped since August 2019.

Recommended actions to bridge compliance gaps:

- Comprehensive aquifer water quality and water level monitoring program should be conducted regularly by O&M staff based on the frequency given in Table 4.4 of the ESMP (Annex 1).
- Regular infiltration performance check (once per week) should be implemented by O&M staff as indicated in the ESMP.
- Updating the NGEST groundwater model (flow and solute transport) that was prepared to monitor the aquifer underlying the project area, and ensure its safeguard. The update will be conducted by a ground water modeling expert.
- Additional staff should be hired to enhance the O&M staff ability to perform the required tests.

5.1.2 Noise quality monitoring

According to the NGEST/ESMP, specific design measures were applied to mitigate the noise emissions during the operation of NGWWTP and TPS. These measures included the enclosure of noise producing equipment inside buildings and /or equipping them with silencers. Based on site inspection and meetings with recent O&M staff, there is a **Full Compliance** with the noise control requirements stated in the NGEST/ESMP. All the noise producing equipment are enclosed in closed buildings (especially the air blowers in NGWWTP) and no noise was detected outside buildings in the NGWWSTP and the TPS sites during site visits

Recommended actions to bridge compliance gaps:

- No action is needed regarding noise quality control due to full compliance with the NGEST/ESMP requirements.

5.1.3 Emissions and air quality monitoring:

- The monitoring program in the NGEST/ESMP required control of the air pollutants from the diesel power generators in both sites (NGWWTP & TPS). **No compliance** to this requirement has been detected. From site inspection, it was noticed that when diesel generators are operated at power cut events in the NGWWTP and TPS, the generator's exhaust is released directly into the air without filtering. This practice is creating a health and air pollution hazard.
- Proper operation of the odor control system in the **NGWWTP** site was required in the NGEST/ESMP as mitigation for air pollution. **Full compliance** to this requirement has been detected. No bad odors were detected during site visits and the odor control system in **NGWWTP** is operating well and in a good conditions. .

- Proper operation of the odor control system in the **TPS** site was required as mitigation in the ESMP for air pollution. **No compliance** to this requirement was detected. During site visits, an offensive bad odor was detected around the screen building and around pond #7.The odor control system in the TPS screening building is not operating and in a bad condition and should be repaired and properly operated and maintained. The reason for the odor system malfunction is the lack of operation and maintenance budget.

Some environmental aspects/risks related to **emissions and air quality** was not mentioned in the **NGEST/ESMP**. These aspects are presented hereafter:

- It was observed during site inspection that the biogas collection, treatment and reuse system in the NGWWTP is improperly operated. The gas storage balloon is punctured and the produced biogas is burned using the emergency torch "'flare" creating **air emissions** and losing a viable energy source. The biogas balloon was damaged by astray ammunitions coming across the nearby boarders. It was not repaired due to lack of funding needed for repair and for constructing protection structure to prevent future punctures.
- It was observed that the overflow pond (Pond # 7) at the TPS is improperly operated and maintained. The pond is full of raw septic wastewater and creating **bad smell and air pollution** and posing CHS and OHS hazards. This situation is created due to the malfunctioning of the most of the pumps (3 out of five pumps) in the TPS. Pumps were not repaired due to Lack of funding.

Recommended actions to bridge compliance gaps:

- Control the air pollutants from the of the power generators emissions by installing exhaust filters.
- Repairing the odor control system in the screening building in the TPS.
- Repair of the existing gas storage balloon and operationalization of the existing gas collection and treatment system.
- Stop disposing the sludge at the TPS and develop an agreement between PWA and Municipality of Gaza for the disposal of the sludge of NGWWTP to Joher El Deek landfill.
- Install a mixer to aerate pond #7 to prevent the occurrence of anaerobic condition and bad smell.
- Air sampling to be conducted as needed and in case of workers or community complains at both sites (NGWWTP and TPS). The main gases to be measured are NH_3 and H_2S (odor producing gases).

5.1.4 Wastewater discharge:

- The monitoring program in the **NGEST/ESMP** required comprehensive wastewater quality monitoring program (Table 4.4, in the ESMP, presented in Annex1, this report). Based on reviewing samples of wastewater lab results

and meetings with recent O&M staff, there is a **partial compliance** with **NGEST/ESMP requirements** in monitoring the wastewater quality in the NGWWTP. The O&M staff in the NGWWTP partially applied the testing program in terms of frequency due to shortage of financial support. Table A3.2 in Annex 3 presents sample of the test results for treated wastewater performed by the O&M staff of the NGWWTP. These results indicated that the NGWWTP is meeting the Palestinian treatment standards. However, full compliance of the monitoring program should be resumed to ensure continuous commitment to treated WW quality standards.

An important environmental risk related to **wastewater discharge monitoring** was detected during site inspection but was not mentioned in the **NGEST/ESMP.** This risk is the raw wastewater flooding to surrounding areas in the TPS site due to the malfunctioning of **the pumps** (3 out of 5 are malfunctioning) and the inadequacy of the overflow pond (Pond #7) at the **TPS** facility. Moreover, this flood occurs also when the treatment capacity of the NGWWTP decrease due to occasional technical difficulties such as increased hydraulic loads. This flooding poses soil and air pollution hazards. Moreover, the community health and safety (CHS) and the workers' health and safety (OHS) are exposed to high risk.

Recommended actions to bridge compliance gaps:

- Implementing comprehensive wastewater quality monitoring program based on Table 4.4, in the ESMP as presented in Annex1 of this report.
- Replacing the malfunctioning equipment in TPS by new ones as indicted in the technical audit of this project (pumps, bar screens, SCADA, etc.…).
- Initiate building capacity program for the operational staff to properly operate and maintain different facilities of the NGWWTP and TPS.
- Starting preparation for constructing phase II of the NGWWTP by updating/preparing tender documents. The preparation of the tender documents is proposed to be finalized by the end of 2020, so that the beginning of the construction could take place in June 2021, and the operation could be started by 2024.
- Constructing an over flow system at the TPS with adequate storage capacity as indicated in the technical audit (overflow line, overflow pond #7, etc.…).
- Replacing/repairing the malfunctioning equipment in NGWWTP by new ones as indicted in the technical audit of this project (bar screens, gas ballon).

5.1.5 Sludge and waste disposal

- According to the NGEST/ESMP, the generated sludge from NGWWTP and TPS will be collected and transported by a licensed contractor. Final disposal of sludge will be to local landfill sites, as agreed by the EQA. During the site visit, the O&M team mentioned that sludge is recently disposed at the TPS site due to the lack of

financial support to pay for transport and disposal at an authorized land fill. Huge piles of sludge still improperly stored in TPS site as observed during site inspection. Despite the fact that this sludge is stabilized in the NGWWTP before disposal in the TPS site, it still form a habitat for mosquitos and other insects and its leachate during rain storms may pollute soil and may eventually pollute ground water if the recent disposal practice continues .Thus, the current sludge management procedures in the NGWWTP are **not complying** with the NGEST/ESMP **and creates pollution, CHS, and OHS hazards.**

Recommended actions to bridge compliance gaps:

- Prepare sludge management plan for the NGWWTP and TPS to ensure its safe handling and disposal in an environmentally accepted manner. The plan should include agreement between PWA and Municipality of Gaza for the disposal of the sludge of NGWWTP to Joher El Deek landfill.
- Stop disposing the sludge from NGWWTP to the TPS and dispose the recently accumulated sludge at TPS to an authorized land fill (e.g. Joher El Deek landfill).

5.1.6 Hazardous waste management

According to the **NGEST/ESMP**, risks associated with hazardous waste spill, handling, and storage are mitigated by specific measures explained here and checked for compliance.

- Employees should be trained on the hazards, precautions and procedures for safe storage, handling and use of all potentially harmful materials relevant to each employee's task and work area. **No compliance** to this requirement was observed. Based on interviews with the O&M staff at the NGWWTP and TPS, they did not receive the required training.

- A first aid station with trained staff, that is able to coordinate with local hospitals in case of emergencies. **No compliance** to this requirement was detected. The existing first aid room lacks the necessary medical equipment and there is no trained staff to perform the required duties.

- Preparing and implementing spill response and emergency plans to address their accidental release. **No compliance** to this requirement was observed. Based on the interview with the NGWWTP and TPS mangers spill response and emergency plans are neither prepared nor employed.

- Follow safety instructions, worker should wear proper clothing. **Partial compliance** to this requirement was detected. From site inspection, the existing staff at the NGWWTP is not provided with all the required PPEs.

Recommended actions to bridge compliance gaps:

- A complete OHS system should be developed for both facilities (NGWWTP and TPS) for the operation and maintenance period. This will include but not limited to
  - Employees should be trained on the hazards, precautions and procedures for safe storage, handling and use of all potentially harmful materials relevant to each employee's task and work area.
  - Providing the O&M staff with the proper PPEs and equipment for dealing with hazardous materials such as polymers, oils, and lubricants.
  - A first aid station with trained staff, which is able to coordinate with local hospitals in case of emergencies.
  - Preparing and implementing spill response and emergency plans to address their accidental release.

5.1.7 Energy conservation

The NGEST/ESMP didn't mention the energy conservation issue. However, according to previous experience, some risks are associated with this project regarding energy conservation and should be considered. These risks are mitigated by specific measures explained hereafter:

- The NGWWTP is exposed to the risk of energy shortage due to the relatively high demand of the plant (around 3 MW) and due to the energy crises in Gaza. This risk is mitigated by using renewable energy sources such as solar energy and biogas. Based on information collected from PWA, fund from AFD & Green climate Fund (GCF) has been saved for constructing a PV system in the NGWWTP to produce around 5 MW but not yet designed or constructed. Moreover, the NGWWTP is equipped with biogas production system but needs repair and commissioning.
- The NGWWTP is recently exposed to the risk of air pollution from biogas burning. During the site visit, it was noticed that the produced biogas is burned using the existing torch producing air pollutants. The biogas is burned because the gas storage balloon is punctured and needs to be repaired and protected from future punctures. Moreover, all the gas system needs to be repaired and commissioned to start biogas production, storage and usage. Based on that, partial compliance to the energy conservation requirements and World Bank standards ESS1 &ESS3 is achieved in the NGWWTP.

Recommended actions:

- Construct the PV system as planned and use it for energy production in the NGWWTP.
- Repairing and commissioning of the biogas system in the NGWWTP and use the produced biogas for energy production.

5.1.8 Organizational capacity and competency

The ESIA identifies the persons/institutions responsible for the implementation and supervision of each item in the management program. The ESIA also presented the organizational chart of the Environmental Management Staff (EMS) under the Project Management Unit (PMU). The following are the main points of concern that were observed during this audit regarding institutional responsibilities and environmental management system at PWA:

- **Institutional responsibilities:**

It was planned that CMWU will be fully responsible for the operation and maintenance of NGWWTP and TPS. Most of the responsibilities of the PWA/PMU were supposed to be moved to the CMWU while PWA will act as a regulator agency. **Partial compliance** was observed regarding this issue since CMWU recently has no responsibility in the operation of the NGWWTP while it has the full responsibility for the operation of the TPS. PMU is recently responsible for the operation the NGWWTP. It is supposed to re-arrange the institutional setup and management structure for operation the NGEST project components between CMWU, PWA and PMU. Other institutions such as environmental quality authority (EQA), ministry of agriculture (MOA) and ministry of health (MOH) were mentioned in the NGEST ESMP as monitoring institutions. These institutions still involved in the monitoring process in the NGWWTP.

- **Current practice of environmental management system (ESMS) at PWA/PMU:**

PWA has developed an Environmental and Social Management Plan for the NGEST project to keep up with the environmental and social policy of the Bank since year 2006. An environmental and social officer (ESO) was supposed to be hired to follow the implementation of the environmental and social management plan (ESMP) together with the other institutions involved in the ESMS. Unfortunately, the ESO was not hired due to financing difficulties. However, during this period, the PMU usually assigned one of its employees as an acting ESO and was responsible for leading the monitoring process as stated in the ESIA/ESMP together with EQA, MOH, MOA and other stakeholders.

Recommendation:

The current ESMS arrangement is not appropriate and should be strengthened by hiring a professional ESO possessing the competency to lead the ESMS of at the PWA/PMU.

5.2 Compliance to social monitoring requirements:

The NEST/ESMP (Annex 1) has outlined a set of social performance standards/indicators that were supposed to be monitored during operation and

maintenance stage. Table 5.2 presents the NEST/ESMP requirements together with the social audit findings of the NGWWTP and the TPS O&M procedures. As shown in Table 5.2, the main social aspects/issues related to this project are:

- Labor and working conditions including occupational health and safety management.
- Community health and safety.
- Stakeholder engagement and public consultation.

The following items (5.2.1 to 5.2.3) present each of above mentioned social aspects together with its audit findings (i.e. gaps and compliance status).

5.2.1 Labor and working conditions and occupational health and safety management:

According to the **World Bank E&S** standards, specific plans and reports should be available in the operation period of the NGWWTP and the TPS including: working conditions, management as well employment and human resources management, child labor, workers' guidance on the workforce code of conduct. The workers grievance mechanism and the occupational health and safety management plan are issues that should be enclosed in the **ESMP** and labor management procedures (**LMP**) of the **WMS** project.

The following is description of the audit findings presented in two parts:

- Occupational Health and safety status.
- Labor and working conditions status.

A. Occupational Health and safety issues

- According to the NGEST/ESMP, the staff is supposed to use proper PPEs for their health protection and safety. **Partial compliance** to this requirement was observed since the staff use some of the standard PPEs such as helmets and vests but still need other equipment such as protective boots, glasses, mask, and overhaul suit suitable for chemicals contact. Moreover, according to the World Bank environmental health and safety (**WB EHS**) requirements when the workers are exposed to chemicals they should use special personal protective equipment (**PPEs**).
- A first aid station with trained staff was supposed to be in place in the NGWWTP, which is able to coordinate with local hospitals in case of emergencies. **Partial compliance** is observed regarding this issue and to **ESS2**. A first aid room has been specified in the administration building of the NGWWTP. However, it lacks the suitable furniture and first aid kits. Moreover there is no trained professional staff on first aid procedures and skills.
- Employees were supposed to be trained on the hazards, precautions and procedures for safe storage, handling and use of all potentially harmful materials relevant to each employee's task and work area. **No compliance** was

observer to these requirements. Recent staff members are not trained on handling chemicals (such as polymers) and sludge.

- The work place should have proper ventilation to refresh oxygen and reduce temperature (labs, control rooms, etc.) According to the **WB EHS** requirements it is necessary to have appropriate ventilation system in closed spaces in case of expected production of gases or dust. **Partial compliance** was observed regarding ventilation. In the NGWWTP, the ventilation equipment are generally functioning well except in the pretreatment building were the ventilation system needs to be repaired. In the TPS, the ventilation system in the pretreatment building is not working and needs to be repaired.

B. Labor and working conditions:

The NGEST/ESMP does not include actions regarding the Employment and Human Resources management as well as Working Conditions Management and Monitoring.

- Workers Grievance mechanism:

The NGEST/ESMP refers to the monitoring of the scope and number of grievances received from the stakeholders, but not to the workers grievance mechanism. Therefore, the **ESMP** which will be prepared to the **WMS** project should include a fully complaint operation environmental and social management plan including the **workers grievance mechanism (GRM)**. The recent O&M staff is using the PWA GRM system. However, a modified version of the PWA GRM system will be ready by the commencement of the WMS project and will be used by the O&M staff for their grievances. Thus, **partial compliance** with the NGEST/ESMP is observed regarding workers **GRM**.

- Communication and training:

Based on the NGEST/ESMP, the workers will undergo environmental and social training in several areas like operation of the WMS project, occupational health and safety. Some of the recent O&M staff received training on some issues such as: First Aid, Fire extinguisher use, safety measures during operation and maintains works. However, they still need to be trained and educated on many other topics as mentioned in sections 5.1 and 5.2 of this report. Thus, **partial compliance** with NGEST/ESMP requirements is observed regarding labor training.

- Risk of GBV and SEA

The NGEST/ESMP did not focus on the issue of Gender based violence (GBV) and sexual exploitation and abuse (SEA). However, GBV and SEA are of high importance according to the World Bank E &S standards. According to the information collected from site and from project documents there is no management plans or procedures

regarding this issue. Thus, mitigation measures for the risk of GBV/SEA should be enclosed in the **ESMP** to be prepared for the **WMS** project to cover this important issue.

- Workers legal rights and workforce code of conduct

Based on the NGEST/ESMP, the workers will receive training regarding their legal rights and workforce code of conduct. The recent staff did not receive the required training. Thus, the recent procedures in the NGWWTP and TPS are **not complying** with the NGEST/ESMP regarding. However, this training is enclosed in the ESMP and LMP reports to be prepared for the **WMS** project.

Recommended actions to bridge compliance gaps:

- Provide workers with PPE Follow safety instructions, worker should wear proper clothing at both sites (NGWWTP and TPS).
- Immediate provision of OHS training to all plant operators and workers as per their job functions
- Initiating a first aid station with trained staff (2 to 3), which is able to coordinate with local hospitals in case of emergencies in the TPS.
- Supplying the existing first aid room in the NGWWTP with necessary missing furniture and equipment and training selected 2 to 3 staff members on first aid skills and procedures.
- Constructing an over flow system at the TPS with adequate storage capacity as indicated in the technical audit (overflow line, overflow pond #7, etc.)
- Replacing/repairing the malfunctioning equipment in NGWWTP by new ones as indicted in the technical audit of this project (bar screens, gas balloon).
- Initiate building capacity program for the operational staff to properly operate and maintain different facilities of the NGWWTP.
- Dismantling the electric distribution panels in the TPS from the lower level in the pumps room and installing them at the upper level in a safe position.
- Construct additional reinforcement of the existing protection structure to the biogas balloon against astray ammunition.
- Organize awareness raising sessions and educate the workers on their legal rights and workforce code of conduct.
- Organize awareness raising sessions and educate the workers and the community in the Project site on issues of GBV/SEA, legal rights, GRM and referral path for victims of GBV/SEA;
- GBV/SEA risks should be monitored continuously through the life cycle of the Project;
- GRM for GBV/SEA should be strengthened and integrated to track complaints related to GBV/SEA, including a feedback system for regular and timely feedback on actions taken to respond to complaints.

5.2.2 Community health and safety

Based on the NGEST/ESMP review, a community health and safety plan for the operation phase have been prepared including the expected risks from the project activities and the required mitigation measures. The main risks mentioned in this plan were the risk of people drowning in the infiltration basins, traffic safety, and possible air pollution. However, other risks (not included in the NGEST/ESMP) were recognized during the audit process such as gender based violence (**GBV**) and sexual exploitation and abuse (**SEA**). The compliance status in implementing the mitigation measures for all mentioned risks is as follows:

- Proper fencing is installed around the NGWWTP and the TPS site as mitigation measure to drowning risk.
- From site visits observations, traffic during the operation and maintenance is minimal and not posing any risk to the community. Most of the activities are limited inside the NGWWTP and TPS sites.
- Sludge disposal from the NGWWTP into TPS is found improper and **don't comply** with the environmental and social standards. It forms a habitat for mosquitos and other insects and its leachate during rain storms may pollute soil and may eventually pollute ground water if the recent disposal practice continues.
- The risk of **GBV/SEA** is not tackled with any mitigation measure. The workers and the community in the project sites have not been educated on issues of **GBV/SEA**, legal rights and referral path for victims of **GBV/SEA**, no exact **grievance redress mechanism** (**GRM**) was included. However, based on the environmental and social instruments required for the WMS project, a stakeholder engagement plan has been prepared, that includes a grievance mechanism for all the key stakeholders.

Recommended actions to bridge compliance gaps:

A. Recommendations regarding **GBV/SEA** risks:

- Organize awareness raising sessions and educate the workers and the community in the Project site on issues of **GBV/SEA**, legal rights, **grievance redress mechanism** (**GRM**) and referral path for victims of GBV/SEA;
- GBV/SEA risks should be monitored continuously through the life cycle of the Project.
- Project **GRM** should include special provisions for GBV/SEA complaints management, including a feedback system for regular and timely feedback on actions taken to respond to complaints.

B. Technical Recommendations regarding **safety and health protection:**

- Repairing the existing surge tank and its accessories to protect the pressure line from explosion (3 air compressors and level sensors).

- Replacing the malfunctioning equipment in TPS by new ones as indicted in the technical audit of this project (pumps, bar screens, SCADA, etc…)
- Initiate building capacity program for the operational staff to properly operate and maintain different facilities of the TPS.
- Preparing tender documents to build phase II of NGWWTP to increase its treatment capacity to cope with the increased hydraulic and pollution loads.
- Stop disposing the sludge from NGWWTP to the TPS and dispose the accumulated sludge at TPS to an unauthorized land fill (e.g. Joher El Deek landfill).
- Prepare sludge management plan for the NGWWTP to ensure its safe handling and disposal in an environmentally accepted manner. The plan should include agreement between PWA and Municipality of Gaza for the disposal of the sludge of NGWWTP to Joher El Deek landfill.
- Prepare a spill control management for sludge transport from the NGWWTP to the authorized land fill.

5.2.3 Stakeholder engagement and Public consultation:

According to the NGEST/ESMP it is required to conduct public information campaigns during the project operation to keep the public informed regarding the operation and maintenance status of the NGWWTP and the TPS. **Partial compliance** was observed regarding this requirement with the NGEST/ESMP. According to the information collected from site and from the PWA/PMU management, PWA has been engaging with various project stakeholders since the end of 2017, as part of the preparation of the BLWWTP decommissioning plan, of which some items are considered under the components of the WMS project (i.e. TPS and pond#7 that are located inside the BLWWTP site). Moreover, number of stakeholder engagement activities has taken place during the preparation of WMS project. The activities have targeted the key stakeholders who need to be involved in the project and the engagement plan preparation; these activities include the following:

- Public consultation meeting with the local communities found to be directly affected by the project (December 3rd, 2019); and
- Informal meetings with municipalities and governmental agencies (November 25-28, 2019).

The stakeholder engagement and public consultations still needs to be enhanced during the O&M as indicated in the SEP which has been prepared for the **WMS project**.

Recommended actions to bridge compliance gaps:

- Adopt and implement the stakeholders engagement plan (**SEP)** which has been prepared in accordance with the terms of the ESF including:
  - Effective information dissemination and consultations.

- Training of key players in the project implementation as needed to implement the plan,
- Organize stakeholder consultations under the **SEP** and emergency preparedness and response;
- Establish appropriate channels of communication to maintain continuous engagement and communicating additional information that may arise at key stages in the project cycle;
- Establishing project **GRM** that will ensure reception and timely response to any complaints made about the project (including those from members of the communities and other stakeholders and will be the basis for developing appropriate mitigation strategies).

Audit findings are presented in Tables 5.1 and 5.2 hereafter.

Table 5.1 : Summary of Audit Assessment on compliance of the NGWWPT and TPS O&M procedures with the ESMP

Item No.	Environmental Issue/ Risk	Mitigation Measures	Audit Assessment Compliance with ESMP and WB ESSs			Description of compliance status
			Compliance	Partial Compliance	None-Compliance	
5.1.1	**Groundwater Quality**					
	Aquifer pollution at the infiltration Basin in the ***NGWWTP site***: • expansion of the nitrogen plume • salinity • pathogenic bacteria (Fecal coliform) • Increased level of toxic contaminants	• Regular cleaning of the infiltration ponds (scraping, sediment removal)	☒	☐	☐	• Full compliance to **NGEST ESMP** mitigation requirements, cleaning is performed as required.
		• Comprehensive aquifer water quality and water level monitoring program (Table 4.4, in the ESMP, presented in Annex1, this report) this includes testing the treated wastewater quality.	☐	☒	☐	• Partial compliance to **NGEST ESMP** mitigation requirements. Water quality and levels testing is performed but not as required in terms of testing frequency as per Table 4.4 **ESMP- Annex1**.
		• Regular infiltration performance check	☐	☒	☐	• Partial compliance to **NGEST ESMP** mitigation requirements. Infiltration performance check is performed but not as required in terms of testing frequency as per the mitigation measures.
		• Follow alternate operations plan (short flooding and drying periods)	☒	☐	☐	• Full compliance with **NGEST ESMP** mitigation requirements, alternate operations plan is performed as required.
		• no wells should be operated within a distance of 6 month residence time from the edge of infiltration basins (>150 meters)	☒	☐	☐	• **Full compliance** with **NGEST ESMP** mitigation requirements, no wells are operated within the specified distance.
5.1.2	**Noise Quality**					
	• Noise generation (pumps, generators) at NGWWTP and TPS	• Ensure that noisy activities occur during daytime and not during	☒	☐	☐	• **Full compliance** with **NGEST ESMP** mitigation requirements, all noise

Table 5.1 : Summary of Audit Assessment on compliance of the NGWWPT and TPS O&M procedures with the ESMP

Item No.	Environmental Issue/ Risk	Mitigation Measures	Audit Assessment Compliance with ESMP and WB ESSs			Description of compliance status
			Compliance	Partial Compliance	None-Compliance	
		holidays or late night times. Random checking is required. • The noise producing equipment are enclosed inside buildings and /or has silencers.				producing equipment are enclosed inside buildings and /or have silencers.
5.1.3	**Emissions and Air quality**					
	• Air pollutant generated by diesel generators at ***NGWWTP and TPS***. • Bad smell from treatment units in ***NGWWTP*** (H_2S, NH_3, etc....) • Bad smell in the inlet works of the screening building in the ***TPS***	• Control the air pollutants from the power generators emissions	☐	☐	☒	• **NO compliance** with **NGEST ESMP** mitigation requirements. No filters are installed on the diesel generators exhaust line. The odor control system at the inlets works building is malfunctioning.
		• Proper operations of the odor control system in the ***NGWWTP*** site	☒	☐	☐	• **Full compliance** with **NGEST ESMP** mitigation requirements, the odor control system in the ***NGWWTP*** site is operated properly and the emissions are controlled. No bad smell is detected.
		• Proper operations of the odor control system in the **TPS** site	☐	☐	☒	• **No compliance** with **NGEST ESMP** mitigation requirements. The odor control system at the inlets works building is malfunctioning.
5.1.4	**Wastewater discharge**					
	• Improper disposal of treated wastewater to the infiltration basins at the NGWWTP.	• Comprehensive wastewater quality monitoring program (Table 4.4, in the ESMP, presented in Annex1, this report)	☐	☒	☐	• Partial compliance with **NGEST ESMP** mitigation requirements. Wastewater is performed but not as required in terms of testing frequency as per Table 4.4 **ESMP-Annex1**.

Table 5.1 : Summary of Audit Assessment on compliance of the NGWWPT and TPS O&M procedures with the ESMP

Item No.	Environmental Issue/ Risk	Mitigation Measures	Audit Assessment Compliance with ESMP and WB ESSs			Description of compliance status
			Compliance	Partial Compliance	None-Compliance	
5.1.6	**Hazardous waste management**					
	• Risk of spill of hazardous waste such as oils, lubricants, polymers. • Risk of storage and handling hazardous materials used in the **NGWWTP** and **TPS** such as polymers.	• Employees should be trained on the hazards, precautions and procedures for safe storage, handling and use of all potentially harmful materials relevant to each employee's task and work area.	☐	☐	☒	• **No compliance** with **NGEST ESMP** mitigation requirements. The existing staff at the NGWWTP did not receive the required training.
		• Follow safety instructions, worker should wear proper clothing	☐	☒	☐	• **Partial compliance** with **NGEST ESMP** mitigation requirements. The existing staff at the NGWWTP did not have all the required PPEs.
		• A first aid station with trained staff, which is able to coordinate with local hospitals in case of emergencies.	☐	☒	☐	• **Partial compliance** with **NGEST ESMP** mitigation requirements. A first aid station exists but lacks some equipment and trained staff.
		• Preparing and implementing spill response and emergency plans to address their accidental release.	☐	☐	☒	• **No compliance** with **NGEST ESMP** mitigation requirements. Spill response and emergency plans are neither prepared nor employed.

Table 5.2 : Social audit findings on compliance status of the NGWWPT and TPS O&M procedures with the NGEST/ESMP

Item No.	Social Aspect/ Risks	Mitigation Measures	Audit Findings			Description of compliance status
			Compliance	Partial Compliance	None-Compliance	
5.2.1	**Labor working conditions including Occupational Health and Safety**					
	• Risk of Accident, injuries and handling of toxic and hazardous material • Noise generation. • Emissions and air pollution in the work environment.	• Follow safety instructions, worker should wear proper clothing.	☐	☒	☐	• Partial compliance with **NGEST ESMP** mitigation requirements. The existing staff at the NGWWTP do not have all the required PPEs . .
		• A first aid station with trained staff, which is able to coordinate with local hospitals in case of emergencies	☐	☒	☐	• **Partial compliance** with **NGEST ESMP** mitigation requirements. A first aid station exists but lacks some equipment and trained staff.
		• Employees will be trained on the hazards, precautions and procedures for safe storage, handling and use of all potentially harmful materials relevant to each employee's task and work area.	☐	☐	☒	• **No compliance** with **NGEST ESMP** mitigation requirements. The existing staff did not receive the required training.
		• The work place should have proper ventilation to refresh oxygen and reduce temperature (labs, control rooms, etc.).	☐	☒	☐	• **Partial compliance** with **NGEST ESMP** mitigation requirements. Ventilation equipment are available in NGWWTP and TPS but need repair/ rehabilitation.

Table 5.2 : Social audit findings on compliance status of the NGWWPT and TPS O&M procedures with the NGEST/ESMP

Item No.	Social Aspect/ Risks	Mitigation Measures	Audit Findings			Description of compliance status
			Compliance	Partial Compliance	None-Compliance	
		• Warning signs and instructions should be properly displayed	☐	☒	☐	• **Partial compliance** with **NGEST ESMP** mitigation requirements. Warning signs are available at the **NWWTP** and not in the **TPS**.
		• Proper fencing should be installed around the facility especially the infiltration basin.	☒	☐	☐	• **Full compliance** with **NGEST ESMP** mitigation requirements. Fences are available both sites (**NWWTP** and **TPS)**.
5.2.2	**Community health and safety**					
	• Risk of people and/or Livestock (sheep, cows), drowning in the infiltration basins	• Proper fencing should be installed around the facility.	☒	☐	☐	• **Full compliance** with **NGEST ESMP** mitigation requirements. Fences are available both sites (**NWWTP** and **TPS)**.
	• Risk on community health and safety associated with sludge hauling and disposal.	• Proper sludge hauling ad disposal procedures from the NGWWTP and from TPS.	☐	☐	☒	• **No compliance** with **NGEST ESMP** mitigation requirements. Sludge hauling and disposal is improper.
5.2.3	**Stakeholder engagement and Public consultation**					

Table 5.2 : Social audit findings on compliance status of the NGWWPT and TPS O&M procedures with the NGEST/ESMP

Item No.	Social Aspect/ Risks	Mitigation Measures	Audit Findings			Description of compliance status
			Compliance	Partial Compliance	None-Compliance	
	• Negative publicity and misconceptions	• Public information campaigns during the project operation.	☐	☒	☐	• **Partial compliance** with **NGEST ESMP** mitigation requirements. Limited public information campaigns were conducted during operation phase.
	• Poor confidence of the Public in the project management and potential conflict that may obstruct the project operation.	• Establishing appropriate channels of communication to maintain continuous engagement and communicating additional information that may arise at key stages in the project cycle;				

6. Proposed action plan to bridge compliance gaps

According to the environmental and social audit performed and presented in section 5 of this report, many **gaps** were found in the monitoring practices during the operation phase of the **NGWWTP** and the **TPS** facilities. **Table 6.1 and 6.2** presents the action plan that will be implemented by the PWA to **bridge the gaps** in in order to comply with the NGEST/ESMP provisions. The action plan presents the following:

1. The environmental (Table 6.1) and/or social (Table 6.2) aspect to be monitored.
2. The action required to bridge the gap.
3. The time frame of action implementation.
4. The required resources (human, financial, equipment) for actions implementation.

General Conclusion:

It has been noticed during the audit that the lack of budget was the most important issue that affected the proper operation and maintenance of the previous investment in the NGETS project. Most of the incompliance gabs are a result of the inadequacy or lack of budgets necessary for applying the monitoring activities and the mitigations measures. Thus, for this proposed project, it is necessary to save the required budgets as stated and planned in the project documents.

Table 6.1: Environmental aspects **Action plan** to bridge the gaps in the applied monitoring program in the NGWWPT and the TPS to comply with the ESMP and world bank E&S safeguards

Item No.	Environmental/Social Aspect	Required action(s) by PWA	Time to complete actions	Required Resources (human, financial, equipment)
	General	• Monitoring and Oversight by PMU, PWA, EQA and MoH (as needed)	• Continuous	• Included in NGWWTP and TPS Operation costs.
	Environmental Aspects			
5.1.1	**Groundwater Quality**			
	Aquifer pollution at the infiltration basins at the NGWWTP: • expansion of the nitrogen plume • salinity • pathogenic bacteria (Fecal coliform) Increased level of toxic contaminants	• Comprehensive aquifer water quality and water level monitoring program (to be conducted regularly based on the frequency given in Table 4.4 (Annex 1).	• As per the frequency given in Table 4.4 along the project life.	• 10,000 USD Per Year
		• Regular infiltration performance check.	• Once per week for each infiltration basin (9 basins)	• No cost, performed by the operation staff.
		• Updating the NGEST groundwater model (flow and solute transport) that was prepared to monitor the aquifer underlying the project area, and ensure its safeguard.	• Once each 5 years	• 5000 USD for groundwater modeling expert or each update.
5.1.3	**Air Quality**			
	• Air pollutant generated by diesel generators at NGWWTP and TPS. • Bad smell from treatment units in NGWWTP (H_2S, NH_3, etc.) • Bad smell in the inlet works of the screening building in the TPS.	• Repairing the odor control system in the screening building in the **TPS**.	• Within the construction contract of the WMS project, expected date is July 2020	• 20000 USD for the repair of the odor control system in the TPS. **[should be added to WMS project budget]**
		• Air sampling to be conducted as needed and in case of workers or community complains.	• Immediate upon receiving complains about air quality.	• 15,000 USD for Air Quality measurements instruments and

Table 6.1: Environmental aspects **Action plan** to bridge the gaps in the applied monitoring program in the NGWWPT and the TPS to comply with the ESMP and world bank E&S safeguards

Item No.	Environmental/Social Aspect	Required action(s) by PWA	Time to complete actions	Required Resources (human, financial, equipment)
	• Air pollutant due to the discharge of biogas into the atmosphere either with or without burning using the existing flare • Bad smell from the disposed sludge produced in NGWWTP and disposed at TPS site.			training of the operation staff on air measurements.
		• In case of exceedance of indoor air quality levels, workers should be equipped with appropriate protecting gear (masks).	• Immediate upon detection of above tolerance concentrations	• Part of the PPEs budget
		• In case of exceedance of outdoor air quality levels, carryout investigations and conduct necessary maintenance,	• Immediate upon detection of above tolerance concentrations	• No cost, performed by the operation staff.
		• Alert surrounding community about possible risks and precautionary measures.	• Immediate upon risk detection.	• **[Part of the SEP budget]**
		• Establish a functional GRM and address relevant complains.	• Immediately upon the commencement of the WMS project agreement with the WB. Expected date is July 2020.	• **[Part of the SEP budget]**
		• Repairing the gas storage system in the. NGWWTP.	• Within the construction contract of the WMS project, expected date is July 2020	• **[Part of the WMS project budget**] to pay for the repair of the balloon and operationalize the overall gas system.
		• Stop disposing the sludge from NGWWTP to the TPS and develop an agreement between PWA and Municipality of Gaza for the disposal of the sludge from NGWWTP to Joher El Deek landfill.	• Immediate signature and implementation of Agreement between PWA and Municipality of Gaza for the disposal of the sludge of NGWWTP to Joher El	• **[Part of the WMS project budget]** to pay for sludge transport and the fees of the Land fill.

Table 6.1: Environmental aspects **Action plan** to bridge the gaps in the applied monitoring program in the NGWWPT and the TPS to comply with the ESMP and world bank E&S safeguards

Item No.	Environmental/Social Aspect	Required action(s) by PWA	Time to complete actions	Required Resources (human, financial, equipment)
		• Removing the accumulated sludge in the TPS to Joher El Deek landfill.	Deek landfill. Expected date is July 2020.	
		• Install a mixer to aerate pond #7 to prevent the occurrence of anaerobic condition and bad smell.	• Within the construction contract of the WMS project, expected date is July 2020	• **[Part of the WMS project budget]** to pay for supplying and installation of the mixer.
5.1.4	**Wastewater discharge**			
	• Improper disposal of treated wastewater to the infiltration basins at the NGWWTP. • Risk of raw wastewater flooding to surrounding areas in the TPS site due to the malfunctioning of the TPS equipment creating health and safety hazards. • Risk of raw wastewater flooding to surrounding areas in the TPS site due to the decreased capacity of the NGWWP of the plant equipment creating health and safety hazards.	• Implementing Comprehensive wastewater quality monitoring program (Table 4.4, in the ESMP, presented in Annex1, this report)	• As per the frequency given in Table 4.4 along the project life.	• Included in the water testing as indicated in item 5.1.1
		• Replacing the malfunctioning equipment in TPS by new ones as indicted in the technical audit of this project (pumps, bar screens, SCADA, etc.…) • Initiate building capacity program for the operational staff to properly operate and maintain different facilities of the TPS.	• Within the construction contract of the WMS project, expected date is July 2020	• Adequate staff should be secured since the current staff is not enough (a total of **9** staff members as indicated in the **LMP**). • Capacity building Budget. • Equipment replacement • **[Part of the WMS project budget]**
		• Starting preparation for constructing phase II of the NGWWTP by updating/preparing tender documents.	Within the construction contract of the WMS project, expected date is July 2020. So that the beginning of the construction could take place in June 2021, and the operation could be started by 2024.	• **[Part of the WMS project budget]** to pay for the consultant to prepare tender documents.
		• Constructing an over flow system at the TPS with adequate storage capacity as indicated	Immediately upon the commencement of the WMS project	• Overflow system construction cost. **[Part of the project budget]**

Table 6.1: Environmental aspects **Action plan** to bridge the gaps in the applied monitoring program in the NGWWPT and the TPS to comply with the ESMP and world bank E&S safeguards

Item No.	Environmental/Social Aspect	Required action(s) by PWA	Time to complete actions	Required Resources (human, financial, equipment)
		in the technical audit (overflow line, overflow pond #7, etc.…)	agreement with the WB. Expected date is July 2020.	
		• Replacing/repairing the malfunctioning equipment in NGWWTP by new ones as indicted in the technical audit of this project (bar screens, gas ballon). • Initiate building capacity program for the operational staff to properly operate and maintain different facilities of the NGWWTP.	Immediately upon the commencement of the WMS project agreement with the WB. Expected date is July 2020.	• Adequate staff should be secured since the current staff is not enough (a total of **27** staff members as indicated in the **LMP**). • Capacity building Budget. • Equipment replacements on the WMS project budget. **[Part of the WMS project budget]**
5.1.5	**Sludge and waste disposal**			
	• Improper storage/disposal/reuse of produced sludge from the NGWWTP leading to: -Ground water pollution -Soil pollution -Air pollution -health hazards (workers and community). Improper handling and disposal of solid waste generated at the NGWWTP and TPS	• Prepare sludge management plan for the NGWWTP to ensure its safe handling and disposal in an environmentally accepted manner. The plan should include agreement between PWA and Municipality of Gaza for the disposal of the sludge of NGWWTP to Joher El Deek landfill.	• Immediately upon the commencement of the WMS project agreement with the WB. Expected date is July 2020.	• **[Part of the WMS project budget]** to pay for sludge hauling and disposal fees**.**
		• Stop disposing the sludge from NGWWTP to the TPS and dispose the accumulated sludge at TPS to an authorized land fill (e.g. Joher El Deek landfill).	• Immediately upon the commencement of the WMS project agreement with the WB. Expected date is July 2020.	• **[Part of the WMS project budget]** to pay for sludge hauling and disposal fees.
5.1.6	**Hazardous waste management**			
	• Risk of spill of hazardous waste such as oils, lubricants, polymers.	• Employees should be trained on the hazards, precautions and procedures for safe storage, handling and use of all potentially harmful materials relevant to each employee's task and work area.	• Immediately upon the commencement of the WMS project agreement with the WB. Expected date is July 2020.	

Table 6.1: Environmental aspects **Action plan** to bridge the gaps in the applied monitoring program in the NGWWPT and the TPS to comply with the ESMP and world bank E&S safeguards

Item No.	Environmental/Social Aspect	Required action(s) by PWA	Time to complete actions	Required Resources (human, financial, equipment)
	• Risk of storage and handling hazardous materials used in the NGWWTP and TPS such as polymers.	• Follow safety instructions, worker should wear proper clothing	• Immediately upon the commencement of the WMS project agreement with the WB. Expected date is July 2020.	• 5000 USD/2years For PPEs **[Part of the WMS project budget]**
		• A first aid station with trained staff, which is able to coordinate with local hospitals in case of emergencies.	Immediately upon the commencement of the WMS project agreement with the WB. Expected date is July 2020.	• **[Part of the WMS project budget]** to pay the preparation of the first aid station and staff training.
		• Preparing and implementing spill response and emergency plans to address their accidental release.	• Immediately upon the commencement of the WMS project agreement with the WB. Expected date is July 2020.	• **[Part of the WMS project budget]** to pay for consultant to prepare the spill response and emergency plan.
5.1.7	**Energy conservation**			
	• Risk of energy shortage • Risk of air pollution from fossil fuel burning for energy production.	• Using solar energy such as photovoltaic technology (PV).	• Immediately upon the commencement of the WMS project agreement with the WB. Expected date is July 2020.	• **The budget is funded by other donors**
		• Using the produced biogas in the NGWWTP for energy production	• Immediately upon the commencement of the WMS project agreement with the WB. Expected date is July 2020.	• **[Part of the WMS project budget]** to pay for repairing and commissioning of the biogas system in the NGWWTP
5.1.8	**Organizational capacity and competency**	• The current ESMS arrangement is not appropriate and should be strengthened by hiring a professional ESO possessing the	• Immediately upon the commencement of the WMS project agreement	• [Part of the WMS project budget]

Table 6.1: Environmental aspects **Action plan** to bridge the gaps in the applied monitoring program in the NGWWPT and the TPS to comply with the ESMP and world bank E&S safeguards

Item No.	Environmental/Social Aspect	Required action(s) by PWA	Time to complete actions	Required Resources (human, financial, equipment)
		competency to lead the ESMS of at the PWA/PMU	with the WB. Expected date is July 2020.	

Table 6.2: Social aspects **Action plan** to bridge the gaps in the applied monitoring program in the NGWWPT and the TPS to comply with the ESMP and world bank safeguards

	Environmental/Social Aspect	Required action(s) by PWA	Time to complete actions	Required Resources (human, financial, equipment)
	Social Aspects			
5.2.1	**Labor and working conditions including Occupational Health and Safety**	Labor Management Procedures (LMP) have been developed in a separate document	-	-
	• Risk of Accident, injuries and handling of toxic and hazardous material • Emissions and air pollution in the work environment. • Risk of the workers and staff ***electrocution*** due to the possible flood in the pumps room in the **TPS**, where the electric distribution boards are installed at low level. • Risk of the pressure line explosion at the **TPS** due to water hammer action that my cause casualties in the operation staff and health hazards.	• Provide workers with PPE • Follow safety instructions, worker should wear proper clothing at both sites (***NGWWTP and TPS***).	• Immediate provision of PPEs to all relevant plant operators and workers according to their job functions.	• 15,000 USD for provision of **PPE** for both sites (***NGWWTP and TPS***). **[Part of the WMS project budget]**
		• Immediate provision of OHS training to all plant operators and workers as per their job functions	• Immediate for recent staff and to be repeated for the new staff that will join the team starting June 2020	• 10,000 USD for OHS Training for both sites (***NGWWTP and TPS***).
		• Initiating a first aid station with trained staff (2 to 3), which is able to coordinate with local hospitals in case of emergencies in the ***TPS***.	• Start Immediately in both sites (NGWWTP and TPS)	• 10000 USD for furniture and medical equipment**. [Part of the WMS project budget]**

Table 6.2: Social aspects **Action plan** to bridge the gaps in the applied monitoring program in the NGWWPT and the TPS to comply with the ESMP and world bank safeguards

	Environmental/Social Aspect	Required action(s) by PWA	Time to complete actions	Required Resources (human, financial, equipment)
	• Risk of biogas holder explosion due to stray ammunition coming from the nearby troubled boarder • Risk of the workers and staff ***electrocution*** due to the possible flood in the pumps room in the **TPS**, where the electric distribution boards are installed at low level. • Risk of GBV/ SEA / CEA • Risk of legal dispute	• Supplying the existing first aid room in the ***NGWWTP*** with necessary missing furniture and equipment and training selected 2 to 3 staff members on first aid skills and procedures.		• Staff Training cost is covered under the **OHS training budget.**
		• Replacing the malfunctioning equipment in **TPS** by new ones as indicted in the technical audit of this project (pumps, bar screens, SCADA, etc.) • Initiate building capacity program for the operational staff to properly operate and maintain different facilities of the **TPS**.	• Same as in **item 5.1.4** in **Table 6.1**	• Same as in **item 5.1.4** in **Table 6.1**
		• Constructing an over flow system at the TPS with adequate storage capacity as indicated in the technical audit (overflow line, overflow pond #7, etc.)	• Same as in **item 5.1.4** in **Table 6.1**	Same as in **item 5.1.4** in **Table 6.1**
		• Replacing/repairing the malfunctioning equipment in **NGWWTP** by new ones as indicted in the technical audit of this project (bar screens, gas balloon). • Initiate building capacity program for the operational staff to properly operate and maintain different facilities of the **NGWWTP**.	• Same as in **item 5.1.4** in **Table 6.1**	Same as in **item 5.1.4** in **Table 6.1**
		• Construct additional reinforcement of the existing protection structure to the biogas balloon against astray ammunition	• Immediately upon the commencement of the WMS project agreement with the	• Construction cost. **[Part of the WMS project budget]**

Table 6.2: Social aspects **Action plan** to bridge the gaps in the applied monitoring program in the NGWWPT and the TPS to comply with the ESMP and world bank safeguards

	Environmental/Social Aspect	Required action(s) by PWA	Time to complete actions	Required Resources (human, financial, equipment)
			WB. Expected date is July 2020.	
		• Organize awareness raising sessions and educate the workers and the community in the Project site on issues of GBV/SEA, legal rights, GRM and referral path for victims of GBV/SEA; • GBV/SEA risks will be monitored continuously through the life cycle of the Project; • GRM for GBV/SEA will be strengthened and integrated to track complaints related to GBV/SEA, including a feedback system for regular and timely feedback on actions taken to respond to complaints.	• Immediately upon the commencement of the WMS project agreement with the WB. Expected date is July 2020.	• GRM staff (ESO) covered under the **SEP budget**. **[Part of the WMS project budget]** • 5,000 USD for Training and awareness raising sessions on GBV/SEA/CEA, legal rights, **GRM** and referral path for victims of GBV/SEA/CEA
5.2.2	**Community health and safety**			
	• Risk of GBV/ SEA / CEA	• Organize awareness raising sessions and educate the workers and the community in the Project site on issues of GBV/SEA, legal rights, **GRM** and referral path for victims of GBV/SEA; • GBV/SEA risks should be monitored continuously through the life cycle of the Project; • **GRM** for GBV/SEA should be strengthened and integrated to track complaints related to GBV/SEA, including a feedback system for regular and timely feedback on actions taken to respond to complaints.	• Immediately upon the commencement of the WMS project agreement with the WB. Expected date is July 2020.	• GRM staff (ESO) covered under the **SEP budget**. **[Part of the WMS project budget]** • Cost for Training and awareness raising sessions is covered under training mentioned in item 5.2.1

Table 6.2: Social aspects **Action plan** to bridge the gaps in the applied monitoring program in the NGWWPT and the TPS to comply with the ESMP and world bank safeguards

	Environmental/Social Aspect	Required action(s) by PWA	Time to complete actions	Required Resources (human, financial, equipment)
	• Risk of the pressure line explosion at the TPS due to water hammer action that may cause casualties in the population and create health hazards.	• Repairing the existing surge tank and its accessories to protect the pressure line explosion (3 air compressors and level sensors).	• Immediately upon the commencement of the WMS project agreement with the WB. Expected date is July 2020.	• Construction cost. **[Part of the WMS project budget]**
	• Risk of raw wastewater flooding to surrounding areas in the **TPS** site due to the malfunctioning of the **TPS** equipment creating health and safety hazards on the community.	• Replacing the malfunctioning equipment in **TPS** by new ones as indicted in the technical audit of this project (pumps, bar screens, SCADA, etc.) • Initiate building capacity program for the operational staff to properly operate and maintain different facilities of the **TPS**.	• Same as in **item 5.1.4** in **Table 6.1**	Same as in **item 5.1.4** in **Table 6.1**
	• Risk of raw wastewater flooding to surrounding areas in the **TPS** site due to the decreased capacity of the NGWWP of the plant equipment creating health and safety hazards on the community.	• Preparing tender documents to build phase II of NGWWTP to increase its treatment capacity to cope with the increased hydraulic and pollution loads.	• Same as in **item 5.1.4** in **Table 6.1**	Same as in **item 5.1.4** in **Table 6.1**
	• Risk on community health and safety associated with sludge hauling and disposal.	• Stop disposing the sludge from **NGWWTP** to the **TPS** and dispose the accumulated sludge at **TPS** to an unauthorized land fill (**e.g.** Joher El Deek landfill). • Prepare sludge management plan for the **NGWWTP** to ensure its safe handling and disposal in an environmentally accepted manner. The plan should include agreement between PWA and Municipality of Gaza for the disposal of the sludge of NGWWTP to Joher El Deek landfill.	• Immediately upon the commencement of the WMS project agreement with the WB. Expected date is July 2020.	• Budget for sludge hauling and disposal to Joher Al deek Land fill from the NGWWTP and TPS **[Part of the WMS project budget]**

Table 6.2: Social aspects **Action plan** to bridge the gaps in the applied monitoring program in the NGWWPT and the TPS to comply with the ESMP and world bank safeguards

	Environmental/Social Aspect	Required action(s) by PWA	Time to complete actions	Required Resources (human, financial, equipment)
5.2.3	**Stakeholders Engagement and public consultation**			
	• Risk of Negative publicity and misconceptions • Poor confidence of the Public in the project management and potential conflict that may obstruct the project operation. • Poor opportunities for vulnerable groups to participate in the various stages of the project. • The weak opportunity for persons with disabilities and women to work in the operation and maintenance of the project. • Risk of GBV/ SEA	• SEP has been prepared. • operationalize a Stakeholders engagement plan (**SEP**) to communicate surrounding community and all stakeholders regarding any issues related to the Plant (***NGWWTP***) and the ***TPS*** operation and any specific needs or measures**. SEP** should include: - Effective information dissemination and consultations, - Training of key players in the project implementation as needed to implement the plan, - Organize stakeholder consultations under the SEP and emergency preparedness and response; - Revise the documents as per received feedback; - Establish appropriate channels of communication to maintain continuous engagement and communicating additional information that may arise at key stages in the project cycle; - Prepare progress reports periodically. - Establishing project grievance redress mechanism (**GRM**) that will ensure reception and timely response to any complaints made about the project.	• **SEP** to be fully operational within 2 months including a **GRM** system	• **SEP** activities covered under the project budget. **(82,830 USD). [Part of the WMS project budget]** • GRM staff (ESO) is covered under the **SEP** budget.

ANNEX 1

ESMP of the NGEST project (2006)

4 ENVIRONMENTAL MANAGEMENT PLAN

4.1 Environmental Management Plan Objectives

4.1 The planned project has been classified as Category "A" under the World Bank Operational Policy (OP) 4.01. For all projects of Category "A" a comprehensive Environmental Assessment (EA) as well as an Environmental Management Plan (EMP) are obligatory. The implementation of the EMP is the means by which the adverse environmental impacts of the planned project, subject to mitigation measures, are effectively mitigated and by which the effectiveness of the mitigation is monitored.

4.2 The preparation of the EMP involves the identification of feasible and cost- effective measures that may prevent or reduce potentially significant adverse environmental impacts to acceptable levels.

4.3 This EMP has three basic components:

- Environmental Mitigation.
- Environmental Monitoring and Enforcement.
- Capacity Building Requirements.

4.2 EMP for Part A: NGEST

4.2.1 Institutional Setup

4.4 A responsible entity is necessary to enforce and monitor the implementation of the EMP components. Some monitoring and mitigation measures require the contribution of other governmental institutions, in cooperation with the responsible entity. The institutional setup and capacity building section aims to coordinate the environmental policies, plans, programs and decisions of the various parties involved in the different environmental aspects of the project. This setup and related capacity building will ensure a proper implementation of the proposed mitigation measures.

4.5 In general, in the West Bank and Gaza Strip, the two leading bodies of the regulatory framework in the water and wastewater sector are the National Water Council (NWC) and the Palestinian Water Authority (PWA). The municipalities, village councils and joint service councils are responsible for operating and maintaining water and wastewater facilities. Figure 4.1 shows the proposed institutional setup framework for the Emergency phase. Three levels of institutional management are involved in the project as follows:

Governmental Level Management

4.6 The governmental level management is mainly represented by PWA supported by other ministries and governmental agencies including National Water Council, Environmental Quality Authority , Ministry of Local Government, Ministry of Planning, Ministry of Finance, Ministry of Religious Affairs, Ministry of Tourism and Antiquities, Ministry of Health, and Coastal Municipalities Water Utility (CMWU). PWA is responsible for coordination of activities with other agencies in order to ensure smooth implementation of the project from the inception phase of the project to construction and operation. PWA is also responsible for coordination with the Israelis to avoid any trans- boundary problems. PWA and other governmental agencies can form a Steering Committee for the project. The role of this steering committee will be finalized at the end of the construction phase and the specific tasks and duties for each involved entity will be defined according to their responsibilities in line with the laws and regulations. Annex II gives a survey of the existing governmental agencies and their responsibilities.

Project Management Unit (PMU)

4.7 In 2000, the PMU was created as a part of the PWA. The PMU consists of a project director,

engineers, supervisors, administrative assistant and financial assistant. The PMU is responsible for day-to-day activities; procurement, higher supervision, accounting, evaluation, monitoring, variation orders, and reporting. During construction and operation phases the PMU is responsible for coordination with the municipalities (later will be part of CMWU) in the Northern Gaza Governorate. Also, it is the responsibility of the PMU director to coordinate with the representatives of other stakeholders to ensure proper implementation of EMP or to discuss any issue. The PMU is a temporary entity, which will be restructured most probably in 2008, after the Coastal Management Water Utility is established. As shown in Figure 4.1 the proposed institutional setup of the project outlines the responsibilities of the PMU at different phases of the project.

4.8 The PMU should be strengthened with a consultant during the construction phase for the management of the construction activities and for control of their compliance with the laws and standards. Another consultant should be commissioned to assist in monitoring, testing and quality assurance. There are some changes on the role of PWA and PMU during the different phases of the project and after establishment of the proposed Coastal Municipalities Water Utility (CMWU) which is proposed to operate all water and wastewater facilities in Gaza Strip. Therefore the relationship between, PWA, PMU and CMWU will change during the project phases according to the change of their responsibilities. However, reporting to the Steering Committee is the responsibility of PMU during the first three years (2006-2008) and the responsibility of CMWU after establishment of the CMWU in 2008.

PMU's Proposed Staff

4.9 One of the PMU's staff members should be an environmental specialist or an engineer with strong environmental background to participate in the environmental management and monitoring processes. The tasks of the environmental expert are:

(a) Environmental Auditing:
- ✓ Monitor all construction activities at BLWWTP and NGWWTP and the new sewer connection, including the transportation and storage of construction material by regular site visits.
- ✓ Ensure that the EMP is applied during all phases of the project by informing the responsible administrative entities and taking care that timely actions are taken in cases of non-compliance.

(b) Coordinate environmental training activities for staff, engineers and contractors.

(c) Coordinate with municipalities, EQA and other involved parties in order to mitigate the environmental impacts by providing instructions for the implementing agencies.

(d) Assistance in preparation of the progress reports during implementation of the EMP.

4.10 PMU is responsible for supervision during the emergency phase, which comprises one year of construction and two years of operation. A qualified international operator is now contracted to operate all water and wastewater services under the supervision of PMU. PWA in this stage will be a coordinating agency. After the new infiltration basins are constructed, the environmental expert is proposed to be relocated to the CMWU to perform the activities mentioned above during the operation phase.

4.11 To ensure building up the capacity of the involved parties, special training is necessary for the key members, i.e., PWA, CMWU, EQA, contractor and other monitoring and control agencies.

Coastal Municipalities Water Utility (CMWU)

4.12 PWA follows the strategy to combine all activities which are executed by several municipalities, village councils, and water and wastewater departments nowadays under the roof of one single, efficient Regional Water and Wastewater Utility. A Memorandum of Understanding for the creation of the CMWU and the outsourcing of water and wastewater services to private contractors has been signed. It is proposed

that the CMWU, which will be the owner of the assets, will be responsible for setting and monitoring the key objectives in terms of service delivery, while PWA will mainly focus on regulatory environmental aspects (such as groundwater quality, groundwater abstraction, and wastewater quality and discharge) and some selected economic aspects (such as the adherence to national water tariff guidelines). The existing CSC will be integrated into the CMWU. During the first stage of the project, the CSC is responsible to facilitate construction of the infiltration basins.

4.13 A transitional period is proposed before the CMWU will have the full operational control of water and wastewater services. During this transitional period, the operator will have the responsibility for all managerial and operational aspects of the water and wastewater systems in the Gaza strip, including the use of the Operating Investment Fund. Depending on the type of contract, the operator may have other responsibilities outside the operation and maintenance of the proposed treatment plant. All procurements and services will be procured in accordance with World Bank guidelines.

The Recommended Environmental Consultants

4.14 In order to ensure smooth implementation of the proposed monitoring plan and mitigation measures it is necessary to conduct an intensive capacity building program for the involved parties during the inception phase of the project construction. The capacity building program is proposed to be organized as workshops (four workshops) to cover the following subjects:

- Project components and schedule.
- Description of the EMP components.
- Institutional arrangements and coordination methodologies.
- Quality control and assurance plans.

4.15 The needed consultant for the capacity building is clearly identified in the proposed institutional setup as **environmental** Consultant 1. The other capacity building programs such as on-the job-training, staff training and training for contractors could be conducted by the same consultant as well be described in the capacity building requirements.

4.16 Another qualified consultant is proposed to be responsible for construction compliance supervision as Consultant 2. The duties of this consultant are direct compliance supervision, reporting to PMU, quality control and quality assurance of implementation.

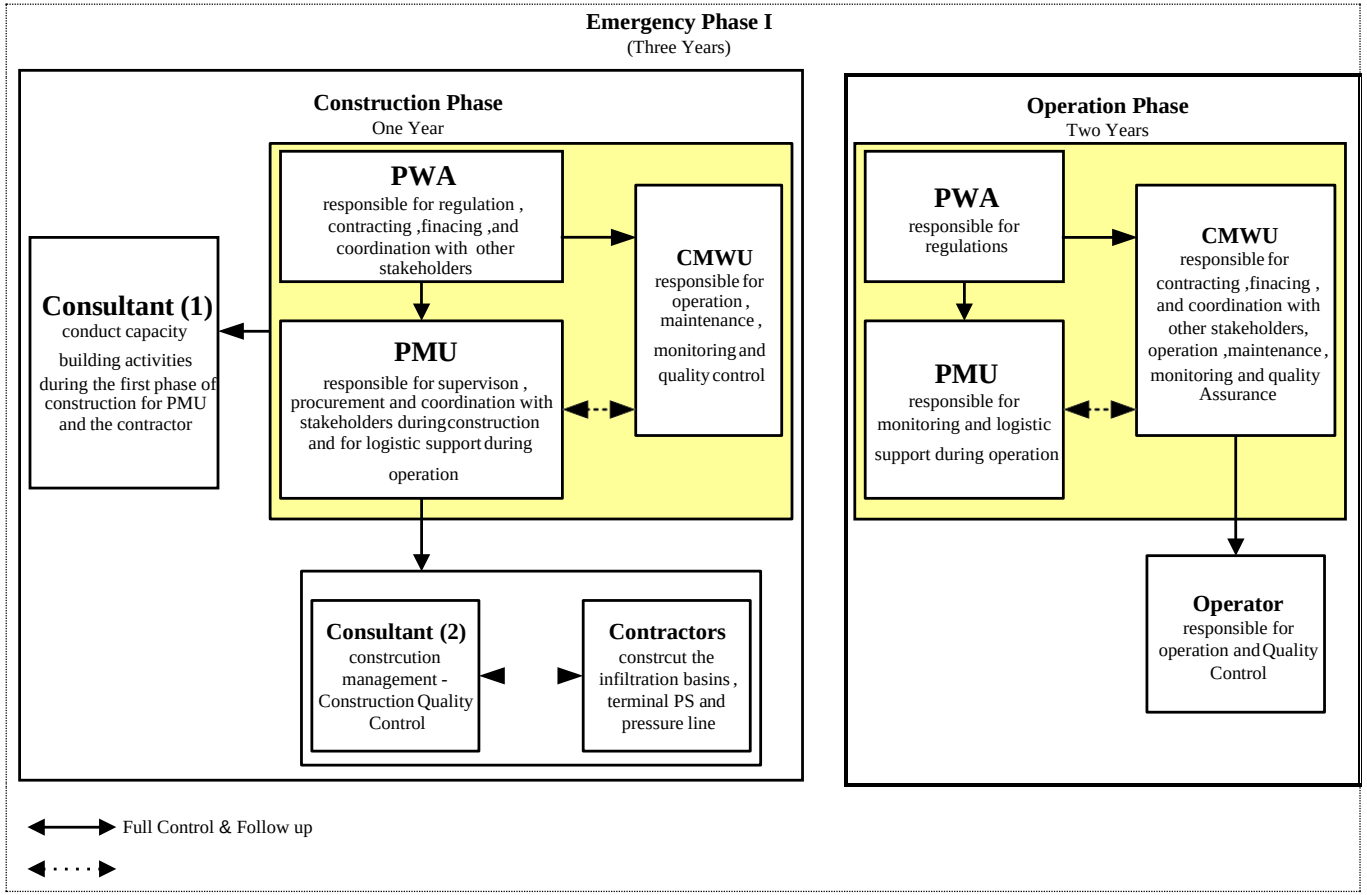


Figure 4.1: Institutional Setup Framework for Part A

4.2.2 Mitigation Measures and Monitoring Actions

4.17 Avoiding or mitigation of environmental impacts is by far preferable to compensation or rehabilitation measures after an impact has happened.

4.18 It is the task of the EA and especially the EMP to identify significant impacts, to define measures to avoid or at least to minimize these impacts and to take care that these measures are properly applied at all project phases. The following paragraphs describe the proposed mitigation measures and monitoring actions for each project phase in general before the most significant measures are defined in detail.

4.19 As identified earlier, impacts during the one year long construction phase are primarily associated with the construction of the pressure line and the infiltration basins. The significant accompanying activities comprise land consumption, earthworks, material transport and movement of heavy machinery. Such impacts are mostly short-term, local, and caused by the contractors activities at the construction sites and the access roads and can be mitigated through proper construction management in coordination with the contractor and the authorities concerned. The contractor in cooperation with the monitoring agency and the environmental expert are responsible for implementing the mitigation measures during the construction phase.

4.20 Impacts during the operation phase of the emergency project, which is about 2 years, are primarily associated with ground water, soil, health and land use. The most significant impact at this phase is the infiltration of partially treated wastewater into the ground water.

4.21 Environmental monitoring is the timely and proper survey of the significant environmental impacts of a project during all project phases. Monitoring results help judge the success of mitigation measures in protecting the environment. They are also used to ensure compliance with environmental standards, and to identify necessary changes in the project design or operation.

4.22 The Environmental Monitoring plan sets out a framework for monitoring the environmental situation at all project sites (BLWWTP, NGWWTP and sewer line). In order to ensure that the reality complies with the demands of the EMP environmental, monitoring should be carried out concerning the following aspects:

- Construction and transport activities.
- Health and safety measures (construction and operation workers, local inhabitants).
- Site cleaning, solid wastes removal, hauling and disposal.
- Efficiency of the treatment process.
- Quality of treated wastewater.
- Aquifer Water quality in the vicinity of the infiltration ponds.
- Monitoring of unexpected leakages or system failures.
- Top soil of the infiltration basins against clogging issues.
- Agricultural soil subjected to sludge or treated wastewater application.

4.23 In addition, the PMU is responsible for monitoring and enforcing the various environmental issues as related to the project activities as outlined in Table 4.2 and Table 4.3. Also, the PMU is responsible for executing any necessary measure out of those highlighted in the table according to the prevailing conditions at the site. Environmental mitigation and monitoring actions are presented in a simple matrix format. They include identification of the problems, mitigation measures, monitoring responsibilities, and the responsibilities to carry out the mitigation and monitoring measures. All the mitigation measures should be incorporated into the construction and supervision contracts.

4.24 The following section highlights the necessary monitoring actions and mitigation measure for the significant environmental issues:

4.2.2.1 Water Quality Mitigation Measures and Monitoring BLWWTP Site:

4.25 Based on the effluent quality testing, considerable differences have been identified between the effluent from the polishing pond and the adjacent effluent lake especially concerning nitrogen, BOD, and SS. At the beginning of the emergency phase, the partially- treated effluent wastewater will be taken from the polishing pond at BLWWTP, pumped to the new site and recharged into the groundwater via the new infiltration ponds. The effluent quality in the polishing pond is expected to improve due to the upgrading of the BLWWTP facilities (inlet works, aeration) at the beginning of the emergency phase. The combination of existing aeration capacity (88 KW) and enough retention time can produce a relatively good effluent (BOD < 50 mg/l) for flow up to14,000 m^3/day. According to EU standards, it is required to provide 5 KW aeration capacity every 1000 m^3 of influent. As the influent increases to about 18,000 m^3/day, the retention time will be less than 1.2 day which is not enough for aeration. As a result the treatment efficiency will decrease.

4.26 The following measures are recommended before infiltration phase begins at the new site:

- Upgrading of the inlet works for a better performance of debris screening and sand removal. Neither the existing screen nor the sedimentation facilities, which have to be cleaned manually, seem to be sufficient or sufficiently maintained for the pre- treatment of the incoming wastewater.
- Cleaning and installation of additional aerators in Ponds 3 and 4. These ponds should be fully aerated with at least 100 KW aeration power.
- Ponds 3 and 4 should be cleaned to increase the depth from 1.5 - 1.75 m currently to their original design (2.4 m).

4.27 When the infiltration at the new site begins, and with all upgrading activities at BLWWTP realized, the effluent levels of BOD, SS and Total N would be significantly lower than the present values. Previous records in 2001 and 2002 show that the BOD was about 45 mg/l (Shomar, 2004). Chloride concentration from both the polishing pond and the lake is suitable for infiltration and will have even positive effects on the high chloride concentration of the aquifer. Nothing significantly can be done in the emergency case within the available budget to reduce the total nitrogen concentration in the effluent. Using large area infiltration basins, low application depth, and more drying days than flooding will enhance the nitrification process in the soil top layers and de-nitrification in the deeper layers. Increasing the drying period will supply more oxygen to the soil that will enhance the nitrification process of Kejldal nitrogen to NO_3. Some decay will occur if the infiltrated effluent passes through soil layers that is rich with organic materials (Clay) but that part of the aquifer does not have enough of these lenses. High degree of treatment can be achieved by allowing partially-treated sewage effluent to infiltrate into the soil. Soil Aquifer Treatment (SAR) removes SS, BOD, bacteria, viruses and Reduce N, Ph, Heavy Metals significantly.

4.28 The local infiltration of the lake water at the two storm water infiltration facilities should continue until the lake level has gone down at least by 4 to 5 m. During winter time storm water enhances leaching and dilution processes at the basin bottoms. The infiltration of the lake water can be done at a rate of about 4.000 m^3/day in summer and much lower in winter because of the incoming storm water. Natural evaporation will do part of

the lake water level reduction (open water evaporation 840 mm/year). When the lake water level is reduced significantly, the sun light and oxygen can reach the whole depth and the lake will be an effective part of the treatment process.

NGWWTP Site:

4.29 In order to reduce the expansion of the nitrogen plume and to minimize any trans- boundary effects, the following measures are proposed:

- Infiltration Basins 7 and 9 will not be used during the emergency phase.
- Only the direct effluent from BLWWTP from the polishing pond (12,000m^3/day and its natural increase) will be used for infiltration at the beginning.

4.30 Figure 4.2 and Figure 4.3 show the short and long term impacts of these measures. Comparing the results with Figure 3.16 shows that the nitrogen plume at the end of the emergency phase will extend about 200 m to the west and about 100 to the east of the infiltration site. Comparing the results shown in Figure 3.13 and Figure 4.3, it can be seen that the transport path will be confined to a smaller area at the long run. The reason is that the regional flow will surplus this small infiltration quantity and force it in the western direction.

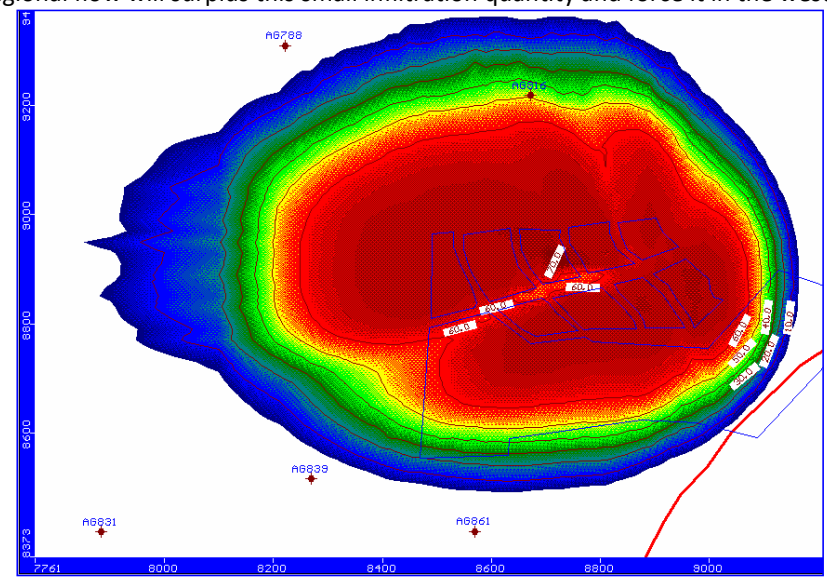


Figure 4.2: NO3-N Plume at the End of Part A using 12,000 m3/day and not using Infiltration Basins 7 and 9

Monitoring for Year 2006-2008

4.31 Regarding the risk of pollution from pathogens, no well should be operated within a distance of 150 m (6-month residence time) from the edge of infiltration basins (contour line, Figure 3.21). The groundwater beyond that area will be hygienically safe.

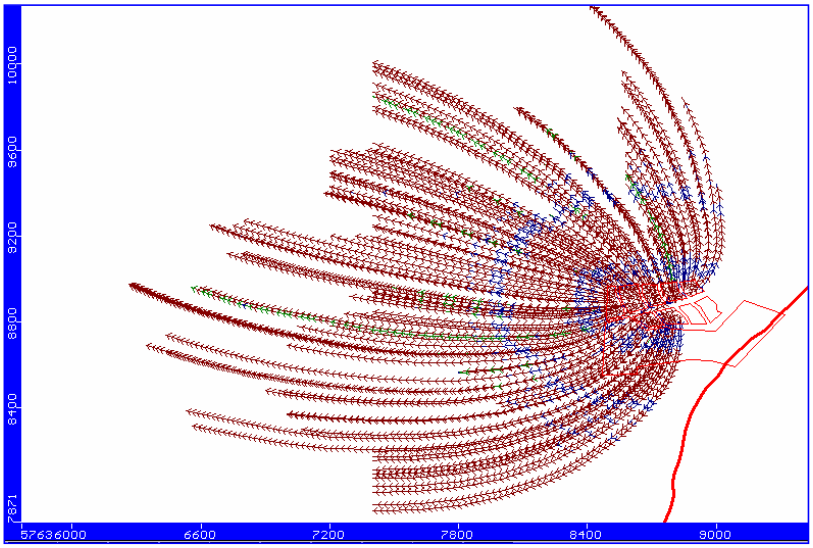


Figure 4.3: Long Term extent of Particle Transport if Basins 7 and 9 are not Used

Recommendations for after 2008

4.32 Considering the worst case scenario (if the NGWWTP is not implemented and infiltration with partially treated sewage continues after 2008), recovery scheme around the infiltration site has to be implemented or pumping to the infiltration basins must be stopped.

4.33 Figure 4.4 shows the proposed locations of recovery wells. It is proposed to have 24 wells that are 100 m apart and are tentatively located about 200-300 m north and south and 400 west of the infiltration basins. The wells are located at the edge of agricultural lots near existing roads and inside the proposed industrial area as it will be easy to connect them in a regional irrigation scheme in the future. Figure 4.7 also shows nine private agricultural wells in the nearby areas (Q14, Q15, Q53, Q54A, Q54D, Q55, Q56, and R12) that can be upgraded or renovated and used as recovery wells in addition to the new wells. The recovery scheme in addition to the nearby agricultural wells should be able to pump 10% more than what is infiltrated. Figure 4.4 shows how the proposed recovery wells will be able to capture most of the infiltrated particles.

4.34 The operation of the agricultural wells in the surrounding areas of the infiltration basins should be regulated by PWA in order to ensure that all the infiltrated effluent is recovered. The quality of the abstracted water should be strictly monitored to ensure health and safety of the users. In case of any problem in any of the water quality parameters, the necessary action should be decided and enforced by PWA.

4.35 Figure 4.5 also demonstrate the effectiveness of the proposed recovery system in reducing the expected extent of the contaminant plume compared with the model results shown in Figure 3.20. The proposed new wells will be able to pump19,200 m^3/day (800 m^3/day for each well and screened between -10 to -30 from the mean sea level).

4.36 The exact location and design of the proposed wells should be part of PWA plans for a regional reuse scheme. The planning should take into consideration the tariff and how and where this pumped water will be used. And in order to be prepared for the worst case. The planning for this activity should start soon.

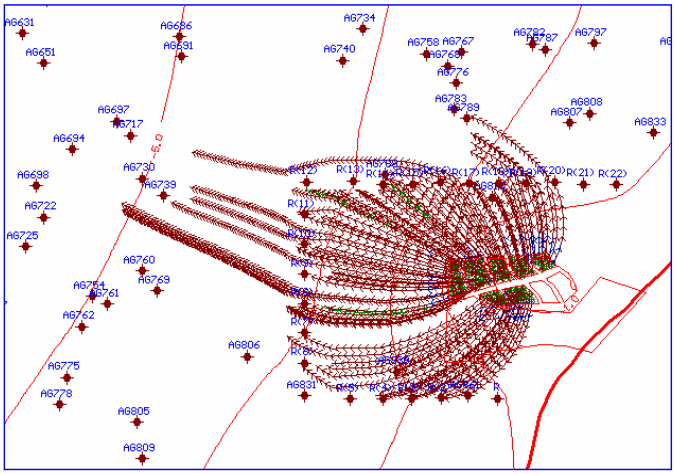


Figure 4.4: Impact of the Proposed Recovery System in Capturing the Contaminant Particles.

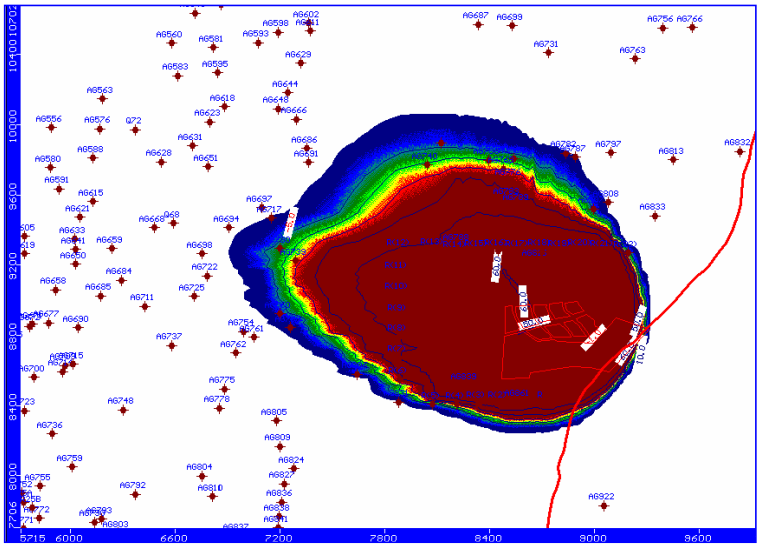


Figure 4.5: Long Term Extent of the NO3-N Plume with the Implementation of Recovery System.

Locations for Monitoring Wells

4.37 At the infiltration site, the observation points have to cover the deep part of the aquifer and the zone between the water table before infiltration and the water table after infiltration. Some of the already implemented observation wells can be utilized. DB wells should be used to monitor the deep part of the aquifer beneath the infiltration site. SD2 or one of the SD group should be used to monitor the shallow part of the aquifer. Figure 4.6 shows the proposed location of the new monitoring wells.

4.38 At the west of the infiltration site 3 lines of observation wells should be considered. The line comprises two sets of three observation wells located at 200 m radius from the edge of infiltration basin (east and west

of the infiltration basins). The second line comprises of two wells located at 350 m radius from the edge of infiltration basin. In addition to that one observation well should be located at 500 m distance from the edge of infiltration basins. All these wells should be screened somewhere between -20 to -5 m from MSL.

4.39 Table 4.1 shows a list of parameters that should be monitored at different frequency for the different project phases. This table was designed based on local experience and the experience from the Dan region monitoring program. Samples from the observation wells are taken after at least half an hour of pumping in order to exchange the water in the well. After the start of operation of the new NGWWTP measurements for influent and effluent should be performed daily for all the proposed parameters in the table.

4.40 The aquifer water quality monitoring should start upon the completion of construction of the infiltration basins to establish a baseline data for the new site. Some of the nearby existing wells (see Figure 4.7) that are now used for monitoring can also be utilized for this purpose (Q14, Q15, Q53, Q54A, Q54D, Q55, Q56, and R12).

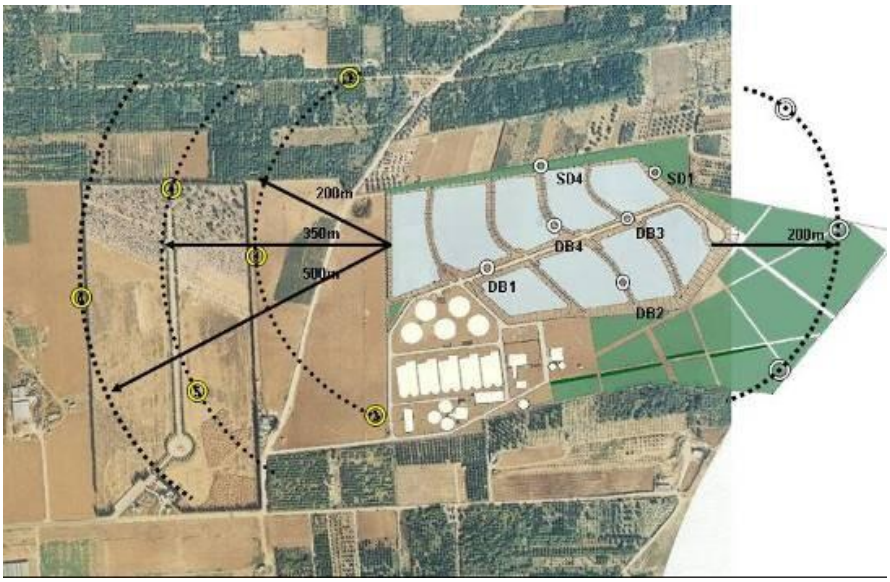


Figure 4.6: The Proposed Location of the Monitoring Wells

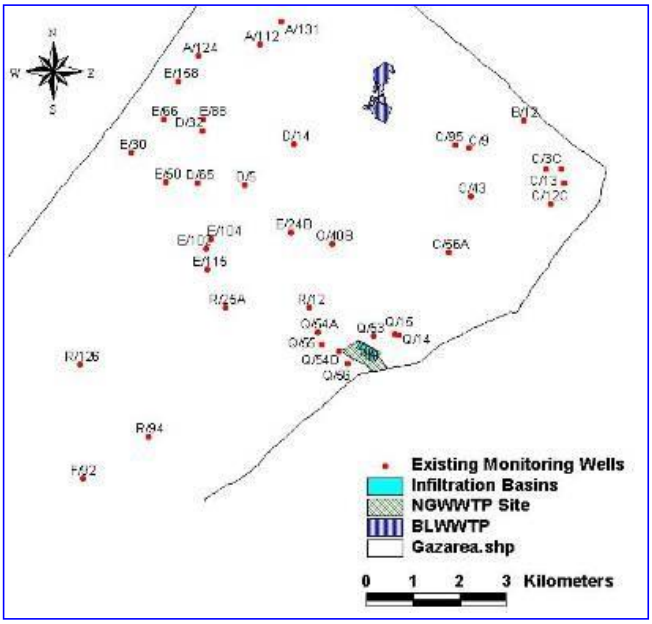


Figure 4.7: Existing Production Wells that are Used for Monitoring

Table 4.1: Proposed Monitoring Parameters during Part A Emergency Phase

Parameter	Pumped Effluent	Aquifer water	
	every month	every two weeks	every three months
Later level	N/A	X	X
pH	X	X	X
EC	X	X	X
TDS	X	X	X
SS	X		
BOD	X	X	X
COD	X	X	X
NO3	X	X	X
NH3/NH4	X	X	X
Cl	X	X	X

SO4	X		X
P	X		X
Ca	X		X
Mg	X		X
K	X		X
Na	X		X
Faecal Coliform	X	X	X
Total Coliform	X		X
B	X	X	X
Detergents (HPLC)	X	X	X
Heavy metals	X		X

4.2.2.2 Environmental Health and Safety Mitigation Measures and Monitoring

4.41 As discussed in the preceding chapter, the expected impacts during construction phase are related to danger resulting from equipment and vehicles movement. Limiting the speed in the construction site and working hours to the day hours as well as enforcing the maintenance of mobile equipment will mitigate the impacts. Also, fencing the whole construction site will save workers and children from dangerous activities.

4.42 At the BLWWTP inlet works a mechanical screening and de-gritting system should be installed as soon as possible to avoid the risk for the workers, who presently have to enter the facility in order to remove waste and sediments. This measure has already been proposed in the previous EA in 1999 and was not realized.

4.43 During the emergency phase and in order to prevent people, especially children away from falling into the drying lake it is proposed to fence and to guard the wastewater lake as soon as possible, at least at the beginning of the emergency phase. As another alternative, creating jobs for about 20 guards is preferred more than fencing which is very costly and only necessary until the lake is completely dry.

4.2.2.3 Soil Mitigation Measures and Monitoring

4.44 Major part of the excavated clay from the new site (900,000 m3) can be transported to the existing depressions south east of BLWWTP. Many farmers will be interested in improving their farm soil with this clay. Hence, part of the clay can be sold to farmers at the transportation cost. Also part of the clay can be used for the Lake bottom soil remediation and leveling after the drying process.

4.45 For the rehabilitation of the lake bottom, an area of 340 dunums covered with sludge, the consultant proposes to use biological treatment methods. The first step in the treatment process happens automatically. As soon as the sinking water level of the lake reaches the bottom a better oxygen supply will initiate the microbiological decay of the bottom sludge. When the lake bottom is dry enough to be entered it could be planted with deep-rooting grass or weed species for some years. The roots of the plants break up the densified soil, contribute to a better oxygen supply also of deeper soil layers which enhances bacterial activity and accelerates the biological rehabilitation process including the decomposition of hazardous organic material. As the chemical analyses of samples from the lake bottom sludge showed no significant levels of heavy metals or other toxic substances the vegetation could be cut regularly by the farmers and be used as animal fodder.

4.46 It is highly recommended after draining of the lake to take few soil samples from the deeper parts of the lake to check for heavy metals and other toxic substances. The mitigation actions can be decided accordingly.

4.47 When the soil of the lake bottom has achieved an advantageous soil structure, due to the natural rehabilitation. it could be either used as green land or also for agricultural purposes, because it is rich in nutrients and it is not necessary to use huge amounts of chemical fertilizers there. From an ecological point of view green land is the better option. Parts of the green area could also be used for recreational activities (sport sites, parks). This solution definitely would contribute to a better living quality for the local residents.

4.48 The infiltration basins are operated in a cycle of flooding and drying. The cyclic drying of infiltration basins will restore the infiltration capacity by breaking up sludge layers and bio-films. Each pond is equipped with a level meter and when the level reaches a predetermined maximum value, the inflow is stopped. After operation for a certain time for example 3 days or when each of the ponds in operation has reached the predetermined maximum level of approximately 0.5 m, the next group of ponds in order is flooded. The ponds not subject to the flooding cycle are dried and this will ensure that infiltration capacity is maintained. The length of flooding and drying periods must be optimized by practical experience and observation of effect. An initial

approach is that an average flooding period lasts for 0.5 - 1 day and is followed by a drying period of 2-4 days, or longer, if necessary. The short alternation of flooding and the drying periods will minimize algae growth and this will prevent a quick clogging of the ponds.

4.49 Periodically, scraping and excavation will be required to remove silt and organic matter. This may be done with a front-end loader once or twice a year. The excavated material washed in a sand-washing unit and the clean sand is refilled into the pond. Regular disking is sometimes used, however it should be avoided to practice this too often, because heavy machinery may compact underlying soils and they become less permeable. Further the practice of disking will mix the clogging materials with surface soil. The best practice for maintaining infiltration rates at the site will be found out during operation.

4.50 For each basin time related reports should be kept concerning water levels, water flow, observations of algae growth and remarks concerning the quality of the infiltration water. The reporting procedure should make it possible to combine the observations with the actual infiltration water quality. Time for start and stop of flooding/drying periods should be noted, as well as scraping and cleaning activities.

4.2.2.4 Socio-economic Mitigation Measures and Monitoring BLWWTP Site:

4.51 The whole lake should be fenced and/or at least be guarded in order to prevent people, especially children, and livestock from falling into the lake. Because of the steep sand dams and the sludge at the bottom falling into the lake as well as rescue operations would be dangerous.

4.52 To reduce the small negative impact in the existing location, noise mitigation measures discussed in other parts of the report should be carefully implemented and observed to ensure that the impacts to the neighboring communities are minimized.

4.53 As for the temporary disruption for the use of agricultural land, this can be mitigated through direct compensation for their losses during the season. The agricultural season in this area starts mainly in October and ends in April or May, thus the project construction especially in agricultural areas can be done in off season times to minimize the negative impact.

NGWWTP Site:

4.54 A public awareness campaign is proposed to show the effects of the project on the overall economic and social conditions in the northern area of Gaza especially with respect to improved water quality and agricultural and commercial land.

4.55 High coordination with the Ministry of Religious Affairs to ensure their buy-in and the Islamic view of constructing this new project. This, if done properly, should also be used in the public awareness campaign.

4.56 The tariff should be planned based upon recovery of operating and replacement costs and that the initial investment in infrastructure must come from other sources, at least in the medium term. At the long run the future tariff should take into consideration the following factors:

- To achieve cost recovery
- To maintain social equity
- To adopt flexible price mechanism that discourages wasteful uses of water and raise awareness of the economic value of resources invested in this vital sector.
- To promote environmental efficiency aimed at effective preventive measures to preserve water

resources.

4.2.3 Capacity Building during Emergency Phase

4.57 The current staff of the PMU, CMWU, PWA and EQA have the basic skills that enable them to follow-up the implementation of mitigation measures and execute the monitoring plan during the construction and operation phases of the emergency phase. However, during the inception phase of the emergency project, it is necessary to hire a consultant to conduct the following proposed workshops:

- Project components and schedule.
- Description of the EMP components.
- Institutional arrangements and coordination methodologies.
- Quality control and assurance plans.

4.58 The PWA project manager is responsible to arrange these workshops. The PMU, CMWU, PWA and EQA representatives should attend these workshops. The qualified contractor should be aware about the environmental mitigation measures, costing, schedule and institutional arrangements. This issue should be highlighted before the bidding stage and the EMP should be an essential annex of the project contract documents.

Table 4.2: Potential Environmental Impacts, Mitigation, and Monitoring Plan for the Construction Phase of the Emergency Project

Potential Impacts at 1 - existing site – BLWWTP 2 - new site - NGWWTP 3 – pipeline between BLWWTP and NGWWTP	Mitigation Measures	Monitoring Measure & Method	Responsibility of Execution	Monitoring & Enforcement Responsibility
- Nuisance, noise and dust at the construction sites (1, 2, 3)	- Definition of Noise and dust mitigation measures, the construction supervision takes care that these measures are applied - Proper activity scheduling and working hours and days and limit the activities to day times and prevent any construction activities at weekends. - Particulate emissions control unit such as scrubbers, cyclones, fabrics, or electric precipitators - Covering of stored spoil material and vehicles removing waste, use of dust suppression - Water spraying - Using relatively new construction and transportation vehicles with lower emissions - Ensure that noisy activities occur during daytime only and not during holidays or late at night	- Site supervision, public consultation,	Contractor PWA	PWA
- Risk of accidents and injuries (1, 2, 3)	- Follow safety instructions, worker should wear proper clothing - A first aid station with trained staff, which is able to coordinate with local hospitals in case of emergencies - Personnel will be trained in Environmental Health and Safety matters including accident prevention, safe lifting practices, safe chemical handling practices, proper control and maintenance of equipment and facilities - Warning signs and instructions in case of emergencies should be properly displayed, workers must be informed about these precautions - Requirements of Palestinian Labor Law especially regarding safety should be applied	- Training program - Site supervision - Public consultation	Contractor Operator	CMWU PWA
- Potential accidental break of existing infrastructure (pipelines, power lines, irrigation network etc. (1, 3).	- Consideration in the detailed design, construction supervision, in case of damage immediate repair.	- Report about compliance with the as-built drawings	Contractor PMU	PMU
- Impairment of agricultural activities during the cultivation period from October until April or May (1, 2, 3)	- Construction activities in agricultural areas should be executed in winter to minimize impacts. If this is not possible farmers will receive compensation	- Site supervision, coordination with local farmers	Contractor PWA	PMU
- Disturbance of the soil structure, densification (2, 3)	- Vehicle movement outside the construction site only on existing roads, no crossing of agricultural areas	- Construction supervision - Public consultation	Contractor	PMU

Table 4.2: Potential Environmental Impacts, Mitigation, and Monitoring Plan for the Construction Phase of the Emergency Project

Potential Impacts at 1 - existing site – BLWWTP 2 - new site - NGWWTP 3 – pipeline between BLWWTP and NGWWTP	Mitigation Measures	Monitoring Measure & Method	Responsibility of Execution	Monitoring & Enforcement Responsibility
- Producing huge piles of clayey soil due to excavations of infiltration basins (2)	- Transfer to depressions located southeast of existing BLWWTP - Selling to farmers at transportation cost	- Site management and Coordination with local farmers	Contractor	PMU
- Loss of agricultural area (1, 2)	- Partly compensated by rehabilitation of the lake area which may be used for agriculture	- Coordination of authorities and local residents	- PWA, - Palestinian Land Authority	- Palestinian Land Authority
- Obstruct the accessibility or property and impairment of the local traffic in the vicinity of the construction sites; risk of traffic accidents (1, 2, 3).	- Proper planning of construction activities, monitoring of risky activities such as excavation and backfilling. - Provision of adequate notification procedures for any road closures. - Monitoring the use of safety measures and tools. - Traffic management (signs, traffic flow) - Speed limits for construction vehicles	- Site monitoring - Complaint monitoring	Contractor PWA Police	PMU
- Local traffic is expected to increase due to the movements of heavy trucks which transport construction material to the site and the excavated clay outside the site (3).	- Traffic signs to ensure proper routing and distribution of traffic - Provision of adequate notification procedures for any road closures - Traffic Management Plan	- Complaint monitoring	Contractor PWA Police	PMU
- Loss of older trees along the roadsides (3)	- Minor local modifications of the pipeline route in order to avoid tree felling - Replanting of trees.	Construction supervision	Contractor PWA	PMU
- Archaeological remains could be discovered (1, 2, 3)	- Monitoring of site excavations - In case of findings information of the concerned agency (MOTA) and additional survey	- Construction supervision	Contractor PMU	PMU & MOTA
- Impact on nearby flora and fauna (1, 2, 3)	- Dust generating activities such as excavations and back-filling should be avoided during flowering period of the plants (March to May) as much as possible - Rare plants could be transferred to safe places - Avoiding of disturbance of breeding activities of rare birds (March to May)	- Good planning for activities - Site investigation	Contractor PMU	PMU MOA
- Improper disposal and pile up of construction materials (1, 2, 3)	- Cleaning and removal of wastes or deposits to landfills or designated areas.	- Construction supervision, - Complaint monitoring	Contactor	PMU

Table 4.3: Potential Environmental Impacts, Mitigation, and Monitoring Plan for the Operation Phase of Emergency Project

Potential Impacts for the Operations of the Emergency Project **1 - existing site – BLWWTP 2 -** **new site - NGWWTP** **3 - pipeline between BLWWTP and NGWWTP**	**Mitigation Measures**	**Monitoring Measure & Method**	**Responsibility of Execution**	**Monitoring & Enforcement Responsibility**
- Grit, sand, and debris entering treatment pond No.1 and impairing the treatment process (1). - Flooding in wastewater networks due to mixing of storm water with sewage during heavy rains (1)	- Upgrading the screen and grit removal structure and maintenance to perform effective screening and sedimentation. - Cleaning of the ponds 3,4 from sand and installation of aerators in the first two ponds. The aerators should be fully operated in the first four ponds. - Proper design of wastewater facilities - Draw emergency plans - The planning and operations should be carried out according to the master plans and the operator (& CMWU) should be informed - Planning of new areas should consider the design constraints of the NGWWTP and proposed future serviced areas.	- Frequent observation	CMWU PWA	PWA, CMWU
- Aquifer pollution at the new infiltration site (3) ▪ expansion of the nitrogen plume ▪ salinity ▪ pathogenic bacteria (Fecal coliform)	- regular daily manual cleaning for the sand sedimentation is necessary - Infiltration basins 7 and 9 will not be used during the emergency phase. - Only the direct effluent from the polishing pond at BLWWTP (12,000m3/day) will be used for infiltration. - no wells should be operated within a distance of 6 month residence time from the edge of infiltration basins (>150 meters) - Follow alternate operations plan (short flooding and drying periods) - Regular cleaning of the infiltration ponds (scraping, sediment removal) is required to remove silt and organic material	- Regular infiltration performance check - Comprehensive aquifer water quality and water level monitoring program (Section 4.4.1.3, Table 4.1, Figure 4.5)	- CMWU - PWA	- PWA,
- Over pumping due to potential drilling of new wells and rehabilitation of existing wells (3)	- Proper spatial distribution of new wells - Controlling measures, penalties for non-compliance, employing guards and installing fencing (to prevent the illegal use of water in basins for agricultural purposes by local farmers.	- Comprehensive testing program	PWA MOA CMWU	- PWA
- Hazards during drying out of the lake (after pumping) in the old site of BLWWTP (1)	- Creating jobs for about 20 guards to prevent people, especially children away from falling into the drying lake. (it is preferred more than fencing which is very costly and only necessary until the lake is completely dry) - The first layer of sand after drying the lake should be left to dry enough	- Site visits - Reporting (guards)	Operator	PMU, CMWU
- Risk of Accident and injuries (1, 2)	- Follow safety instructions, worker should wear proper clothing - A first aid station with trained staff, which is able to coordinate with local hospitals in case of emergencies - Warning signs and instructions should be properly displayed - Requirements of Palestinian Labor Law especially regarding safety will be applied	- Testing programs - Awareness - Complaint monitoring - Site visits	Operator	PMU CMWU PWA
- Impact to landscape, disturbance of aesthetic features, expansion of built-up areas (1, 2)	- Landscaping (esp. screening by planting of trees, substitution of cut-down trees) - Following all mitigation impacts that minimize and/or control the dust, odor, noise, and aesthetic features.	- Supervision - Site visits	Operator	PMU MOTA

	- Proper land use plan for the lake area should be considered - Considering of not only onsite but also offsite effects - Proper operations and maintenance management, and reshaping of construction sites			
- Livestock (sheep, cows), could drown in the infiltration basins (2)	- Proper fencing should be installed around the facility.	- Site Visit	- Designer, contractor	- PMU - CMWU
- negative publicity and misconceptions (2)	- Public information campaigns before the project is executed		PWA	PMU, PWA

4.3 EMP of Part B (NGEST)

4.3.1 Institutional Setup

4.59 The proposed institutional setup for Part B (NGEST) is similar to the proposed institutional setup for the emergency phase. Some special arrangements are necessary according to the variations of construction period and involved institutions. PWA, PMU and CMWU have the same responsibilities of those during emergency phase. Figure 4.8 shows the proposed institutional setup for Part B components.

4.60 One of the expectations during the operation of NGWWTP is that the CMWU will have the full responsibilities for operation and maintenance of all water and wastewater facilities in Gaza Strip.

4.61 Most of responsibilities of the PWA will be moved to the PMU and the CMWU during the operation phase and PWA will act as a regulator agency.

4.62 It is recommended to engage an international consultant to train the involved agencies and operator about the implemented treatment process. This treatment process is a new technology and local people are not familiar with its requirements. The international consultant is clearly identified as consultant (3) in Figure 4.8.

4.3.2 Mitigation Measures and Monitoring Plan for Part B (NGEST)

4.63 The construction impacts are similar to those expected during the emergency phase. Such impacts are mostly short-term, local, and caused by the contractors activities at the construction sites and the access roads and can be mitigated through proper construction management in coordination with the contractor and the authorities concerned.

4.64 Impacts during this long-term phase mainly concern ground water, soil and human health. These impacts are long term impacts either direct or indirect. The proposed mitigation measures will minimize the impacts as far as possible. The operator is responsible for the implementation of all mitigation measures. The expected impacts and the proposed mitigation measures during construction and operation phases are detailed in Table 4.5 and Table 4.6. The Environmental Monitoring plan for Part B components sets out a framework for monitoring the environmental situation at all project sites (BLWWTP, NGWWTP and sewer line). In order to ensure that the reality complies with the demands of the EMP environmental, monitoring should be carried out concerning the same issues that were considered during the emergency phase.

4.3.2.1 Water Quality Mitigation Measures and Monitoring

4.65 After completion of the NGWWTP (Phase 1) the full treatment process will produce high quality effluent that will be suitable for infiltration that will allow the subsequent direct use for unrestricted irrigation according to both local and international quality guidelines. The model simulation results did not show any negative impact to the aquifer water quality. Therefore, no mitigation measures are required but the aquifer water will be subject to regular and comprehensive monitoring.

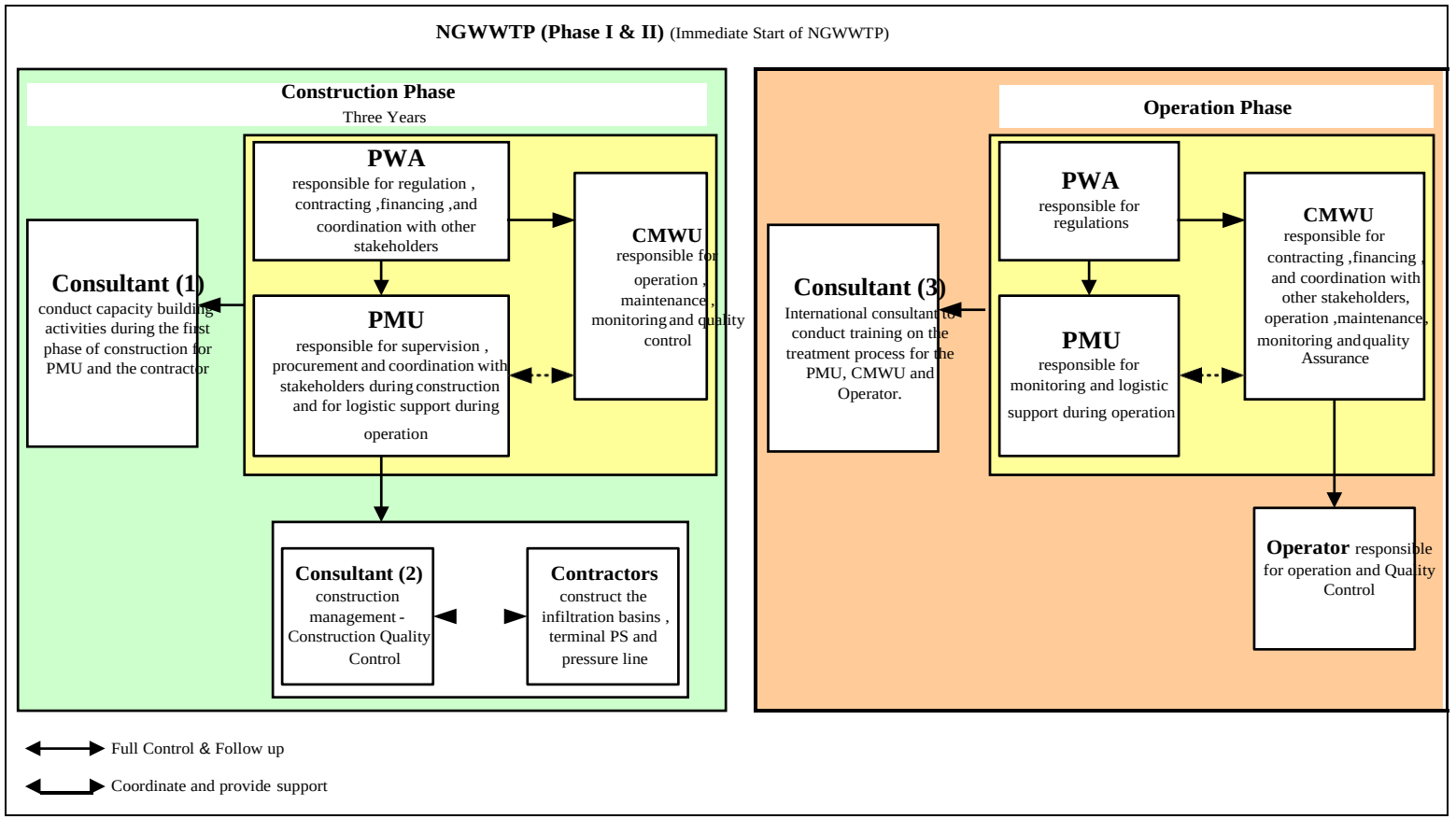


Figure 4.8: Institutional Setup Framework for NGWWTP

4.66 The effect of the infiltration of the treated wastewater should be subject to thorough monitoring for both water level and water quality in the aquifer. In order to make a suitable selection of the number and location of the observation points, the following selection criteria are used:

- The geographical distribution in relation to hydraulic stresses (the center and the extent of the water level mound).
- The half-life time of pathogenic bacteria.
- The extent and the variation of contaminant plume.
- Availability of existing monitoring wells that can be utilized. The proposed monitoring wells are

shownin Figure 4.6.

4.67 The existing production wells were not designed as formally constructed observation wells but they can be used to support the data taken from the designed monitoring wells. In the immediate vicinity of the site there are several production wells which may be used for monitoring (Q14, Q15, Q53, Q54A, Q54D, Q55, Q56, and R12).

4.68 Table 4.4 shows a list of parameters that should be monitored at different frequency for the different project phases. This table was designed based on local experience and the experience from the Dan region monitoring program. Samples from the observation wells are taken after at least half an hour of pumping in order to exchange the water in the well. After the start of operation of the new NGWWTP measurements for influent and effluent should be performed daily for all the proposed parameters in the table.

Table 4.4: Proposed Monitoring Parameters for Effluent Aquifer Water

Parameter	Pumped Effluent	Aquifer	
	Every Month	Every Month	Every six Months
Later level	N/A	X	X
pH	X	X	X
EC	X	X	X
TDS	X	X	X
SS	X		
BOD	X	X	X
COD	X	X	X
NO3	X	X	X
NH3/NH4	X	X	X
Cl	X	X	X
SO4	X	X	
P	X	X	
Ca	X	X	
Mg	X	X	
K	X	X	
Na	X	X	
Faecal Coliform	X	X	X
Total Coliform	X	X	
B	X	X	X
Detergents (HPLC)	X	X	X

Parameter	Pumped Effluent	Aquifer	
	Every Month	Every Month	Every six Months
Heavy metals	X	X	

4.3.2.2 Environmental Health and Safety Mitigation Measures and Monitoring

4.69 The NGWWTP projects include a 100 day storage place for the sludge. Almost all the farmers in Gaza apply organic fertilizers in November and April. For the rest of the year the sludge or the organic fertilizer is rarely used. Hence, additional storage place for sludge should be provided to accommodate at least one year sludge production. There is additional place within the NGWWTP site than can be utilized for that.

4.70 Although vegetables are grown on 40% of the cultivated area in Northern Gaza they have not been included in the potential area for sludge use. Even though the sludge will be pasteurized it is considered unacceptable for application to ground crops which are eaten raw. This is because a double protection barrier for health is preferred, just as proposed for effluent reuse. In other countries sludge is used for vegetables which are cooked but a high degree of control on application and cropping constraints is required to ensure safety. That degree of control is less easy to apply where a large number of small farms will be supplied with sludge. The attitudinal research carried out also indicates that farmers and consumers are suspicious about sludge on vegetable crops.

4.71 During the de-construction works the application of the safety measures and competent site supervision reduces the risk of accidents.

4.72 If the wastewater cannot be pumped to the NGWWTP, Pond No. 7 will be used as an emergency basin. The retention time of this basin is only a few days. Emergency repairs and actions should be planned in advance and implemented quickly.

4.3.2.3 Soil Mitigation Measures and Monitoring

4.73 The application of sewage sludge to land in member countries of the European Community is governed by Council Directive No. 86/278/EEC, 1986. This directive prohibits the sludge from sewage treatment plants from being used in agriculture unless specified requirements are fulfilled, including the testing of sludge and soil. Parameters subject to provisions of the Directive include the following:

- Dry matter (%)
- Organic matter (% dry sludge)
- pH
- Salinity
- Nitrogen, total and ammoniacal (% dry sludge)
- Phosphorous, total (% dry sludge)
- Potential toxic metals like (mg/kg dry solids): Zn, Cu, Ni, Cd, Pb, Pb, Hg, Cr,
- Mb, Se, Ar and Fl are four parameters added by UK department of environment.

4.74 Sludge must be analyzed for the Directive parameters at least once every 6 months and every time significant changes occur in the quality of the sewage treated. The frequency of analysis for the additional four parameters by UK may be reduced to not less than once in five years provided that their concentrations in the sludge are consistently no greater than the following reference concentrations (mg/ kg dry solids): Mb=3, Se=2, Ar=2 and Fl=200. Therefore, strict regulations and constant monitoring of the sludge quality must be applied as well as a regular control of the soil structure and soil quality where the sludge is applied.

4.75 The concentration of potentially toxic elements in arable soils must not exceed certain determined limits within the normal depth of cultivation as results of sludge application (see Annex II). Application rates should be based on the content of nitrogen or phosphorous (macronutrient) whichever is the more limiting factor. When the soil test does not recommend phosphorus fertilization, sewage sludge should not be applied. Application rates should also be limited by the soil's cumulative pollutant load of heavy metals based on the suggested soil limits recommended in Annex (II).

4.3.2.4 Socio-economic Mitigation Measures and Monitoring

4.76 A public awareness campaign to show the impact of the project on the overall economic and social conditions in the northern area of Gaza especially in terms of improved water quality and agricultural and commercial land.

4.77 High coordination with the Ministry of Religious Affairs to ensure their buy-in and the Islamic view of constructing this new project. This, if done properly, should also be used in the public awareness campaign.

4.78 In cooperation with local police, the project management should plan for the least disruption of traffic by providing alternative routes approved by the police department in the area.

4.79 At the long run the future tariff should take into consideration the following factors:

- To achieve cost recovery.
- To maintain social equity.
- To adopt flexible price mechanism that discourages wasteful uses of water and raise awareness of the economic value of resources invested in this vital sector.
- To promote environmental efficiency aimed at effective preventive measures to preserve water resources.

4.3.3 Capacity Building

4.80 An international consultant is required to conduct training about wastewater reuse and sludge monitoring for the representatives of PWA, PMU, CMWU and the operator in the following subjects:

- Advanced training in testing and monitoring inlet quality, outlet quality, sludge removal and treatment, odor removal, etc.
- Reuse of treated wastewater and sludge in agriculture applications.

4.81 During the implementation of the NGWWTP, a training program would be designed to be implemented by this recommended consultant. The training would target three levels:

- On-the-job training for a selected project staff to direct activity planning, design, and implementation with respect to environmental protection.
- Staff Training. The training should be provided through short duration seminars and workshops. Oriented site visits and intensive training, one-month duration, should also be provided for selected staff members.
- Training for contractors should be provided, including one or two-day's workshops for local contractors, focusing on: preparation and use of the appraisal/mitigation forms, use of environmental guidelines, and implementation of mitigation measures. Also, they should be trained on safety measures for construction works, proper construction wastes disposal and cleaning measures during construction.

4.82 Representatives of the involved agencies; PWA, PMU and CMWU are proposed to attend the training sessions. As part of the comprehensive capacity building program, the purpose and outcomes of the EA and EMP reports will be explained and the further development of a database based on the information collected during the assessment could enhance the EMP.

Table 4.5: Potential Environmental Impacts, Mitigation, and Monitoring Plan for the Construction of NGWWTP

Potential Impacts at **1 - existing site – BLWWTP** **2 - new site - NGWWTP** **3 – pipeline between BLWWTP and NGWWTP**	**Mitigation Measures**	**Monitoring Measure & Method**	**Responsibility of Execution**	**Monitoring & Enforcement Responsibility**
- Nuisance, noise and dust at the construction sites (1, 2, 3)	- Definition of Noise and dust mitigation measures, the construction supervision takes care that these measures are applied - Proper activity scheduling and working hours and days and limit the activities to day times and prevent any construction activities at weekends. - Particulate emissions control unit such as scrubbers, cyclones, fabrics, or electric precipitators - Covering of stored spoil material and vehicles removing waste, use of dust suppression - Water spraying - Using relatively new construction and transportation vehicles with lower emissions - Ensure that noisy activities occur during daytime only and not during holidays or late at night	- Site supervision, public consultation,	Contractor	PWA CMWU
- Risk of accidents and injuries (1, 2, 3)	- Follow safety instructions, worker should wear proper clothing - A first aid station with trained staff, which is able to coordinate with local hospitals in case of emergencies - Personnel will be trained in Environmental Health and Safety matters including accident prevention, safe lifting practices, safe chemical handling practices, proper control and maintenance of equipment and facilities - Warning signs and instructions in case of emergencies should be properly displayed, workers must be informed about these precautions - Requirements of Palestinian Labor Law especially regarding safety should be applied	- Training program - Site supervision - Public consultation	Contractor	CMWU PWA
- Potential accidental break of existing infrastructure (pipelines, power lines, irrigation network etc. (1, 3).	- Consideration in the detailed design, construction supervision, in case of damage immediate repair.	- Report about compliance with the as-built drawings	Operator	CMWU PWA
- Nuisance and psychological problems concerning the construction and operations of the new WWTP on the Existing Cemetery (2).	- Coordination with the Ministry of Religious Affairs to ensure their acceptance of the project - public awareness campaign	- Public campaign	PWA MWRA	PWA MWRA
- Impairment of agricultural activities during the cultivation period from October until April or May (1, 2, 3)	- Construction activities in agricultural areas should be executed in winter to minimize impacts. If this is not possible farmers will receive compensation	- Site supervision, coordination with local farmers	PMU,	PWA CMWU

Potential Impacts at **1 - existing site – BLWWTP** **2 - new site - NGWWTP** **3 – pipeline between BLWWTP and NGWWTP**	**Mitigation Measures**	**Monitoring Measure & Method**	**Responsibility of Execution**	**Monitoring & Enforcement Responsibility**
- Disturbance of the soil structure, densification (2, 3)	- Vehicle movement outside the construction site only on existing roads, no crossing of agricultural areas	- Construction supervision - Public consultation	PMU,	PWA CMWU
- Producing huge piles of clayey soil due to excavations of infiltration basins (2)	- Transfer to depressions located southeast of existing BLWWTP - Selling to farmers at transportation cost	- Site management and Coordination with local farmers	PMU,	PWA CMWU
- Loss of agricultural area (1, 2)	- Partly compensated by rehabilitation of the lake area which may be used for agriculture	- Coordination of authorities and local residents	- PWA, - Palestinian Land Authority	- Palestinian Land Authority
- Obstruct the accessibility or property and impairment of the local traffic in the vicinity of the construction sites; risk of traffic accidents (1, 2, 3).	- Proper planning of construction activities, monitoring of risky activities such as excavation and backfilling. - Provision of adequate notification procedures for any road closures. - Monitoring the use of safety measures and tools. - Traffic management (signs, traffic flow) - Speed limits for construction vehicles	- Site monitoring - Complaint monitoring	Contractor PMU Police	PWA MOT
- Local traffic is expected to increase due to the movements of heavy trucks which transport construction material to the site and the excavated clay outside the site (3).	- Traffic signs to ensure proper routing and distribution of traffic - Provision of adequate notification procedures for any road closures - Traffic Management Plan	- Complaint monitoring	Contactors, PMU	PWA MOT
- Loss of older trees along the roadsides (3)	- Minor local modifications of the pipeline route in order to avoid tree felling - Replanting of trees.	Construction supervision	Contractor PWA	PMU
- Archaeological remains could be discovered (1, 2, 3)	- Monitoring of site excavations - In case of findings information of the concerned agency (MOTA) and additional survey	- Construction supervision	Contractor PMU	PMU MOTA
- Impact on nearby flora and fauna (1, 2, 3)	- Dust generating activities such as excavations and back-filling should be avoided during flowering period of the plants (March to May) as much as possible - Rare plants could be transferred to safe places - Avoiding of disturbance of breeding activities of rare birds (March to May)	- Good planning for activities - Site investigation	Contractor	PMU PWA

Potential Impacts at **1 - existing site – BLWWTP** **2 - new site - NGWWTP** **3 – pipeline between BLWWTP and NGWWTP**	**Mitigation Measures**	**Monitoring Measure & Method**	**Responsibility of Execution**	**Monitoring & Enforcement Responsibility**
- Improper disposal and pile up of construction materials (1, 2, 3)	- Cleaning and removal of wastes or deposits to landfills or designated areas.	- Construction supervision, - Complaint monitoring	Contactor	PMU

Table 4.6: Potential Environmental Impacts, Mitigation, and Monitoring Plan for the Operation of NGWWTP

Potential Impacts for the Operations of the Emergency Project 1 - existing site – BLWWTP 2 - new site - NGWWTP 3 - pipeline between BLWWTP and NGWWTP	Mitigation Measures	Monitoring Measure & Method	Responsibility of Execution	Monitoring & Enforcement Responsibility
- Grit, sand, and debris entering pressure station and impairing the treatment process (2). - Flooding in wastewater networks due to mixing of storm water with sewage during heavy rains (2) - Increase of wastewater quantities is expected after developing the non-serviced areas (2)	- Upgrading the screen and grid removal structure and maintenance to perform effective screening and sedimentation. - Proper design of wastewater facilities - Draw emergency plans - The planning and operations should be carried out according to the master plans and the operator (& CMWU) should be informed - Planning of new areas should consider the design constraints of the NGWWTP and proposed future serviced areas. - Implement proper tariff structure (for both water and wastewater) - Planning of new areas should be consider the design constraints of the NGWWTP and proposed future serviced areas.	- Frequent observation	Operator	TCMWU, PWA
- Increase the level of toxic contaminants	- The aquifer water will be subjected to comprehensive monitoring - Public awareness - Proper operations and maintenance plans - Issued a restrict regulations and standards - Implement a periodic testing program	- Complaint monitoring - Site visit - Random quality assurance	Operator CMWU	PWA
- Potential Impact of Sludge and irrigation by WW (2) ▪ Potential pollution of the raw eaten crops ▪ Children are often present on the farms and fallen fruit may be picked off the ground ▪ labors and farmers at farms that are irrigated by treated wastewater or fertilized by sludge may be subjected to some danger of Ascaris	- Control the use of sludge for specific crops with restricted standards (Specific regulation to control the use of treated wastewater in irrigation according to the quality of treated wastewater and according to soil structure). - no sludge to be used without treatment - Public Awareness program for the neighboring communities (using the available media is recommended) - Provide workers with appropriate protective clothing including rubber gloves, boots, long sleeved shirts and pants. - train workers to wash hands and faces frequently with soap and water and make both available - Test samples from active chamber and mature chamber after fallow period for Ascaris eggs and fecal coliforms - Treat sludge before secondary use and don't allow disposal in or neat water bodies.	- Testing programs - Awareness - Complaint monitoring	Operator CMWU	MOA, PWA,
- Risk of Accident, injuries and handling of toxic and hazardous materials (1, 2)	- Follow safety instructions, worker should wear proper clothing - A first aid station with trained staff, which is able to coordinate with local hospitals in case of emergencies - Employees will be trained on the hazards, precautions and procedures for safe storage, handling and use of all potentially harmful materials relevant to each employee's task and work area. - Warning signs and instructions should be properly displayed - The work place should have proper ventilation to refresh oxygen and reduce temperature (labs, control rooms, etc.). - Requirements of Palestinian Labor Law especially regarding safety will be	- Testing programs - Awareness - Complaint monitoring - Site visits	Operator	CMWU PWA

Potential Impacts for the Operations of the Emergency Project 1 - existing site – BLWWTP 2 - new site - NGWWTP 3 - pipeline between BLWWTP and NGWWTP	Mitigation Measures	Monitoring Measure & Method	Responsibility of Execution	Monitoring & Enforcement Responsibility
	Applied			
- Impact, change the soil structure (1 &2)	- The site should be cultivated with grass to take up the existed trace elements. - The grass should be cut three times a year, this process will grantee the site cleaning (phytoremediation). - Planting fodders and grass is recommended. - Industrial wastewater should be separately disposed or patricianly treated in site to reduce its heavy metals content to acceptable values to be discharge to the public sewer system	- Complaint monitoring	Contractor	PWA CMWU
- Bad smells from the wastewater treatment process (2)	- Proper design, construction and operations of the odor control system stack - Suitable design of the chimney	- Random checking - Complaint monitoring	Operator	CMWU PWA
- Noise generation by some activities (1 & 2)	- Ensure that noisy activities occur during daytime and not during holidays or late night times	- Random Checking	- Operator	PMU
- Air pollutant generated by traffic, construction activities and electricity generators	- Using relatively new construction and transportation vehicles with lower emissions - Control the air pollutants of the power generators - Control the activities and movement routes in the site to specify the construction area.			
- Uncontrolled expansion of built up areas (make them subjected to uplift pressure and danger) (1&2)	- Proper land use plan should be considered	- Site visits - Random checking	- Municipality of Gaza	- MOLG MOP
- Disturb of aesthetic features (1&2)	- Ensure aesthetic view of the WWTP - Offsite and onsite design should be integrated - Planting of trees and bushes, shrubs, trees, and flowers. Planning and implementing of appropriate landscaping program (planting should be planed carefully to far enough from the WWTP fence to ensure a natural aeration of wastewater in the logons)	- Site visits	- PMU	PWA
- Livestock (sheep, cows), could drown in the infiltration basins (2)	- Proper fencing should be installed around the facility.	- Site Visit	- contractor - PMU	- CMWU
- negative publicity and misconceptions (2)	- Public information campaigns before the project is executed	Public campaign	PWA	PWA, MOH, EQA

4.4 EMP Cost Estimate and Schedule

4.83 The cost of the Environmental Management Plan (EMP) is divided into several parts to reflect the different phases of the project and the requirements of each phase. Table 4.7 lists the main components of EMP and the related estimated costs.

4.84 The cost of EMP includes the costs of the capacity building and the quality control requirements. The costs of implementation of mitigation measures and monitoring (except for short term water quality and BLWWTP effluent quality) are excluded for the following reasons:

- The implementation of the mitigation measures is the responsibility of the PMU during construction and the responsibility of the operator during operation phase. The costs of implementation of mitigation measures will be included in the cost of contract.
- Monitoring costs were excluded because the monitoring as outlined in the EMP requirements is part of the duties of the local agencies. So, they will monitor the implementation without any extra costs. Only the costs for training, consultancies and other specific issues will be considered.

Table 4.7: EMP Cost Estimates (US$)

Item	Unit	Quantity	Unit Cost US$	Phase	
				Construction	Operation
Part A – 2006-2008					
Consultant 1: Environment Specialist hired to train in techniques for monitoring, testing and wastewater reuse	workshops	4	1,000	4,000	
Consultant 2: Local Environment Specialist hired to ensure compliance to EMP	workshops	4	1,500	6,000	
Quality Test for Existing BLWWTP effluent and infiltrated water including aquifer monitoring	Yearly	2	48,000		96,000
Construction of Monitoring Wells (9 wells)	LS	LS	150,000	150,000	
Environmental Auditing	Yearly	2	5,000		10,000
Miscellaneous*	Yearly	3	3,000	3,000	6,000
Total (Part A)				**US$275,000**	
Part B – 2008-2012					
Consultant 3: International Consultant hired to train the local institutions at the NGWWTP project components and Process (operation)	Training Programs (week/each)	3	5,000		15,000
On-the-job training	Month	3	2,500		7,500
Quality Test for influent and effluent of NGWWTP and aquifer monitoring	Yearly	4	48,000		192,000
Environmental Auditing	Yearly	4	5,000		20,000
Miscellaneous*	Yearly	5	4,000	12,000	8,000
Total (Part B)				**US$260,000**	

Any unexpected emergency mitigation measure will be covered from this amount.

4.85 A schedule for the implementation of the various activities of the Environmental Management Plan is prepared and shows the duration of the activities and timing of the proposed periodic assessments as shown in Table 4.8.

Table 4.8: Tentative EMP Implementation Schedule

Item	**Details**	**Yearly Schedule**				
		1St year	2nd Year	3rd Year	4th year	5th year
Emergency Phase						
Consultant hired to train the local institutions at the emergency project (construction and operation)	workshops	**XXXX** (4 Work -shops)				
Quality Test for Existing BLWWTP effluent and infiltrated water including aquifer monitoring.	Quality Tests (Yearly)		**X**	**X**		
Environmental Auditing	Yearly		**X**	**X**		
Miscellaneous*	Yearly	**X**	**X**	**X**		
NGWWTP (Including Emergency)						
Local Qualified Consultant hired to train the local institutions at NGWWTP (Parts 1 and 2) project (construction)	workshops	**XXXX**			**X**	**X**
International Consultant hired to train the local institutions at the NGWWTP project components and Process (operation).	Training Programs (week/each)			**X**		
On-the-job training	Month			**XXX** (three months)		
Quality Test for influent and effluent of NGWWTP and aquifer monitoring.	Quality Tests (Yearly)		**X**	**X**	**X**	**X**
Environmental Auditing	Yearly		**X**	**X**	**X**	**X**
Miscellaneous*	Yearly	**X**	**X**	**X**	**X**	**X**

ANNEX 2

Laws, Polices, Regulations and Standards

Relevant to the WMS project

Laws, Polices, Regulations and Standards Relevant to the WMS project

1. Legal and Institutional Framework

The project is guided by the local laws and regulations set by the Palestinian Authority along with the World Bank environmental and social standards. Therefore, this chapter of the report discusses the applicable World Bank environmental and social standards as well as the existing Palestinian legal and policy framework. The chapter also discusses the institutional framework for the project.

1.1. National Polices, Regulations and Standards

1.1.1. Palestinian Environmental Assessment Policy

The Palestinian Environmental Assessment Policy (PEAP) was approved by decree No: 27-23/4/2000. The PEAP supports the sustainable economic and social development of the Palestinian people. Specifically, the PEAP promulgates the following:

- Ensure an adequate quality of life in all aspects, and ensure that the basic needs and social, cultural, and historical values of the people are not negatively impacted as a result of development activities.
- Preserve the capacity of the natural environment.
- Conserve biodiversity and landscape, and promote the sustainable use of natural resources.
- Avoid irreversible environmental damage, and minimize reversible environmental damage from development activities.

In accordance to the PEAP, environmental auditing has been designed to deal with such existing development. Its aim is to mitigate negative environmental impacts through evaluating their environmental management and performance. An environmental audit is prepared by the owner or operator of the development activity, and focuses on mitigation measures for existing environmental impacts to comply with relevant environmental standards and regulations. Decisions resulting from an Environmental Audit Report can include:

i. Suspension of the permit for the development activity by the permitting authority until specified measures are implemented;
ii. Agreement on conditions that will be applied to the development activity, including a plan of implementation; or
iii. Exemption of the development activity from further compliance with the EA Policy.

Implementation of agreed upon terms and conditions should follow a specified time schedule, and requires continuous follow-up and evaluation.

1.1.2. Palestinian Environmental Law

The Palestinian Environmental Law (PEL) No. 7 of 1999 was developed by EQA to protect environmental resources, including land environment; air environment; water resources and

aquatic environment; and natural, archaeological and historical heritage. According to the PEL, the protection of these resources shall be addressed in all social and economic development plans in view of sustainable development and protection of the rights of future generations.

The core issues of concern in the PEL are the protection of public health and social welfare, as well as the conservation of ecologically sensitive areas, biodiversity and rehabilitation of environmentally damaged areas. The PEL also sets penalties for violating any article presented under this law.

Article 8 of this law reads, "*The competent authorities, consistent with their respective specialization, shall encourage undertaking appropriate measures to reduce the generations of solid waste or any other hazardous waste to the lowest level possible, and to the best extent possible, shall encourage solid waste treatment, recycling or processing*".

In accordance with Article 12, and 13, the disposal of any hazardous substance or waste should not be done, unless such a process is conform with the terms, regulations, instructions and norms specified by EQA, in coordination with specialized agencies.

1.1.3. Palestinian Water Law

Legislation for the regulation and management of the water sector was encompassed in the approved Water Law No. 3, which was signed on July 2002. The objective of this law as stated in Article 2 is to develop and manage the water resources, increasing their capacity, improving their quality and preserving and protecting them from pollution and depletion.

A new Water Law No. 14 was issued in 2014 to establish for a new phase for the water and wastewater sector and its governance and management. This law aims to develop and manage water resources, increase their capacity, improve their quality, preserve and protect them from pollution and depletion, and to improve the level of water services through the implementation of integrated and sustainable water resources management principles.

1.1.4. Palestinian Public Health Law

In accordance with the Palestinian Public Health Law (PPHL) No. 20, developed by the Ministry of Health (MoH) and issued upon resolution by the Legislative Council in 2004. The role of the PA as represented by the MoH and other authorities is to ensure the control of communicable, non-communicable, and genetic diseases by practicable means, including the removal of health nuisances.

In accordance to Article 43, i*t is forbidden for any individual to use wastewater for fertilization or irrigation of agricultural land, only in accordance with the bases and standards specified by the competent authority*.

1.1.5. The Palestinian Law on Agriculture

In accordance with the Palestinian Low on Agriculture No. 2 (PLC, 2003), issued upon resolution by the Legislative Council in 2003, as stated in Article 54: *the Ministry of Agriculture shall put forward, in cooperation and liaison with the Water Authority and other competent authorities, the water plans and policies related to the agricultural sector in accordance with a list of principles that includes*:

- The best use of water and the use of modern irrigation systems and methods.
- Preserve water sources and purify them in a manner that makes them usable.
- Conduct regular tests and analyses on agricultural water and verify the extent of its suitability for agriculture.
- Benefit from the non-potable water and treated water.

Article 24 of this law reads; *Crops may not be fertilized by human excrements or by any fertilizer, which is mixed with or derived from liquid or solid wastes, except after being treated in accordance with accredited specifications and standards*.

According to Article 55 of this law, *the irrigation of agricultural crops with wastewater shall be totally prohibited unless it has been treated in accordance with the national standards that are certified by the competent technical authorities.*

1.1.6. Palestinian Ambient Air Quality Standards

The Palestinian Ambient Air Quality Standards (PS 801- 2010) were developed by the Palestinian Standards Institution (PSI) through the Environment Committee. The result is health based standards and objectives for a number of pollutants in air, including particulate matter, nitrogen oxides, ozone and sulfur oxides as shown in Table 1-1 for the comparison between the Palestinian and the WHO ambient air standards.

Table 1-1: WHO and Palestinian Ambient Air Quality Guidelines

Parameter	Averaging Period	WHO Guideline value* ($\mu g/m^3$)	Palestinian Guideline value ($\mu g/m^3$)
PM_{10}	24-hour	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)	150
	1-year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)	70
NO_2	1-hour	200 (guideline)	400
	24-hour	--	200
	1-year	40 (guideline)	100
O3	1-hour	--	200
	8-hour	160 (Interim target-1) 100 (guideline)	120
SO_2	1-hour	--	350
	24-hour	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)	250
	1-year	--	60
	10-minute	500 (guideline)	--

* PM 24-hour value is the 99th percentile.

1.1.7. Palestinian Noise Level Guidelines

The Palestinian Standards Institution have established the Outdoor Noise Standards (PS 840-2005), through the Environment Committee, to Provide information for the protection of public health against the outdoor noise level. These guidelines are shown in Table 1-2. The Palestinian and the WHO guidelines have almost the same levels, with the Palestinian guidelines having more detailed types of receptors.

Table 1-2: Palestinian Outdoor Noise Level Guidelines

Receptor	**One Hour L_{Aeq} (dBA)**	
	Daytime (07 am – 08 pm)	Nighttime (07 am – 08 pm)
Rural residential areas, hospitals, schools	40	30
Residential	50	40
Residential with some commercial activities, or along main roads	55	45
Commercial	65	60
Industrial	75	65

1.1.8. Technical Specifications for the reuse of treated wastewater in Irrigation

The Technical Specifications for the reuse of treated wastewater in irrigation 34 / 2012 (PSI, 2012), were developed by the Palestinian Standards Institution (PSI), to regulate the use of treated wastewater in a manner that does not impose any risk to the health of human beings, plants and animals. And to ensure that the environmental elements including soil, air and water will not be at risk when the treated wastewater is used for irrigation.

These Technical specifications divide the treated wastewater into four categories according to its quality; high quality (A), Good quality (B), Moderate quality (C) and Poor quality (D). In addition, the specifications provide regulations to ensure the safe transportation of treated wastewater to be used in irrigation.

In accordance to Article 8 of these specifications, *it is forbidden to use the treated wastewater to provide water for livestock and poultry, irrigate vegetables, and/or recharge the groundwater aquifer directly and/or in fish farming.*

1.2. World Bank Environmental and Social Standards

The Environmental and Social Framework (ESF) that was launched on October 1, 2018 forms a new set of environment and social policies to enable the World Bank and Borrowers (in this case PWA) to better manage environmental and social risks of projects and to improve development outcomes. An essential part of this framework is the ten Environmental and Social Standards, which establish the standards that the Borrower and the project should meet through the project life cycle, as follows:

- ESS 1: Assessment and Management of Environmental and Social Risks and Impacts;
- ESS 2: Labor and Working Conditions;
- ESS 3: Resource Efficiency and Pollution Prevention and Management;

- ESS 4: Community Health and Safety;
- ESS 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement;
- ESS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- ESS 7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities;
- ESS 8: Cultural Heritage;
- ESS 9: Financial Intermediaries; and
- ESS 10: Stakeholder Engagement and Information Disclosure.

1.2.1. ESS 1: Assessment and Management of Environmental and Social Risks and Impacts

ESS 1 sets out the Borrower's responsibilities for assessing, managing and monitoring environmental and social risks and impacts associated with each stage of a project supported by the Bank through Investment Project Financing, in order to achieve environmental and social outcomes consistent with the ESS's.

Environmental and social audit is an instrument to determine the nature and extent of all environmental and social areas of concern at an existing project or activities. The aim of the audit is to identify significant environmental and social issues in the existing project or activities, and assess their current status, specifically in terms of meeting the requirements of the ESSs1-10. The audit reviews also issues not covered by the ESSs, to the extent that they represent key risks and impacts in the circumstances of the project.

The audit identifies and justifies appropriate measures and actions to mitigate the areas of concern, estimates the cost of the measures and actions, and recommends a schedule for implementing them.

1.3. WHO Guidelines and Standards

1.3.1. WHO Ambient Air Guidelines

The WHO Air Quality Guidelines (2005) are recommended by the WB Environmental, Health and Safety Guidelines to be applied in the absence of national legislated standards, in order to prevent or minimize significant to ambient air, by ensuring that emissions do not result in pollutant concentrations that reach or exceed these guidelines and standards. Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines. Table 1-1 sets a comparison between the WHO and Palestinian ambient air quality standards.

1.3.2. WHO Noise Level Guidelines

Guidelines for Community Noise, World Health Organization (WHO), 1999, provided guidelines values for noise levels measured out of doors. These levels, presented in Table 1-3, should not be exceeded by any noise source.

Table 1-3: WHO Outdoor Noise Level Guidelines

Receptor	One Hour L_{Aeq} (dBA)	
	Daytime (07 am – 10 pm)	Nighttime (07 am – 10 pm)
Residential, institutional, educational	55	45
Industrial, Commercial	70	70

1.4. Institutional arrangements

The Palestinian Water Authority (PWA) will be responsible for the implementation of the Project. The Project Management Unit in PWA (PMU) will be responsible for Project oversight, monitoring, reporting, facilitation, hiring of consultants, contract awards, and coordination with stakeholders to ensure that the project objective is achieved.

For the first five years of the project operation PWA will be responsible for the operation and maintenance of the NGWWTP. However, after this period the operation will be under the responsibility of the Coastal Municipalities Water Utility (CMWU) and the four municipalities in the northern governorate in the Gaza Strip, namely Beit Lahia, Beit Hanoun, Jabalia, and Um Alnaser.

Other governmental institutions will also be involved in the project monitoring activities, such as the Environment Quality Authority (EQA), the Ministry of Health (MoH), and the Ministry of Agriculture (MoA). These institutions will mainly be involved in monitoring the project compliance with Palestinian legislations and standards.

ANNEX 3

Samples of Water and wastewater quality monitoring tests

Table 5: Results of ground water quality of the monitored wells

Sample Identification				Sample Location														
	Parameter	Unit	Sample	MW1	MW3	MW7	MW8	MW10	Q20	Q51	Q52	Q53	Q56	Q65	Q86	SW	RW28	RW29
1.	Water level (m)			-0.91	-0.84	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R
2.	pH	-	G*	7.3	7.2	7.4	7.8	7.4	7.5	7.6	7.4	7.3	7.4	7.8	7.2	7.5	7.9	8.0
3.	DO	mg/l	G	2.09	1.50	6.20	5.60	5.45	5.10	7.09	2.60	2.42	2.62	3.62	2.25	4.39	-	-
4.	Temperature	C0	G	24.5	25.4	26.1	24.8	23.2	25.7	25.6	25.2	25.0	25.3	25.7	23.4	26.1	26	25
5.	Conductivity(EC)	µs/cm	G	2200	2200	3500	2800	1610	2520	1600	2100	2260	2280	3050	2400	2300	2100	2100
6.	TDS	mg/l	G	1408	1408	2240	1792	1030	1612	1024	1344	1445	1460	1950	1536	1472	1344	2344
7.	Chloride	mg/l	G	358	382	734	531	246	555	244	357	395	390	608	429	386	315	327
8.	Turbidity	NTU	G	12.35	4.83	17.05	32.7	9.07	0.53	1.01	2.69	0.0	1.67	1.84	0.92	9.8	3.77	0.70
9.	PO_4-P	mg/l	G	0.505	0.027	0.038	0.127	0.082	0.021	0.058	0.052	0.032	0.040	0.031	0.052	0.062	0.026	0.189
10.	Magnesium	mg/l	G	50	74	59	24	123	68	99	121	94	122	115	100	111	84	64
11.	F	mg/l	G	1.1	1.8	1.6	1.6	0.8	1.8	0.9	0.7	0.1	1.4	1.8	1.0	1.1	1.6	2.0
12.	Detergents as MBAS	mg/l	G	1.93	1.98	2.31	1.81	2.13	2.67	2.88	2.95	1.94	2.95	2.94	2.69	2.67	3.43	2.20
13.	T. H as $CaCO_3$	mg/l	G	297	495	330	150	759	452	653	724	639	683	627	739	782	505	340

Table A3.1: Groundwater quality monitoring laboratory results for the NGEST project.

Table A3.1: Groundwater quality monitoring laboratory results for the NGEST project.

Sample Identification				Sample Location													
	Parameter	Unit	Sample	MW1	MW3	MW7	MW8	MW10	Q20	Q51	Q52	Q53	Q56	Q65	Q86	SW	RW28	RW29
14.	Alkalinity as $CaCO_3$	mg/l	G	659	634	614	602	426	338	441	587	571	569	478	494	564	579	571
15.	BOD_5	mg/l	G	10	15	12	13	10	14	15	15	20	16	15	5	10	15	15
16.	COD	mg/l	G	20	34	30	49	27	25	32	47	44	53	34	14	20	35	29
17.	T. Coil	CFU/100ml	G	Nill	20	Nill	Nill	Nill	Nill	26	Nill	8	Nill	Nill	10	66	50	Nill
18.	Fecal Coli	CFU/100 ml	G	Nill	14	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	Nill	2	6	Nill
19.	Nitrate-NO_3	mg/l	G	40.9	7.6	33.8	50.2	45.4	22.0	60.8	55.5	14.4	43.3	49.6	35.4	47.8	226	180
20.	Ammonia-NH_3	mg/l	G	0.46	7.87	0.019	1.28	0.66	0.04	0.25	0.76	15.23	1.18	0.89	16.53	10.82	0.019	0.019
21.	Ammonia-N	mg/l	G	0.390	3.990	0.016	1.040	0.540	0.030	0.210	0.620	12.480	0.970	0.730	13.550	8.870	1.016	0.016
22.	Nitrate-N	mg/l	G	9.300	1.700	7.700	11.400	10.300	5.000	13.800	12.600	3.200	9.800	11.300	8.000	10.900	51.300	40.900
23.	Nitrite-N	mg/l	G	0.020	0.000	0.010	0.360	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.020	0.030	0.400	0.020
24.	Total nitrogen	mg/l	G	9.170	5.690	7.726	12.800	10.840	5.030	14.01	13.230	15.680	10.770	12.030	21.520	19.800	52.716	40.936
25.	TKN	mg/l	G	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
26.	Benzene	mg/	G	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
27.	Sulfate	mg/l	G	47	31	116	87	45	103	65	54	58	67	97	71	54	50	51
28.	Oil and Grease	mg/l	G	0.000	0.000	0.000	0.000	0.009	0.005	0.005	0.002	0.007	0.003	0.005	0.000	0.004	0.000	0.001
29.	Phenols	mg/l	G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A3.2: Groundwater quality monitoring laboratory results for the NGEST project

10. Laboratory Data

3.1 Laboratory in flow data analysis

Intlet												
	EC (µS/cm)	PH	TSS (mg/L)	COD (mg/L)	BOD (mg/L)	TKN (mg/L)	NH4-N (mg/L)	NO3-N (mg/L)	NO2-N (mg/L)	TN (mg/L)	TP (mg/L)	FC (CFU/100ml)
1/Nov	2870	8.1	378		410	39.3	28.1	0.8	-00	38.9	6.2	3*10^7
2/Nov	2810	8.0	400		430	37.4	28.0	0.8	-00	38.2	4.8	2*10^7
3/Nov	2880	8.1	380		460	28.7	18.2	0.8	-00	27.3	6.8	4*10^7
4/Nov	2420	8.3	480		470	53.4	38.4	0.8	-00	53.8	4.7	6*10^7
5/Nov	2860	8.1	380		440	48.0	35.8	0.6	-00	48.5	6.2	8*10^7
6/Nov	2760	8.0	380		380	28.7	18.1	0.8	-00	27.3	6.8	4*10^7
7/Nov	2420	8.3	438		420	53.4	38.3	0.8	-00	53.8	4.7	2*10^7
8/Nov	2860	8.0	438		0	45.4	32.5	0.7	-00	48.1	6.2	3*10^7
9/Nov	2780	8.0	437		0	84.0	45.5	0.7	-00	84.7	6.8	2*10^7
10/Nov	2820	8.1	380		390	45.4	32.0	0.8	-00	48.2	8.0	4*10^7
11/Nov	2820	8.1	440		0	48.1	34.5	0.6	0.05	48.7	6.8	4*10^7
12/Nov	Evacuation											
13/Nov												
14/Nov												
15/Nov												
16/Nov	2710	8.1	0		480	58.7	42.5	0.3	-00	58.0	7.9	3*10^7
17/Nov	2710	8.1	380		420	58.7	42.7	0.5	-00	58.2	7.8	2*10^7
18/Nov	2620	8.1	380		360	58.0	40.0	0.7	-00	58.7	6.4	6*10^7
19/Nov	2800	8.2	480		280	61.4	42.7	1.9	0.04	63.3	6.4	3*10^7
20/Nov	2820	8.2	620		360	58.8	40.0	1.5	-00	58.1	6.8	3*10^7
21/Nov	2680	8.2	480		380	58.3	41.5	0.5	-00	58.8	8.2	2*10^7
22/Nov	2810	8.2	480		380	55.4	38.9	0.8	-00	58.0	6.8	4*10^7
23/Nov	2380	8.2	620		280	42.7	28.4	0.7	0.04	43.4	6.3	2*10^7
24/Nov	2840	8.2	384		350	58.7	44.8	0.8	-00	58.3	4.8	4*10^7
25/Nov	2660	8.3	600		370	53.4	37.8	0.3	-00	53.7	8.3	1*10^7
26/Nov	2640	8.2	400		340	55.7	38.3	0.2	-00	55.9	8.1	3*10^7
27/Nov	2670	8.2	340		380	53.4	37.4	1.7	-00	55.1	6.2	4*10^7
28/Nov	2610	8.2	380		380	59.1	45.1	0.4	-00	59.5	6.8	4*10^7
29/Nov	2630	8.2	470		360	51.8	36.2	0.7	0.05	52.4	6.5	3*10^7
30/Nov	2480	8.3	680.0		330	49.8	38.1	1.8	-00	51.4	6.9	6*10^7

Table A3.3: Groundwater water level in the monitoring wells for the NGEST project.

Appendix B:

The results of the groundwater levels measurement in the 13th and 14th round.

1- The ground water level, pH and EC of the monitored wells in the 13th round, performed on June, 2018.

NO.	Code	Date	Water Level (m)	pH	EC µs
1	MW1	4-6-2018	-1.08	7.2	2150
2	MW2	4-6-2018	-2.79	7.2	2650
3	MW3	4-6-2018	-1.05	7.1	2260
4	MW4	4-6-2018	-3.49	6.8	2160
5	MW5	4-6-2018	-0.83	7.6	1630
6	DB	4-6-2018	-0.96	7.0	2340
7	SW	4-6-2018	NR	6.6	2260
8	Q86	4-6-2018	1.5	-	-
9	Q53	4-6-2018	6.4	7.0	2320
10	Q15	4-6-2018	NR	--	-
11	Q56	4-6-2018	NR	--	-
12	Q65	4-6-2018	NR	7.2	3020
14	Q20	4-6-2018	0.58	7.3	2550

*NR= Not Recorded