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Feasibility Study for Alexandria West Wastewater Treatment Plant Extension and Upgrade
Reference code: TA2016022 EG FTF

Environmental & Social Impact

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In association with

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The authors take full responsibility for the contents of this report. The opinions expressed do not necessarily reflect the view of DFID, the European Union or the European Investment Bank

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ABBREVIATIONS

ASDCO	Alexandria Sewage & Drainage Co.
BOD	Biochemical Oxygen Demand
CAPW	The Construction Authority for Potable Water and Waste Water
COD	Chemical Oxygen Demand
DS	Dry Substance Content
ECS	Effluent Conveyance System
EEAA	Egyptian Environmental Affairs Agency
EIB	European Investment Bank
ERP	Emergency Response Plan
EU	European Union
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FS	Feasibility Study
GOE	Government of Egypt
CFU	Colony Forming Units (in 100ml)
ha	Hectare (10,000 m^2, 2.5 feddan)
HCWW	Holding Company for Water and Wastewater
ID	Inner Diameter
IP	Implementation Plan
m	Meter
m^3/h	Cubic meter per hour
mg/l	Milligram per litre
masl	Meter above sea level
MDF	Mechanical Dewatering Facility
MP	Monitoring Plan
Mg	Magnesium
MWI	Ministry of Water and Irrigation
MoHUUC	Ministry of Housing, Utilities and Urban Communities
NAP	Egyptian National Action Plan
NARSS	National Authority for Remote Sensing and Space Science
ND	Nominal Diameter
NRC	National Research Centre (Cairo)
pe	Population Equivalent
PMU	Project Monitoring Unit
SAR	Sodium Absorption Ratio

TDS	Total Dissolved Solids
ToR	Terms of Reference
TP	Total Phosphorus
TN	Total Nitrogen
TSS	Total Suspended Solids
Qd	Daily Flow
VSS	Volatile Suspended Solids
WWTP	Wastewater Treatment Plant

1 Non-technical Summary

1.1 Background

The current report presents the Environmental and Social Impact Assessment (ESIA) for the proposed project Upgrade and Extension of Alexandria West Wastewater Treatment Plant (WWTP) from primary treatment of 461,000 m^3 per day to secondary treatment and expand the total capacity of the plant to 600,000 m^3 per day. The project will support the depollution of Lake Maryout and the Mediterranean Sea and provide an additional source of water, thus improving the economic situation for fishery, agriculture/forestry and tourism in the area. Also, this project will improve the health and environmental situation of the population living in the Governorate of Alexandria.

The basis of the current ESIA is is the first stage which identifies to the prospective Project Sponsors during the feasibility study, the issues and aspects that will need to be covered in the final environmental and social impact assessment to satisfy requirements of the project sponsors and financing agencies as well as the requirements of the Egyptian Environmental Affairs Agency (EEAA).

The current scope of the Consultant is to the prepare feasibility study and conceptual designs. It is likely that any proposals for mitigation measures to reduce any particular impacts shall be elaborated and considered in the detailed design phase.

The main aims of the study are to undertake a environmental and social assessment for the proposed project, with the specific objectives to:

a) Undertake a due diligence of all environmental and social issues and ensuring the financing sponsor EIB that no serious negative impact (environmental / social) shall be encountered with the project implementation and operation.
b) Assess significance of potential and likely impacts with consideration to likely significant impacts (both positive and negative) as well as reversible or irreversible, direct or indirect, long term and immediate impacts as well as avoidable and unavoidable impacts.
c) Propose an ESMP and corresponding monitoring plan to avoid, reduce and mitigate potential negative impacts.
d) Provide guidance on detailed ESIA requirements that will be required to be conducted prior to final project design and implementation.

1.2 Legal and Institutional Framework

This section addresses the legislative and institutional framework relating to ESIA development, specifically relevant to the wastewater treatment plant upgrade and expansion works and the environmental and social impact assessment associated with this type of projects. For this project the ESIA has been prepared under specific consideration of the:

- Environmental and Social Standards of the EIB, especially the EIB E&S Practices Handbook covering ten performance standards (PS).
- Core labour standards of the International Labour Organisation (ILO).

The national framework considers a wide canon of environmental laws and regulations of the Government of Egypt. Specific reference is made in particular to the Environmental Protection Law No.4/1994 amended by law 9/2009 and law 105/2015 and their executive regulations and in Regulation No. 37 on Environmental Impact Assessments guidelines issued in the year 2005.

1.3 Public Participation and Stakeholder Engagement

Both Egyptian legislation and EIB safeguards state clearly that public and stakeholder engagement is mandatory to give the opportunity to the public, stakeholders and surrounding community to collect information about the project and allowing to express their opinion.

A public consultation meeting (PCM) was organised and has been held on Tuesday 29 May 2018 in the Alexandria Wastewater Company Headquarters. The meeting has been chaired by the Chairman of Alexandria Wastewater Company with the presence of: the Chairman's advisor, design engineers, environmental engineer of the company as well as representatives of EEAA, MRWI, MOLAR, Ministry of Health and El-Qlaa Harbour Company and the concerned public.

Among others, the following points are the major and important comments and remarks raised by the stakeholders attending the PCM:

- Effluent and sludge reuse alternatives.

  It was agreed that the main alternatives had been identified and that reuse should be an objective, although it was outside the scope of the current project.
- The upgrade and extension project of Alexandria West WWTP should be extended to include the execution of the reuse application scheme in irrigation for the effluents from East and West WWTPs.

  It was agreed that this needed to be addressed as a matter of priority but was outside the scope of the current investment project. According to the terms of reference for the project, options for reuse were to be studied but were not included in the scope of the investment. It was agreed that there was not detriment in considering the reuse as a separate project.
- Design consultant to review the feasibility of the sludge digesters (especially in view to experience collected from Gabal El-Asfar WWTP) before proposing it into the upgrade and extension design.

  This was agreed and has been done. The economic assessment confirms that under the current economic climate and projected electricity tariffs, digesters and energy recovery is justified and viable.
- Mitigation measure for odour control from the proposed treatment units should be considered properly.

  It was confirmed that the final design should include odour control at key locations, including the Inlet Works and all areas dealing with primary sludge.
- The representative of El-Qlaa Harbour discussed the issue of the current disposal location and future disposal location of the effluent. The current effluent disposal location causes disturbance to the barges and ships that navigate and use the inland harbour through the last reach of Nubaria Canal. It has been requested taking into consideration the navigation passage and docking facilities inland harbour when selecting the location of the effluent disposal after the upgrade and extension.

  In response, it was confirmed that the final design will consider the outfall from the WWTP to the lake to ensure that it had adequate capacity and did not cause hydraulic problems. The consultant's technical team has requested from El-Qalaa Harbour's representative to provide the master plan of the harbour to consider it during the selection of the effluent disposal and to perform the required studies including hydrodynamic modelling if required. No further requirements have been raised from Al-Qalaa Harbour's representative.
- Al-Qalaa Harbour representative requested also restoration and reshaping the last reach of El-Qalaa Drain to its design cross section.

  The consultant's technical team as well as Alexandria Wastewater Company engineers replied that this wide area shall be used for future upgrade and extension anyway and that it would be upgraded. No further comment has been raised from Al-Qalaa Harbour's representative.

These points were discussed, clarified and clearly answered by the consultant's technical team and no other comments and remarks were raised from the stakeholders' side. The details of the stakeholders' comments and the consultant's replies are given in Section 6.

1.4 Current Alexandria West WWTP Status and Proposed Upgrade

The existing Alexandria West WWTP covers 13.6 ha (680m x 200m) and is located at the West side of Alexandria along Road 218. The landscape of the WWTP site is characterized by the large open surface water bodies (El-Omoum Drain, El-Qalaa Drain, Lake Maryout and the Mediterranean Sea).

The plant is bounded from its North Side with a road and legal low-class residential area. The North West corner is occupied with the illegal settlements. The East and North East side is an empty flat low land close to be a marsh land which is currently being filled and utilized in some residential projects. The South side is allocated for the pilot wastewater treatment plant (natural reed beds) with a capacity of 50,000 m^3/day belonging to EEAA. A part of the existing site, the North-West corner, is occupied by illegal buildings. Although procedures have been initiated in the past to relocate the occupants, no actions shall be taken to relocate these illegal settlements during the upgrade and extension of the WWTP.

In the South side there is also the discharge channel disposing the treated wastewater to El-Omoum Drain. From here the effluent is discharged to Lake Maryout and ultimately to the Mediterranean Sea via El-Max Pumping Station.

Surrounding developments, in terms of sensitive buildings and settlements, are present, but the proposed site is adjacent to the international harbour for importing and exporting (Al-Qalaa Harbour) is located on the west side of the Alexandria West WWTP location. It is separated from the WWTP site by Al-Omoum Drain. However, the disposed effluent of the WWTP flows to Al-Omoum Drain adjacent to the Harbour.

Current Alexandria West WWTP Status

The treatment system in Alexandria West WWTP is mainly primary treatment for 460,000 m^3 per day by screens or grit chambers followed by primary sedimentation. The approximate existing population in the area served by the treatment plant is 1.3 million. The main plant provides primary treatment and has been constructed in two stages:

- Stage 1: consisting of inlet PS, grit removal and mechanical dewatering building, in operation since 1993; and
- Stage 2: consisting of primary settlement and chlorine building, in operation since 2006.
- In addition, a MBBR pilot biological treatment plant with a capacity of 50,000m^3 per day has recently been commissioned.

The treatment plant influent comes from the west region of Alexandria. This area is composed of residential, commercial, and industrial areas. Sludge is pumped to the plant from the Alexandria East Treatment Plant. The treatment plant discharges the primary treated wastewater effluent into Lake Mariout.

After mechanical dewatering by belt presses, generated sewage sludge is transferred to Site 9N, some 30 km outside of Alexandria covering an service area of around 4,200 Feddans.

The Alexandria West WWTP covers an area of 136,000m^2 (680m x 200m). The area for the project expansion will require 172,500m^2. For this purpose, additional 8.4 ha (21 Feddan) of the adjacent shallow lake area will be now allocated for the WWTP upgrade and extension.

Proposed Upgrade and Extension

The proposed wastewater treatment technologies discussed and assessed in the Concept Design Report are only for **secondary treatment** since the preliminary and primary treatment stages already exist at Alexandria West WWTP. Tertiary and advanced treatment processes have also not been considered since the required effluent standards for Alexandria WWTP do not warrant this level of treatment.

The existing facilities will be retained as far as possible; inlet works, grit removal, primary settlement, sludge dewatering. The following basic options are identified for appraisal in concept development. This list is not exhaustive and may be developed further during the appraisal.

Standard Treatment Options at Alexandria West WWTP:

- Biological Treatment
    - Activated Sludge
    - Sequential Batch Reactors (SBR) Sludge Treatment
    - Gravity thickeners, digesters and CHP

Advanced Treatment Options at Alexandria West WWTP

The land area available at the West WWTP is critical for the standard treatment processes, even with the additional 8.4 ha (21 Feddan). Therefore, the following options will be considered to reduce the area required:

- - 2 level bio-reactors (activated sludge or SBRs)
- - 2 level final settling tanks
- - Mechanical thickening
- - MBBR
- - MBR*

Proposed Effluent Reuse and/or Disposal

Having in mind the potential combined effluent reuse and/or disposal of both WWTPs latest available figures of Alexandria East WWTP of the year 2015 indicate an average flow of ~ 675,000m³ per day ranging between minimum 370,000 m³ per day and maximum 1,120,000m³ per day. Under consideration of the Alexandria West WWTP the current combined average volume would be 1,075,000m³ further increasing to 1,275,000m³ after the upgrading of the West WWTP.

Four Concepts have been identified and assessed to provide a strategy for beneficial reuse of the combined effluent flows. These are as follows:

- Alternative 1: Effluent Reuse West of Alexandria (along Alamein-Wadi Natron Road)
- Alternative 2: The Irrigation Area south of the Nasr Canal (proposed by ASDC)
- Alternative 3: The Hammam Extension Reclamation Area (proposed by MWRI)
- Alternative 4: Improvement of Water Quality in Lake Maryout

Sludge Treatment Options for Site 9N

In future Site 9N is considered forming the central facility for ASDCo's sludge reuse strategy. Considering today's sludge generation of ~1,300t/d (Alexandria West & East WWTPs) the initial calculation indicates a significant increase of the sludge volumes ranging between 1,575m³/d and 1,782m³/d.

In future all sludge is proposed to be converted to vermi-compost; the first quantities are expected to be ready for marketing in June-July 2018. Composted sludge is proposed to be sold to farmers for 150 LE/m³ plus transport charge.

Alternatively, by September 20, 2015 a contract was signed by ASDCo and the Alexandria Portland Cement Company agreeing the provision of dried sludge as additive fuel. With reference to the quantity of dried sludge to be supplied a volume of approximately 100 m³/d with a minimum 80% DS is considered.

Responding to this contractual requirement sludge would have to be converted into additive fuel by drying to a DS content of 80%. This means the only process step is the turnaround of the sludge until the final DS is achieved (air drying in windrows).

However, as informed by the Alexandria Portland Cement Company is considering the dried sludge of having a too low caloric value in order to provide a valuable fuel additive replacement. Provided the low volatile organic dry solids content of the sludge in combination with a 'wasting' of the sludge by dust and sand during the processing/storage at Site 9N may be considered as realistic.

In response, the contract mentioned above is set on hold; however, ASDCo is taking efforts to meet the requirements of the cement company.

1.5 Impact Identification and Assessment

As the project is at concept design stage, the environmental assessment of impacts in this ESIA has focused on potential impacts only and, where appropriate, identifies the need for further assessment during the detailed design stage and preparation of the final ESIA. Impact assessment here is qualitative throughout and aims to identify the potential for an impact to allow subsequent quantitative analysis once detailed design has commenced.

The potential environmental and social impacts have been separated into those occurring during the construction phase and those occurring during the operational and maintenance phase. Key environmental and social issues addressed in the ESIA study are summarised in **Table 1**.

Issue	Construction Phase	Operation Phase
Key environmental and social issues		
Air and Dust	X	X
Noise and Vibration	X	X
Land and Soil	X	X

Water Resources	X	X
Waste Generation and Disposal	X	X
Visual and Aesthetics	X	X
Occupational Health and Safety	X	X
Traffic Control	X	X
Climate and Atmosphere		X
Socio-economic issues		
Employment	X	X
Community Health and Safety	X	X
Presence of foreign workers on neighbouring community	X	
Effluent reuse opportunities		X

Table 1: Key environmental and social issues

1.6 Mitigation Measures and Environmental & Social Management Plan

Where impacts are identified that have the potential to be significant, consideration will be given to their reduction through the use of mitigation measures in order to reduce the scale or magnitude of their effects. These would be recommended for consideration by the Project Sponsor and ideally incorporated as part of the final ESIA that would be undertaken at that stage.

It is stressed that best practice in environmental and social impact assessment is to minimize or eliminate impacts from any development through the iterative design of the facility and it is urged that the Project Sponsor, undertakes the final ESIA in parallel with the detailed design. In this way, impacts can be avoided rather than having to be mitigated.

In this context reference is made to the construction and operation phases with reference to issues introduced before. The objective of the Environmental and Social Management Plan (ESMP) is to ensure the integration of environmental and social requirements and proposed mitigation and monitoring measures into the construction contractor's obligations.

The ESMP shall be fully integrated in the construction activities, hereby addressing the responsibilities of the construction contractor (the Contractor), the Engineer and the Employer.

1.7 Final ESIA Requirements

According to the EEAA regulations and classifications, new wastewater treatment projects can be classified as Category B (projects with relatively large environmental impacts) or Category C (projects with substantial environmental impacts). The categorisation of wastewater treatment plants depends on capacity as defined in Law No. 4/1994 amended by Law No. 9/2009 and 105/2015, which stipulates that wastewater treatment plants with a capacity below150,000m^3/d are Category B whereas, if the capacity exceeds 150,000 m^3/d then the project is classified as Category C. This has been recently amended by the *"Protocol for Cooperation between the Ministry of Environment and the Ministry of Housing, Utilities, and Urban Communities for the Application of Criteria and Environmental Conditions for Wastewater Projects"* which sets the threshold between the two categories to 1,000,000 population equivalent served.

However, as the project concerns the expansion and upgrade of an existing wastewater treatment plant on an existing site, rather than the construction of a new plant, it could also fall under section 5.2 of the "*Guidelines of Principles and Procedures for Environmental Impact Assessment"* referring to special cases and in particular expansions of existing facilities/projects.

As the final decision on the categorisation of the project rests with the EEAA and their agreement with the MoHUUC, this study has been prepared as a full ESIA to cover the higher requirements of a Category C project. Along with the full ESIA to be presented to the EEAA, Form B for wastewater Feasibility Study for Alexandria West Wastewater Treatment Plant Extension treatment plants shall also need to be completed. In addition, the detailed engineering design should be submitted to the EEAA for approval and permitting. Therefore, the ESIA must be completed during the detailed design phase.

Category C projects require by law two compulsory rounds of public consultation, one at scoping stage and one before submission of the draft final ESIA to the competent authority for approval. The first round of public consultation has taken place in May 2018, as indicated in Section 6 of the present document. A second round will be organised once the present ESIA document is updated on the basis of the detail design specifications.

The final ESIA should address and update the following based on the final project specifications:

- Environmental Management Plan (EMP) –to detail how impacts will be controlled through mitigation during all stages of the project, who will be responsible for these actions, how success of mitigation (or otherwise) will be judged, what measures are to be taken in the event of exceedances and violations, and what reporting routes and strategies will be in place.
- Implementation Plan – this should present and discuss the steps, processes and phases to implement the suggested mitigation measures of the EMP. At the present time, these are still to be prepared once project implementation is approved.
- Monitoring Plan – this should present and discuss the monitoring program that should be developed to ensure the application of mitigation measures are properly and efficiently.
- Emergency Response Plan – this should ensure that several mitigations available to be implemented in case of sudden and unexpected incidences which might threaten the environment.
- Social Management Plan – this should identify the mitigation measures to minimize and avoid adverse impacts.

The scope and methodology for the final ESIA including the second public consultation should be agreed in advance with the relevant authorities and statutory bodies during the final design stage and the final ESIA report shall be prepared in both English and Arabic. Submission of the report in Arabic is a formal prerequisite of EEAA approval, This will also allow for disclosure and accessibility of information to all stakeholders and assure transparency.

2 Introduction

The current report presents the Environmental and Social Impact Assessment (ESIA) for the proposed project which is the upgrade and extension of Alexandria West Wastewater Treatment Plant WWTP from primary treatment technology in the Alexandria west WWTP (461,000 m^3/day) to secondary treatment and expand the total capacity of the plant to 600,000 m^3/day. The project will support the depollution of Lake Maryout and the Mediterranean Sea and provide an additional source of water and is suggested to improve the economic situation for fishery, agriculture/forestry and tourism sectors in the area. Also, this project will improve the health and environmental situation of the population living in the Governorate of Alexandria.

As per the feasibility study and baseline report, the project is expected to achieve the following objectives:

- Provide an environmentally acceptable standard of treatment for the available discharge locations.
- Increase in capacity of the Alexandria West WWTP to match the needs up to the year 2050.
- Reduce the load polluting Lake Maryout, El Max Bay and the Mediterranean by providing an environmentally acceptable standard of treatment for the available discharge locations.
- Propose possibilities for effluent and sludge reuse. The treated effluent may be used as an additional water source in various forms of agriculture / forestry and as such reduce the pressure on existing water sources in an already water-scarce country.
- Minimize the O&M costs, e.g. by limiting the energy consumption, generating energy from the biogas during the treatment of the sludge etc.
- Minimize the emission of greenhouse gases to the atmosphere.

The purpose of the current ESIA is a first stage which identifies to the project sponsors during the feasibility stage, the issues and aspects that will need to be covered in the final ESIA to satisfy requirements of the project sponsors and financing agencies as well as the local requirements of the Egyptian Environmental Affairs Agency (EEAA).

The designer of the Alexandria West WWTP Dorsch International Consultants is preparing feasibility study and conceptual designs only at this stage; as such, it is likely that any proposals for reducing a particular impact shall be elaborated more to be considered at the detailed design phase.

The main aims of this ESIA study are to undertake a environmental and social assessment for the proposed project, with the specific objectives to:

a) undertake a due diligence of all environmental and social issues;
b) assess significance of potential and likely impacts with consideration to significant impacts (both positive and negative) as well as reversible or irreversible, direct or indirect, long term and immediate impacts as well as avoidable and unavoidable impacts with reference to the construction and operation phases of the WWTP;
c) propose an environmental and social management plan (ESMP) to avoid, reduce and mitigate potential negative impacts; and to maximize the positive impacts
d) provide guidance on likely detailed ESIA requirements that will be required to be conducted prior to final project design and implementation.

2.1 Background

As per the FS and baseline report by Dorsch, the Alexandria Wastewater Master Plan (MP), prepared in the February 2018, included an assessment of wastewater facilities and needs up to 2037 The MP covered all 7 administrative districts of Alexandria and defined the current and future intake area of the Alexandria West WWTP. Two new residential areas under development south of Lake Maryout were included in the future service area of the WWTP. It was calculated that the wastewater from an expected additional population of 235,000 would be discharged to the Alexandria West WWTP and that a capacity increase of about 200,000 m^3/d would be necessary. The MP was reviewed in 2011 in the USAID financed project on Alexandria West WWTP. The conclusion from this review was that the calculated capacity increase in the MP was still valid.

2.2 Objectives of the Alexandria West WWTP Extension and Upgrade Project

As per the FS and the baseline report, the overall goal of the project is to contribute towards efficient and sustainable water resources management in Egypt as well as to the Egyptian climate protection efforts.

The project will contribute to the environmentally sound disposal/utilization of effluent and sludge and energetically optimized and environmentally sound sludge treatment for the wastewater generated from the Alexandria West catchment, which is currently served by the Alexandria West WWTP.

Beyond that the project will support the depollution of Lake Maryout and the Mediterranean Sea and provide an additional source of water and thus improve the economic situation for fishery, agriculture/forestry and tourism sectors in the area. Also, this project will improve the health and environmental situation of the population living in the Governorate of Alexandria.

As per the feasibility study and baseline report, the project is expected to achieve the following objectives:

- Provide an environmentally acceptable standard of treatment for the available discharge locations.
- Increase in capacity of the Alexandria West WWTP to match the needs up to the year 2050.
- Reduce the load polluting Lake Maryout, El Max Bay and the Mediterranean by providing an environmentally acceptable standard of treatment for the available discharge locations.
- Propose possibilities for effluent and sludge reuse. The treated effluent may be used as an additional water source in various forms of agriculture / forestry and as such reduce the pressure on existing water sources in an already water-scarce country.
- Minimize the O&M costs, e.g. by limiting the energy consumption, generating energy from the biogas during the treatment of the sludge etc.
- Minimize the emission of greenhouse gases to the atmosphere.

The extension and upgrade of the Alexandria West WWTP is included as one of the projects in the –National Action Plan (NAP) 2015 and is of top priority for the Government of Egypt.

2.3 Objectives of the ESIA

The basis of the current ESIA for the proposed upgrade and extension of the Alexandria West WWTP is a first stage which identifies to the prospective Project Sponsors during the feasibility stage, the issues and aspects that will need to be covered in the final detailed ESIA to satisfy requirements of the project sponsors and financing agencies as well as the local requirements of the EEAA to obtain the governmental permitting for construction and operation of the upgrade and extension of the WWTP.

The current scope of the Consultant is to the prepare feasibility study and conceptual designs. It is likely that any proposals for mitigation measures to reduce any particular impacts shall be elaborated and considered in the detailed design phase.

The main aims of the study are to undertake an environmental and social assessment for the proposed project, with the specific objectives to:

a) Undertake a due diligence of all environmental and social issues and ensuring the financing sponsor EIB that no serious negative impact (environmental / social) are foreseen to be encountered with the project implementation and operation.
b) Assess significance of potential and likely impacts with consideration to likely significant impacts (both positive and negative) as well as reversible or irreversible, direct or indirect, long term and immediate impacts as well as avoidable and unavoidable impacts.
c) Propose an ESMP and corresponding monitoring plan to avoid, reduce and mitigate potential negative impacts.
d) Provide guidance on detailed ESIA requirements that will be required to be conducted prior to final project design and implementation.

In line with standard ESIA practice and permitting requirements imposed by legislation by the EEAA, the final ESIA should cover the direct effects and any indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects of the proposed project during the construction, operation and maintenance and decommissioning phases. The current ESIA has the same scope.

At this stage, only information relating to the concept design has been available. Therefore, only a qualitative assessment of predicted impacts has been undertaken, based on the known level of detail of each component and activity of the project and on consultant's professional experience of similar construction projects of a similar magnitude.

The spatial scope for the ESIA is the footprint of the WWTP site itself, as well as adjacent areas within a sphere of influence i.e. the area that a potential impact will be observed as a result of the proposed project.

The spatial scope is unlikely to change from the current ESIA and the detailed ESIA to be prepared at the detailed design stage.

Re-assessment of potential impacts in light of more detailed baseline data and information on the detailed design may be needed.

Whilst consideration of impacts during the construction phase has been addressed in this assessment, it is considered that the greatest potential for impacts from the proposed upgrade and extension shall be positive impact during the operation of the WWTP and enhancement of the water quality and the availability for more water for agriculture application and sludge reuse. Positive social impact on human health shall also be achieved during operation while considerable amount of job opportunities shall be achieved during construction.

2.4 Scope and Purpose of the Draft ESIA Report

The current report presents the purpose, objective, methodology, analysis, findings and recommendations for the ESIA of the Alexandria West WWTP upgrade from primary treatment to secondary treatment and extension from 460,000 m^3/day to 600,000 m^3/day.

Although the report is prepared as per the local regulations and legislations set by the EEAA as well as the Public Consultation Meeting (PCM), the current ESIA report shall not be submitted to EEAA for obtaining Governmental Approval but it shall be submitted to the Financing Authority EIB as part of the feasibility study. **Table 2** details the structure and content of this ESIA study.

Chapter	Content
Section 1: Non-Technical Summary	The non-technical summary provides a brief description about the current study in non-technical form.
Section 2: Introduction	This section gives the background about the project and its objectives, the objectives of the current ESIA study and its scope, ESIA approach and methodology, and the engagement process of the public and stakeholders.
Section 3: Project Description including Alternatives	This section presents description of the current status of the WWTP and the treatment process including effluent and sludge disposal. It also presents the alternatives for the proposed upgrade and extension of the WWTP. It also discusses the project significance and “No Project” alternative analysis.
Section 4: Legal and Institutional Framework	This section presents the environmental and social legislations as that are considered in this ESIA: mainly EU regulations and local Egyptian regulations and legislations especially those for ESIA preparation and water quality standards and effluent disposal limits and sludge disposal and reuse limits.
Section 5: Environmental and Social Baseline Conditions	This section presents a description of the WWTP site and surroundings from environmental point of view as well as from socio-economic point of view. Physical environment and biological environment for the WWTP site and surroundings have been discussed.
Section 6: Outcome of the Public Participation and Stakeholder Engagement	This section presents the public participation involvement that has been considered in this ESIA study. Public consultation meeting has been held and the major and important outcomes have been discussed.
Section 7: Impact Identification and Analysis	This section presents identification and analysis of the potential environmental and social impacts of the proposed project. The identification as well as the analysis has been performed for the two phases of the project: construction phase as well as the operation and maintenance phase.
Section 8: Environmental and Social Management Plan	This section presents suggested mitigation measures to remedy the potential negative environmental impacts as well as negative social impacts. The ESMP layout and content has been given along with

	the emergency response plan, implementation plan and monitoring plan.
Section 9: References	This section gives list of the reference documents that have been used to develop this ESIA report including legislations, available documents on the Alexandria West WWTP from previous studies as well as studies developed under this contract.

Table 2: Report Structure

2.5 ESIA Approach and Methodology

This section of the ESIA sets out the approach and methodology and identifies the potential environmental impacts of the proposed project. The potential environmental impacts have been separated into those occurring during the construction phase and those occurring during the operational and maintenance phases.

As the project is at concept design stage, the environmental assessment of impacts in this ESIA has focused on potential impacts only and, where appropriate, identifies the need for further assessment during the detailed design stage and preparation of the final ESIA. Impact assessment here is qualitative throughout and aims to identify the potential for an impact to allow subsequent quantitative analysis once detailed design has commenced.

2.5.1 Methodology

The approach and methodology that has been followed for this ESIA study can be summarized as follows:

- Desk study; identification and review of existing documents, data and information relevant for preparation of the ESIA study.
- Consultation with relevant stakeholders to identify interested parties and environmental and social issues relevant to the proposed project Through PCM to be held as per the EEAA requirements with the presence of all the interested parties.
- Identification of the baseline environment, sensitive resources and receptors.
- Identification of the future baseline environment without the project.
- Identification of the main components and activities of the proposed project facility during the construction and operational phases that could have an effect on the environment (to the extent that information has been available for the concept design stage).
- Qualitative prediction of the type, nature and significance of environmental impacts. Impacts are defined as changes in the environment that result from the implementation of the proposed project. They can be either positive or negative and actual or potential, and are described in terms of the following: likelihood of the impact occurring, scale and intensity (low, medium, high), duration (short term, long term or permanent), spatial influence (local, regional, national, international), magnitude in relation to agreed or set standards, type (positive or negative) and reversibility (reversible/temporary, irreversible/permanent).
- Typically, short term impacts are those considered to occur during the construction period.

2.6 Public Participation and Stakeholder Engagement

As illustrated in the previous section, both Egyptian and EU legislations and regulations state clearly that public and stakeholder engagement is mandatory to give the opportunity to the public, stakeholders and surrounding community to express their opinion in the project and gain knowledge about the project. This may lead also to alter, modify the project design, location, etc. to consider the community needs and concerns.

At this stage, the Alexandria West WWTP extension and upgrade project is still in the feasibility and concept design phase, however EIB requested compliance with their environmental and social safeguards.

In this context a PCM has been scheduled on Tuesday 29 May 2018. It was held within the Alexandria Wastewater Company Facility. Although at this stage the ESIA will not be submitted to the EEAA for review, approval and obtaining governmental permitting of the project, the Environmental Consultant shall carry the PCM according to the EEAA regulations. The PCM shall be documented and recorded and this documentation and recording shall be annexed to this current ESIA study. The outcomes and major points raised and discussed in the performed PCM is provided Chapter 6.

A stakeholder is defined as any individual or group who is potentially affected by a project or who has an interest in the project and its impacts. The objective of stakeholder identification is therefore to establish which organizations and individuals may be directly or indirectly affected (positively and negatively). Stakeholder identification is a permanent process, requiring regular review and updating as the project proceeds. The main groups of stakeholders identified so far are listed in **Table 3**.

Group of stakeholders	Stakeholders
Local residents	• Residents located along roads adjacent to the WWTP and in the surrounding areas
Land owner	• Alexandria Governorate • Alexandria Wastewater Company • Ministry of Water Resources and Irrigation MWRI who owns and operates open water bodies around the WWTP
Public facilities	• Education (schools, kindergartens) • Religious (mosques, churches, cemeteries) • Medical (hospitals, clinics, medical center) • Utilities (electricity, water supply)
Business and service provider	• Al-Qalaa Harbour adjacent to the WWTP
Administrative Bodies and Authorities	• National authorities - Ministry of Environment (MoE) - EEAA Egyptian Environmental Affairs Agency. - Ministry of Health and Population - Ministry of Water Resources and Irrigation - Ministry of Agriculture and Land Reclamation
International donors	• EIB European Investment Bank
Bodies involved in Project implementation	• Supervision Department - Alexandria Wastewater Company
Non-Governmental Organizations (NGOs) and independent experts	• Specialized environmental, social and research organizations, NGOs • Experts on a national and international level
Media	• Public Relation department – Alexandria Wastewater Company • Radio, TV

Table 3: Identified stakeholders

All stakeholders were invited to the PCM, although not all choose to attend. For the outcome of the PCM reference is made to Chapter 6.

3 Project Description including Alternatives

3.1 General

This section presents the current situation of the Alexandria West WWTP as well as the proposed upgrade and extension to change the WWTP from primary treatment with a capacity of 460,000 m³/day to secondary treatment of 600,000 m³/day with sludge treatment facility. **Figure 1** shows the general location of the Alexandria West WWT within Alexandria Governorate.

The approximate existing population in the area served by the Alexandria West WWTP is 1.3 million, and the expected population by the year 2037 is 1.8 million.

Figure 1 General location of Alexandria West WWTP in Alexandria Governorate

Source: Baseline Report

The first part of this section describes the current condition of Alexandria West WWTP in terms of location, available treatment facilities and their conditions, flow rates, ultimate disposal of the treated effluent and the sludge. A summary of current environmental and socio-economic constraints as a result of the current WWTP operation is also introduced.

The second part of this section describes the proposed upgrade and extension potential technologies that may be used as well as the targeted water quality to be achieved from the treatment. Also, the second part presents a summary of the different options for the treated effluent disposal as well as the reuse of the treated sludge.

3.2 Description of Current Alexandria West WWTP Conditions

3.2.1 Current Alexandria West WWTP Status

The Alexandria West WWTP is one of two main existing WWTPs serving Alexandria City, with a total of 20 WWTPs in the Alexandria Governorate. The Alexandria West WWTP is located in the west part of the City of Alexandria on the strip of land between Alexandria Western Harbour and Lake Maryout. This area is highly developed and the only opportunity to extend the site would be to reclaim land from the lake.

The coastal strip to the immediate west is mainly occupied by large industries, which have their own treatment facilities, areas further west are served by either the Ameria WWTP or Agamy WWTP. The areas to the south of Mariout Lake are either served by smaller rural projects or are not yet connected. The wastewater influent to the Alexandria West WWTP is collected from the catchment area of the West and Central Zone of Alexandria City, consisting of residential, commercial, and industrial areas. It is transferred from these zones to the WWTP by gravity through a tunnel, before it is pumped up to the West WWTP inlet. The treatment system in Alexandria West WWTP is mainly primary treatment for 460,000 m³/day by screens and grit chambers followed by primary sedimentation.

This has been constructed in two stages:

- Stage 1: Inlet PS, grit removal and Mechanical Dewatering Building, in operation since 1993.
- Stage 2: Primary settlement and Chlorine Building, in operation since 2006.

The treatment plant influent comes from the west region of Alexandria. This area is composed of residential, commercial, and industrial areas. Until recently, sludge was pumped to the plant from the East WWTP to the inlet tunnels of the West WWTP for co-treatment. However, this practice has now been halted, the East WWTP has recently commissioned its own sludge dewatering plant and its sludge is transported directly to Site 9N. The treatment plant discharges primary treated effluent into Lake Mariout. Excess sludge is dewatered by belt presses located in the Mechanical Dewatering Factory (MDF). Dewatered sludge is then transferred to Site 9N, some 35 km outside the Alexandria. The WWTP covers an area of 136,000m^2 (680m x 200m). **Figure 2** is providing an overview of WWTP main components.

After expansion and upgrade the WWTP area is considered to be 172,500m^2.

Figure 2 Layout of Alexandria West WWTP showing its components

3.2.2 Service Catchment Area

The WWTP serves the central and west sewage catchment areas of Alexandria City covering an area of approximately 35 km^2, as illustrated in **Figure 3** with an estimated population of 15 million based on projections from the last census carried out in 2006. This covers the main administrative, commercial and historic center of the City, including the ancient Alexandria Eastern Harbor, which is now mainly used as an

amenity, and the Alexandria Western Harbor. The Cairo-Alexandria Desert Road also passes through the catchment area.

Figure 3 Service Catchment Area of Alexandria West WWTP

Source: Baseline Report

The central catchment area is predominately administrative, commercial, high level residential and amenities, with only limited incidental industries. The residential population density of 430 persons/ha is not particularly high, but with the high proportion of administrative, commercial, amenities, infrastructure and industries, the catchment is highly developed. Therefore, the population in the area is expected to stay stable, with moderate growth, below the national average.

The major industries to the west of the Nubaria Navigation canal, including refineries and petrochemical processing, are not connected to the West WWWTP. This confines the catchment area to the west. The catchment is similarly confined by the sea to the north, Mariout Lake to the south and the East WWTP catchment area to the east. Therefore, there are very limited possibilities to extend the catchment area.

3.2.3 Industrial Discharges

The major industries to the west of the Nubaria Navigation canal, including refineries and petrochemical processing, are not connected to the West WWWTP. Alexandria Wastewater Company maintains a registry of the commercial and industrial discharges in the catchment and carries out an active program of monitoring and control. There are a total of 505 registered industrial and commercial discharges in the catchment area, ranging from restaurants and petrol stations through to tanneries and manufacturing industries. The records indicate which discharges are compliant with agreed ratios.

However, they do not give any indication of the flow rates (most are not measured) or the actual concentrations of the different parameters. Unfortunately, this information is not available. Also, no detailed descriptions are available for the individual industries to assess in detail which are potentially heavy dischargers. The larger industrial dischargers mostly comply with the Law 93/1962 limits.

Most of the non-compliant discharges tend to be from restaurants and hotels where the problem tends to be COD, BOD and TSS, which can be handled within the design of the West WWTP. The Law 93/1962 limits are higher than for normal domestic wastewater. This contributes to the relatively high wastewater concentrations analysed at the inlet of the West WWTP (compared with the East WWTP). The analyses of records from the West WWTP also confirm that heavy metals are effectively controlled and within imposed limits.

The West WWTP catchment area is already highly developed. No significant industrial development is foreseen and would most probably be strongly objected to both urban planning and socio-environmental reasons. Therefore, the situation with industrial discharges is considered stable and unlikely to change. To be on the safe side and in the absence of any other basis for assessment, it has been assumed that the industrial discharges will remain in proportion with the total flow over the design period of the project to 2050. In practice, it is probable that commercial discharges will increase while industrial discharges may decrease as socio-urban pressure will tend to encourage some industries to relocate to less sensitive areas.

3.2.4 Wastewater Treatment Process

The water treatment processes at the plant include (from upstream to downstream):

- Coarse Screening; 8 channels, 5 with mechanically raked bar screens, 2 with manually raked screens and one channel for future use (25mm coarse screen).
- Influent Pumping Station; 2 interconnected wet wells, each with 3 pumps in adjacent dry well. 4 no. of the pumps are original vertical centrifugal impellers, 2,880 l/s at 26m TDH. Two pumps have been replaced with units rated 2,524 l/s at 24.4 TDH. All motors are 3.15kV, located at low level in the dry wells.
- Grit Removal (8 aerated grit chambers 5.2m wide x 17m x 4,9m deep, 349 m^3/tank), grit removal by clamshell grabs suspended from overhead crane gantries.
- Intermediate Screening; 8 channels, 4 with 8mm mechanical screens, 4 with 25mm manual screens.
- Rectangular Primary Sedimentation Tanks; 16 tanks in two batteries; Battery 1: length 65m x 10,3m width x 3,58m deep; 2.397 m3/tank, Battery 2 length 65m x 10,3m width x 3,76m deep; 2.517 m^3/tank.
- Primary Sludge and Scum Pumping Station. 8 no. sets of 3 no. pumps, each serving a pair of settling tanks, plus actuated valves and macerators on the sludge lines from each settling tank.
- Effluent Screens; 4 no. 6mm step screens
- Chlorination Unit; chlorine gas 1 ton container store, evaporators, chlorinators, solution injection.
- Effluent Channel to Lake Maryout.
- Potable water supply; flushing, wash water, pump seal water, sludge line flushing.
- Effluent Discharge and Reuse & Sludge Disposal described in detail in sections (3.2.5 and 3.2.6).

Figure 4 to **Figure 6** provide layouts and a flow scheme of the WWTP.

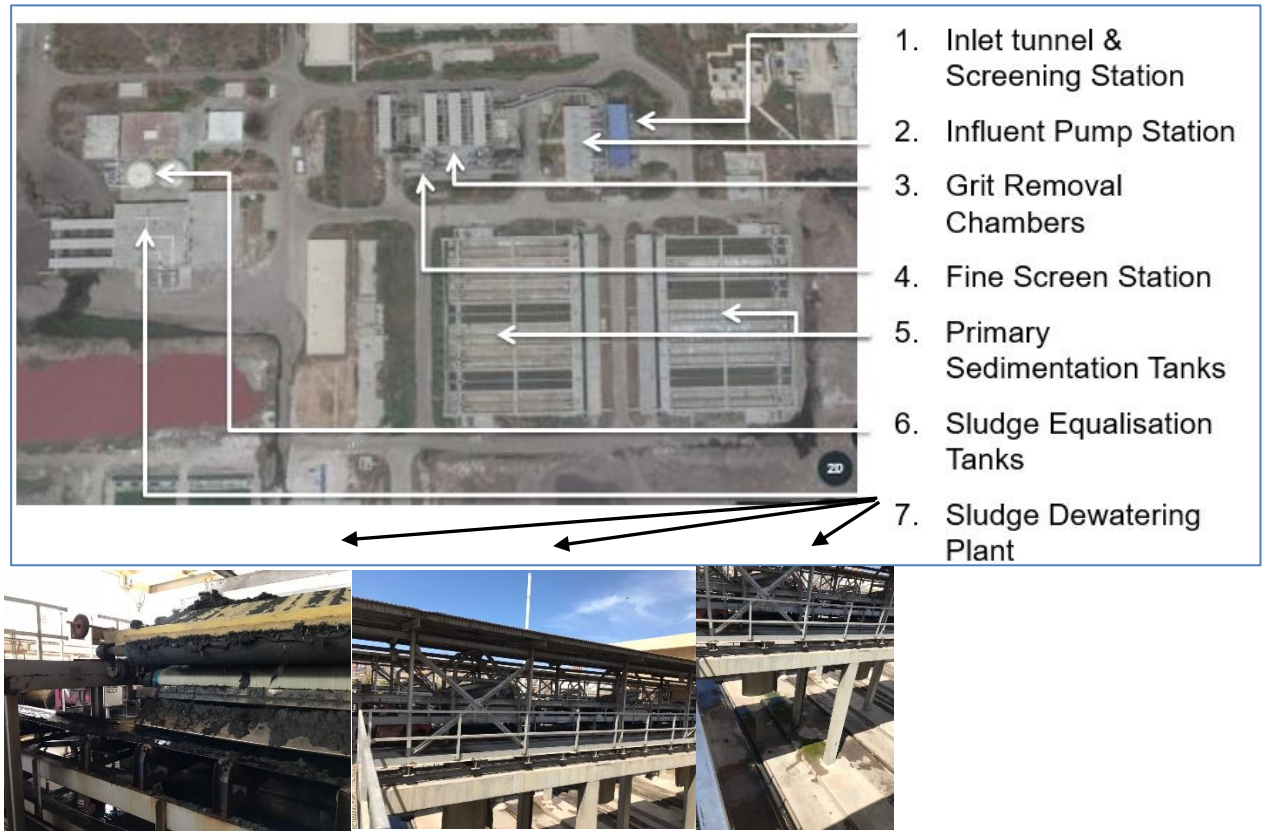

Figure 4: Layout of existing treatment facilities

Source: Baseline Report

Figure 5: Layout of existing treatment facilities (continuation)

Source: Baseline Report

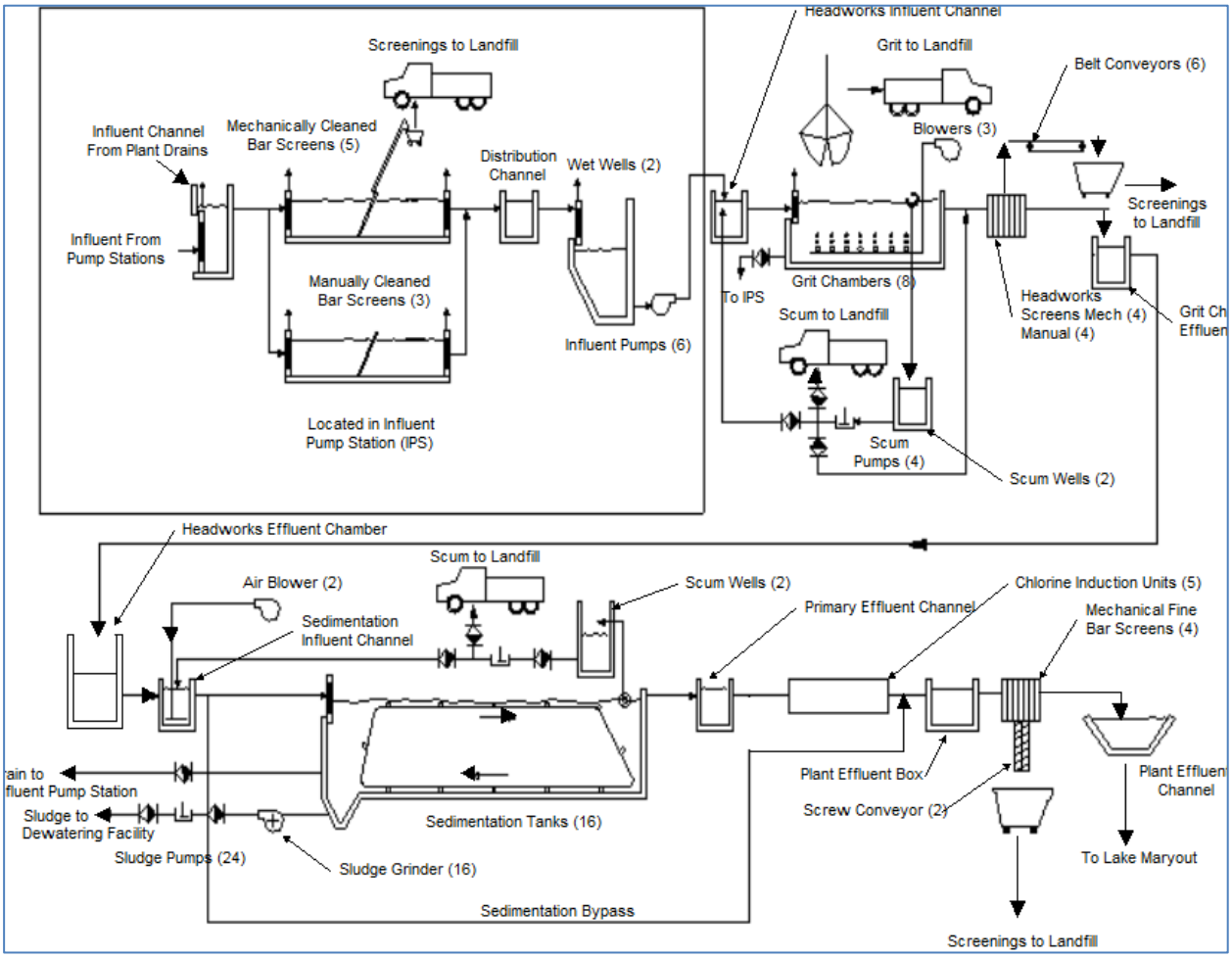

Figure 6: Process Scheme for the Existing WWTP

Source: Baseline Report

3.2.5 Sludge Disposal and Reuse

After reopening of Site 9N in May 2017, the facility is forming the backbone of ASDCo's sludge disposal strategy. Today, all sludge generated at Alexandria West and East WWTPs is transferred to Site 9N for further processing. Corresponding quantities and characteristics are summarised in Table 4.

Alex West WWTP	Alex East WWTP
• 400 t/d (~ 20% DS), primary sludge • dewatered by belt filter presses • processed to compost for agricultural reuse • initially dried to 80% DS for delivery to cement industry	• 800-1,000 t/d (~ 20-25% DS) • mixed (primary+secondary) sludge • dewatered by centrifuges • processed to compost for agricultural reuse • initially dried to 80% DS for delivery to cement industry

Table 4: Current sludge generation and characteristics

Source: Draft Concept Report, Status: March 14, 2018

Before the temporary closure of Site 9N in the year 2013 all sludge from both WWTPs was vermi-composted within a 3-months process to compost optimized for agricultural reuse. The final output was about 100m³/d; all compost was sold to farmers for a price of 70 LE/m³ plus transport charge. Due to the specific characteristics (nitrogen and phosphorus concentration, low concentration of heavy metals, easy handling) the compost was highly accepted by farmers.

After re-opening of the site by May 20, 2017 the production of compost for agricultural reuse was initially abandoned. All sludge has been fully converted into additive fuel in order to fulfil the requirements of the Portland Cement Company, here a DS content of min. 80%.

Given the fact that until today the Portland Cement Company has not started to reuse the sludge considerable quantities have already accumulated being transferred to Site 9N between May - December 2017. Therefore, it was decided by ASDCo to re-activate vermi-composting process and marketing to farmers. This decision was made in cooperation with the Egyptian Environmental Affairs Agency (EEAA) and prior sludge quality testing showing the compliance with the relevant sludge regulation.

Currently, all sludge is in the process of conversion to vermi-compost; the first quantities are expected to be ready for marketing in June-July 2018.

3.2.6 Effluent Discharge

The discharge licenses for both the West and East WWTPs are for discharge to the agricultural drain (El Omoum Drain) under Law 48/1982. The WWTPs could not comply with these standards with only primary treatment. However, a special dispensation under a presidential decree for the discharge of primary treated effluent on condition that the WWTPs are to be upgraded at some stage to secondary treatment for compliance with the discharge standards.

Existing discharge of effluent from both West and East WWTPs is in theory to the El Omoum Drain and to the sea via the Max PS. In practice, the effluent is discharged to an old area of lake and via an open earthen channel to the Nubaria Navigation Canal. The Canal is hydraulically connected to the Mariout Lake and there are channels through the lake which connect to the El Omoum Drain. But the effluent does not enter the main part of the lake itself.

The East WWTP also discharges to the Nubaria Canal 260m to the south as shown in **Figure 7**.

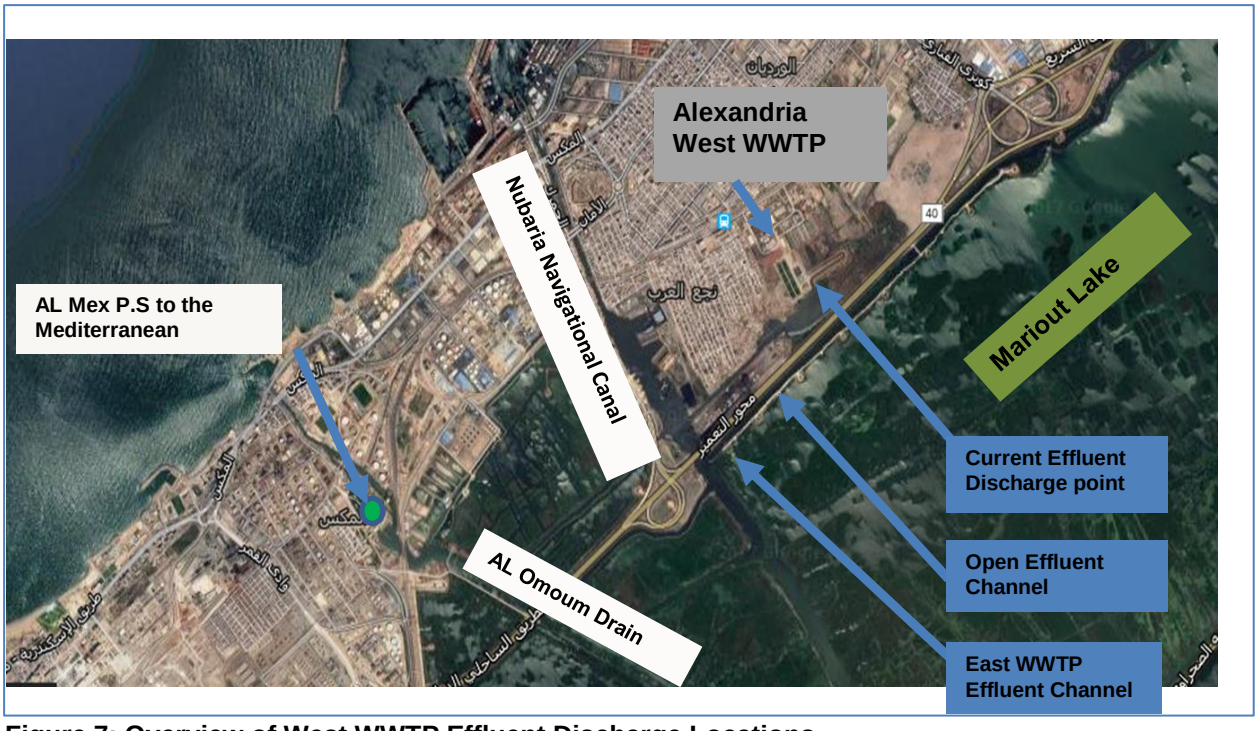

Figure 7: Overview of West WWTP Effluent Discharge Locations.

This section of the Canal is no longer used and there is no active connection to the sea, the only flow is effluent from the East and West WWTPs, which is not regulated and the navigation basin is heavily contaminated by the effluent and acts as a large settling area, this is probably the main source of bad odours which often prevail in the area.

When the Max PS is operating, the effluent flows are drawn through the channels to the El Omoum Drain. **Figure 8** shows the system of canals and drains connected to Lake Maryout and receive the treated effluent of the East WWTP and West WWTP.

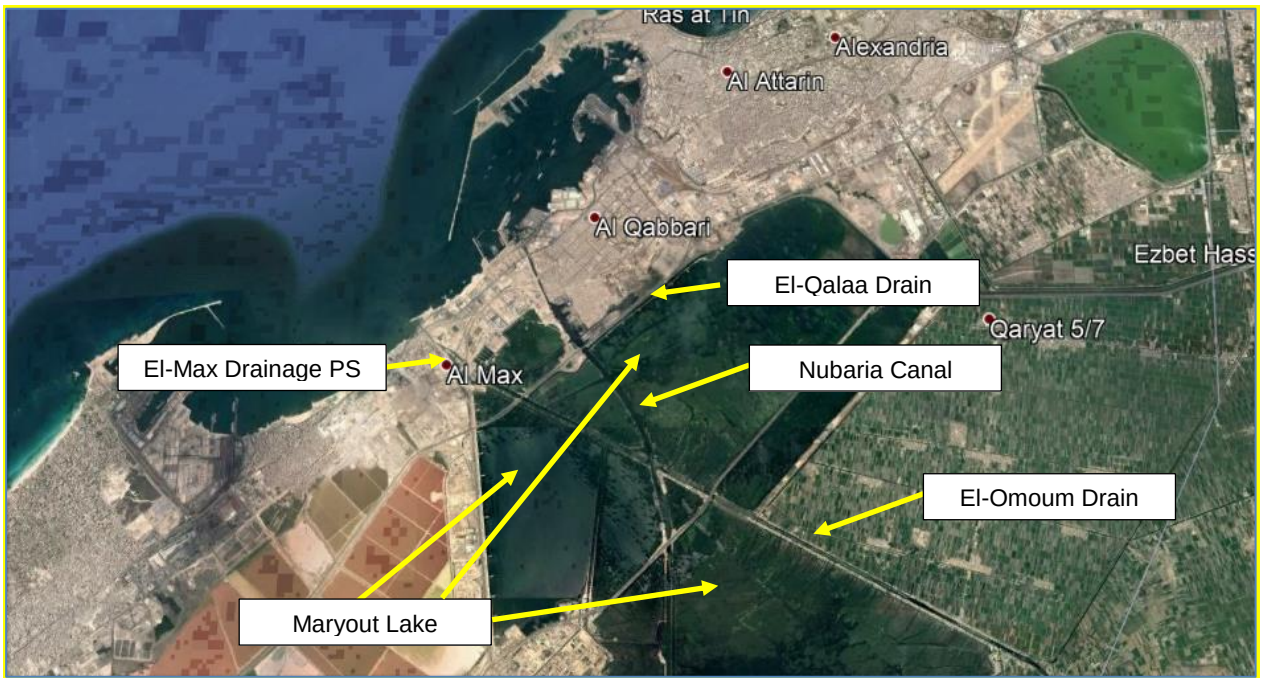

Figure 8: System of canals and drains connected to Lake Maryout.

3.3 Associated Environmental and Social Constraints

Effluent disposal

- Due to a massive pollution over decades today Lake Maryout is in an advanced status of environmental degradation. The primary reason for the degraded overall conditions is the discharge of primary wastewater into the basin via the Qalaa Drain and the Alexandria West WWTP. It is suggested that pollution loads are above levels of the lake self-purification capacity leading to anoxic conditions.
- Effluent discharge over a long period has heavily polluted the connected channels before entering El Omoum Drain, especially by the primary treated effluent of the West WWTP. The water quality will improve now that secondary treatment has started at East WWTP and the level of pollution will further reduce when West WWTP is upgraded. However, the flow channels to El Omoum Drain and Mex PS need to be improved to isolate them in order to prevent contamination of the lake in future.
- To reuse the treated effluent as a water resources for irrigation for the desert lands 28,000 ha (70,000 Feddan) allocated for effluent irrigation located 70km to the west, huge transmission system to transfer this amount of effluent to this area. No infrastructure has yet been implemented to transfer effluent to this location. The economic viability of pumping the effluent to the reuse area will be evaluated
- Additional effluent treatment is generally required for reuse (filtration and disinfection). It is recommended that this is done at the reuse locations and that these costs are associated with the reuse project.

Sludge disposal

- Suggesting a daily transfer of about 1,800m³ mechanically dewatered sludge (specific weight: 1m³ ~ 1t) to Site 9N and a re-transfer of 100 m³ compost (specific weight: 0.5t/m³) to neighbouring farmers with a transport capacity of 15m³ per truck would result in the considerable number of about 110 return tours. Even in case farmers would organise the self-transport of the compost would be associated with significant impacts.

- Until today an unconsolidated volume of ~ 200,00m³ dry sludge is stored at the West WWTP site resulting from the temporary closure of Site 9N during the period 2013 to May 2017. More or less this sludge is disintegrated, wasted and need to be finally disposed.

3.4 Wastewater Treatment Technology Alternatives

The proposed wastewater treatment technologies discussed and assessed in the Concept Design Report are **only for secondary treatment** since the preliminary and primary treatment stages already exist at Alexandria West WWTP. Tertiary and advanced treatment processes have also not been considered since the required effluent standards for Alexandria WWTP do not warrant this level of treatment.

3.4.1 Proposed Upgrade and Extension

The existing facilities will be retained as far as possible; inlet works, grit removal, primary settlement, sludge dewatering. The following basic options are identified for appraisal in concept development. This list is not exhaustive and may be developed further during the appraisal.

Standard Treatment Options at Alexandria west WWTP:

- Biological Treatment
  - Activated Sludge
  - Sequential Batch Reactors (SBR) Sludge Treatment
  - Gravity thickeners, digesters and CHP

Advanced Treatment Options at Alexandria West WWTP

The land area available at the West WWTP is critical for the standard treatment processes, even with the additional 8.4 ha (21 Feddan). Therefore, the following options will be considered to reduce the area required:

- - 2 level bio-reactors (activated sludge or SBRs)
- - 2 level final settling tanks
- - Mechanical thickening
- - MBBR
- - MBR*

Alexandria Wastewater Company has stated that they would not accept an MBR solution. The Consultant agrees with the opinion of the Wastewater Company however this solution has been placed herein as one of the available options and technologies.

Detailed description of the different secondary treatment technologies proposed for the current project has been given in the approved Concept Design Report.

The secondary wastewater treatment alternatives have been evaluated using a decision matrix and weighting criteria. The results of the decision matrix analysis show that the complete mixed CAS process is the preferred wastewater treatment alternative, followed by the SBR process. The plug flow CAS process is less favoured because it is not as flexible as the CMAS process which can easily change from BOD only operating mode, to N removal operating mode. The plug flow CMAS system is not as resilient to toxic shocks from industrial wastewater compared to the CMAS process. The MBBR system occupies less footprint than most of the alternatives assessed but consumes more electricity. Also, it has higher investment costs than the CAS systems, because of the media which is carries a cost unlike bacteria. Therefore, the MBBR system scored less than the three CAS systems.

In the Concept Design Report, the preliminary design and engineering of the CMAS Completely Mixing Activated Sludge and SBR Sequencing Batch Reactor alternatives is therefore prepared and presented.

Figure 9 to **Figure 12** provide flow diagrams and WWTP layouts of the investigated alternatives.

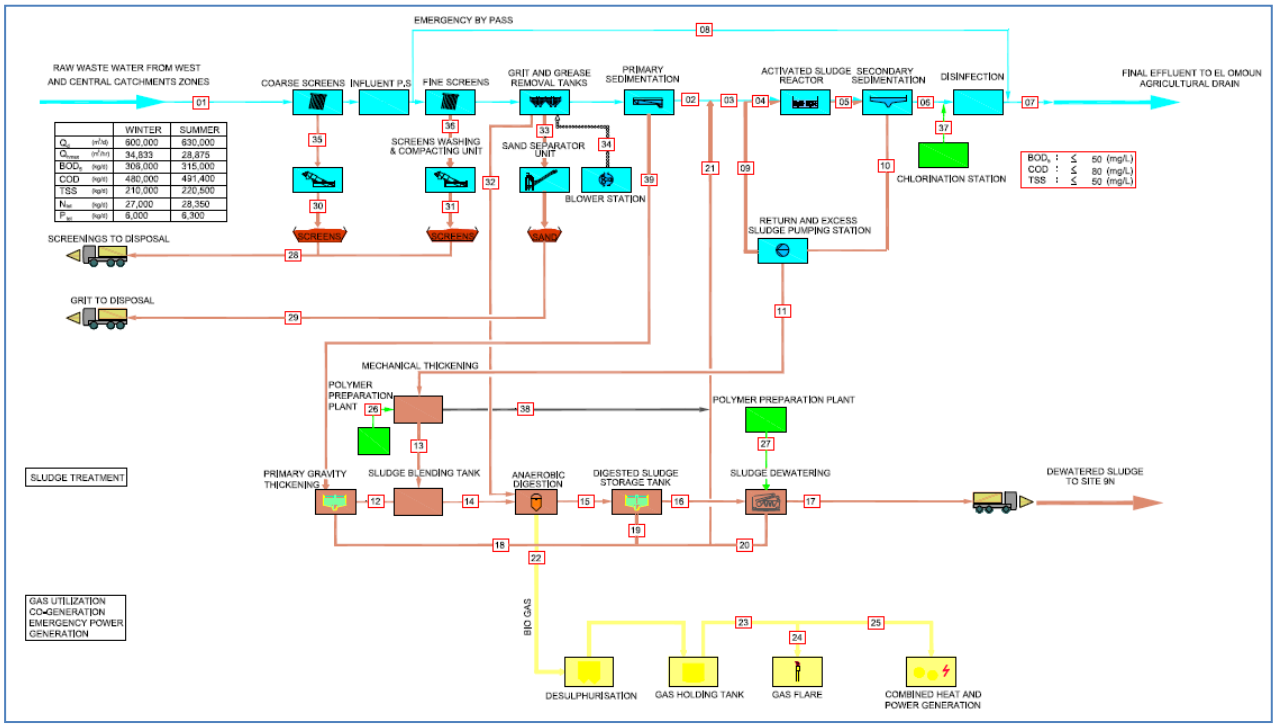

Figure 9: Process flow diagram of alternative (1) - Completely Mixed Activated Sludge (CMAS)

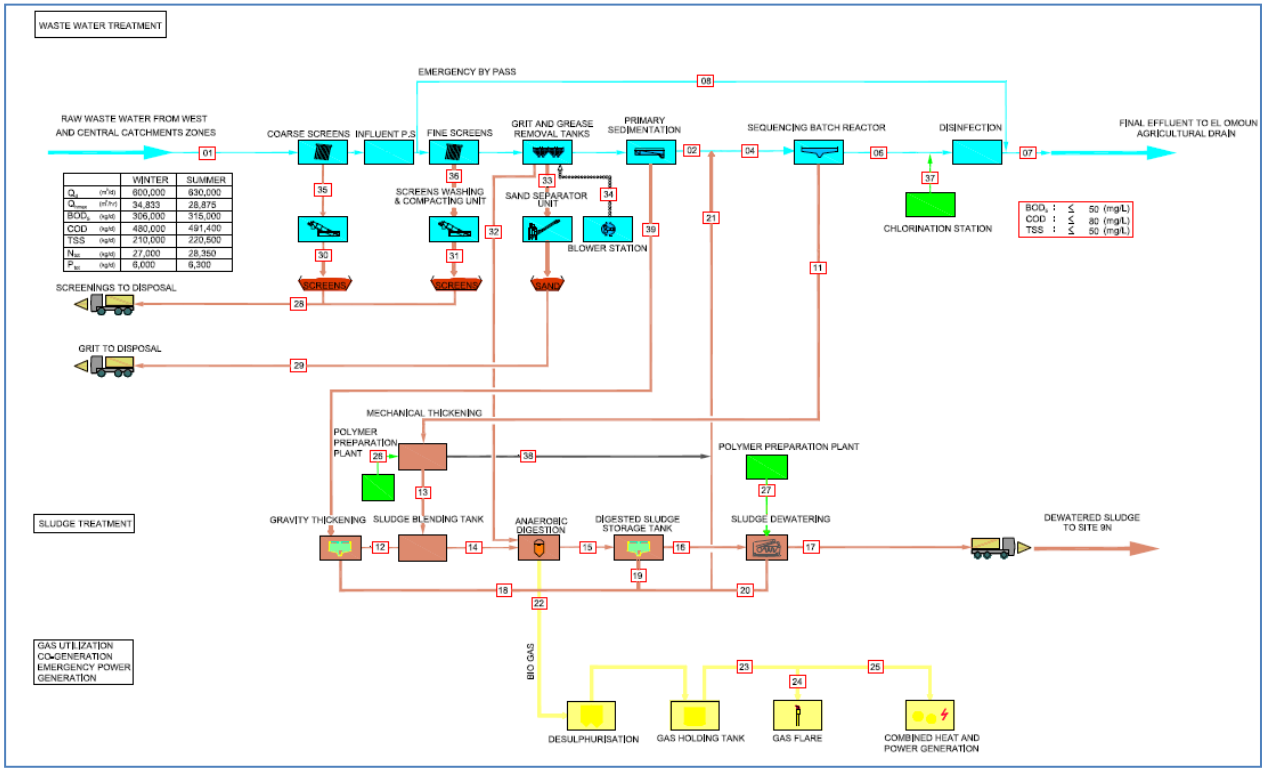

Figure 10: Process flow diagram of alternative (2) - Sequencing Batch Reactor (SBR)

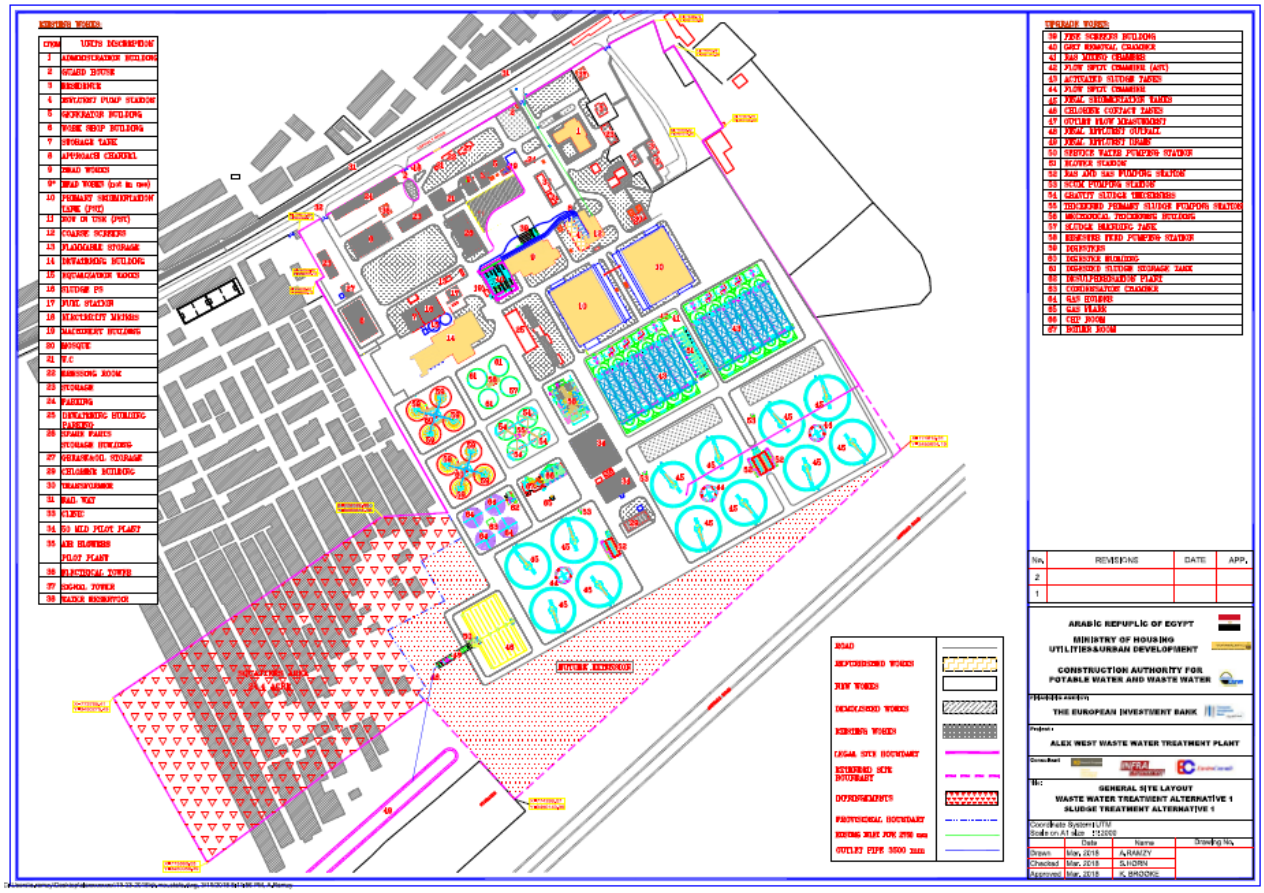

Figure 11: WWTP layout of alternative (1) - Completely Mixed Activated Sludge (CMAS)

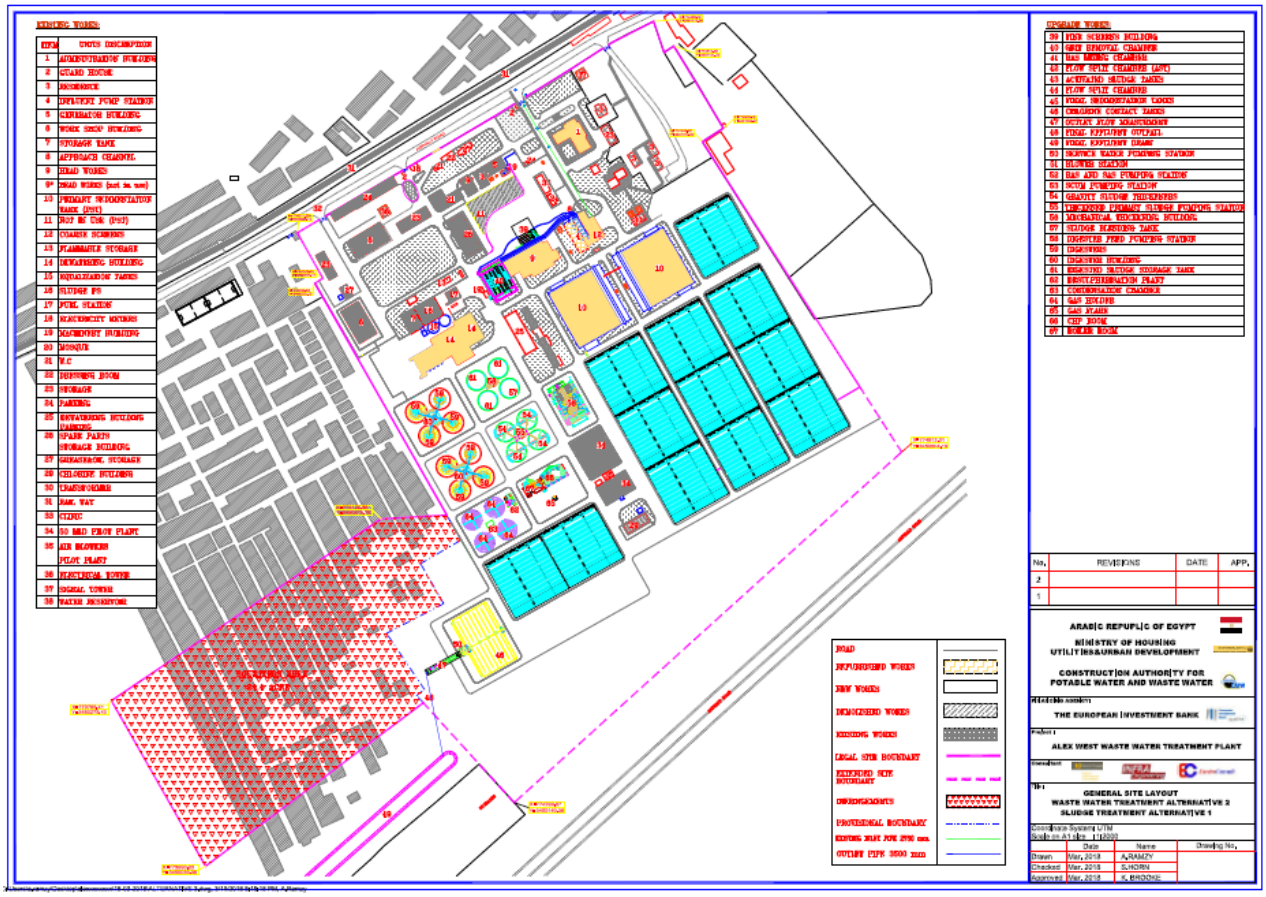

Figure 12: WWTP layout of alternative (2) - Sequencing Batch Reactor (SBR)

3.4.2 Treated Effluent Standard

The selection of wastewater treatment alternatives depends mostly on the treated effluent quality that is required. **Table 5** below presents the treated effluent standard that was recommended for Alexandria West WWTP.

Parameter	Unit	Agri. Drain According to Law 48/1982	Marine Environment According to Law 4/1994
Temperature	°C	35	Not over 10°C above the prevailing rate
pH-Value	-	6-9	6-9
BOD	mg/l	60	60
COD-Cr	mg/l	80	100
COD-Mn	mg/l	40	
DO	mg/l	4	
Oil & Grease	mg/l	10	15
Total dissolved substances	mg/l	2.000	2.000
Suspended Solids	mg/l	50	60
Colour	-	No colour	

Cyanide	mg/l	-	
Turbidity	NTU		50
Phosphate	mg/l	-	5
Nitrate	mg/l	50	40
Fluoride	mg/l	-	1
Ammonia	mg/l		3
Phenols	mg/l	-	1
Total heavy Metals	mg/l	1	
Pesticides	mg/l	-	0,2
E-coli	No. CFU/100ml	5.000	5.000

Table 5: Effluent Standards Recommended for Alexandria West WWTP

Source: Baseline Study Report - 15 September 2017 - Version 02 (Table 17).

3.4.3 Land Availability for Upgrade and Extension

The potential areas available for constructing extensions at the existing site are shown **Table 6**. The total area of the site is shown outlined in blue for the existing area and in red for the additional 8.8 ha (22 Feddan) now allocated in the area of the shallow lake.

	Description	Area (ha)	Area (feddan)
1	Existing WWTP, excluding effluent channel	15.65	37.25
2	Existing read bed and fixed film reactor	3.50	8.33
3	Effluent channel and unused area	22.74	54.12
	Sub total	41.89	99.70
4	Extension area	8.82	22.80
	Total Area	50.71	120.70
	Area available for extensions	31.56	75.12

Table 6: Alexandria West WWTP legal site areas

There are smaller areas within the existing WWTP area which are either unused (but potentially with underground services) or occupied by old, unused, treatment facilities which could be used for support facilities in the extended WWTP, such as upgraded power supply. **Figure 13** shows the WWTP layout of existing facilities, squatter areas and available area for extension.

Figure 13: WWTP Layout showing existing facilities, squatter areas and available area for extension

3.5 Treated Effluent Reuse Alternatives

The effluent generated at Alexandria West WWTP (and also Alexandria East WWTP) is finally discharged into the sea. This practise is not sustainable both in terms of the effluent quality, but also considering the potential of other reuse options.

In the concept design report, four potential effluent reuse concepts are introduced. All proposed reuse effluent concepts are linked with considerable investments and/or in-depth investigations in order to clarify its feasibility and this should be addressed in further reuse study.

After implementation of project Phase I an average effluent volume of 600,000m³ per day is generated. During the summer season this volume can increase to 630,000m³/d, while during the winter season this volume is decreasing.

Parameter	Unit	Phase I	
		Summer	Winter
Current average flow (2017)	m³/d	400,000	
Planned average flow	m³/d	600,000	
Seasonal peak	m³/d	600,000	630,000
Peak flow	m³/h	34,833	28,875

Table 7: Current and future effluent volumes

Having in mind the potential combined effluent reuse and/or disposal of both WWTPs latest available figures of Alexandria East WWTP of the year 2015 indicate an average flow of ~ 675,000m³ per day ranging between minimum 370,000 m³ per day and maximum 1,120,000m³ per day. Under consideration of the Alexandria West WWTP the current combined average volume would be 1,075,000m³ further increasing to 1,275,000m³ after the upgrading of the West WWTP.

Four Concepts have been identified and assessed to provide a strategy for beneficial reuse of the combined effluent flows. These are as follows:

- Alternative 1: Effluent Reuse West of Alexandria (along Alamein-Wadi Natron Road)
- Alternative 2: The Irrigation Area south of the Nasr Canal (proposed by ASDC)
- Alternative 3: The Hammam Extension Reclamation Area (proposed by MWRI)
- Alternative 4: Improvement of Water Quality in Lake Maryout

In the public consultation meeting, the Alexandria Wastewater Company has strongly insisted that the treated effluent must be reused in agricultural usage (in any of the first three alternatives) and not to be wasted and disposed to Lake Maryout even for enhancement of its water quality.

3.6 Sludge Treatment and Disposal Alternatives

3.6.1 Sludge Treatment Alternatives

In the Concept Design Report, an assessment of established sludge treatment processes has been made in order to identify two sludge treatment alternatives that could be applied for the upgrade and extension of Alexandria West WWTP. The main methods of sludge treatment are: thickening, stabilisation (anaerobic/aerobic/chemical), dewatering, drying, composting, and incineration. The decision matrix has been developed and used to select the most suitable alternative for sludge treatment.

Anaerobic sludge digestion is the preferred technology of sludge stabilisation for the upgrade works because of lower energy consumption and renewable energy production. Although similar in performance, apart from less de-waterable digested sludge, the aerobic digester consumes more energy mostly for supplying air to the process, and it is not able to produce renewable energy. Sludge dewatering using BFP is preferred over centrifuge mainly due to lower energy consumption.

The two alternatives for the sludge treatment are:

- Alternative 1: Gravity Thickening (PS) + Mechanical Thickening (WAS)
- Alternative 2: Gravity Thickening (PS+WAS)

Detailed description of the sludge treatment alternatives and the selection of the suitable sludge treatment alternative for Alexandria West WWTP is given in the Concept Design Report.

3.6.2 Sludge Disposal and Reuse

In future Site 9N is considered forming the central facility for ASDCo's sludge reuse strategy.

Table 8 is providing an initial estimation of the future sludge generation after implementations of project Phase I (wastewater inflow: 630,000m³/d in summer) at Alexandria West WWTP under specific consideration of two wastewater treatment options. Considering today's sludge generation of ~1,300t/d (Alexandria West

& East WWTPs) the initial calculation indicates a significant increase of the sludge volumes ranging between 1,575m³/d and 1,782m³/d.

Additionally, after steady operation of the extension works at Alexandria East WWTP this plant will generate another 1,007m³ of sludge per day with a projected DS content of 20% (dewatering by centrifuges)1. Actual figures provided by ASDCo indicate an average sludge generation of 900m3/d2.

In total a considerable sludge quantity of about 1,575-1,882m³ per day will be transferred to Site 9N for further processing.

Item	Unit	Alexandria West WWTP*	Alexandria East WWTP
Specific sludge generation	t/DS/d	201.7	
Sludge volume (mechanically dewatered)	West: m³/d (25% DS) East: m³/d (20% DS)	775	800-1,000 (av. 900)** 1,007***
Estimated total sludge generation > transfer to Site 9N	m³/d (20-25% DS)	**1,575-1,882**	

* - Carbon removal process

** - sludge generation estimated by ASDCo, Dr. Hellaly (March 08, 2018)

**** - Degremont (2008): Rehabilitation and Extension of Primary Treatment and Additional Secondary Treatment. - 1st Design Report

Table 8: Estimated future sludge generation of Alexandria West and East WWTPs

Source: Internal project calculations (status: March 2018)

In future all sludge is proposed to be converted to vermi-compost; the first quantities are expected to be ready for marketing in June-July 2018. Composted sludge is proposed to be sold to farmers for 150 LE/m³ plus transport charge.

As informed by ASDCo, Dr. Hellaly (personal communication March 08, 2018) considering the increasing raw sludge quantities in future all generated compost can be sold to farmers providing a safe and reliable outlet.

Alternatively, by September 20, 2015 a contract was signed by ASDCo and the Alexandria Portland Cement Company agreeing the provision of dried sludge as additive fuel. With reference to the quantity of dried sludge to be supplied a volume of approximately 100 m³/d with a minimum 80% DS is considered.

Responding to this contractual requirement sludge would have to be converted into additive fuel by drying to a DS content of 80%. This means the only process step is the turnaround of the sludge until the final DS is achieved (air drying in windrows).

However, as informed by the Alexandria Portland Cement Company is considering the dried sludge of having a too low caloric value in order to provide a valuable fuel additive replacement. Provided the low volatile organic dry solids content of the sludge in combination with a 'wasting' of the sludge by dust and sand during the processing/storage at Site 9N may be considered as realistic.

[1] Degremont (2008): Rehabilitation and Extension of Primary Treatment and Additional Secondary Treatment. - 1st Design Report

[2] ASDCo, personal communication Dr. Hellaly, March 2018

In response, the contract mentioned above is set on hold; however, ASDCo is taking efforts to meet the requirements of the cement company.

Nevertheless, the combination of both options, and the long successful experience with the generation and marketing of compost is providing a solid basis for future sludge reuse.

3.7 Project Significance and 'No Project' Alternative Analysis

The proposed project of upgrade and extension of Alexandria West WWTP is included as one of the projects in the National Action Plan of Egypt (NAP) 2015 and is a top priority of the Government of Egypt. It contributes towards an efficient and sustainable water resources management in Egypt as well as to the Egyptian climate protection efforts.

The project will support the depollution of Lake Maryout and the Mediterranean Sea and provide an additional source of water and thus improve the economic situation for fishery, agriculture/forestry and tourism in the area. The project will improve the health and environmental situation of the people living in the Governorate of Alexandria. The project will contribute to the environmental sound disposal/utilization of effluent and sludge as well as energetically optimized and environmental sound sludge treatment.

If the project is not executed in case of "No Project Alternative", the Alexandria West WWTP shall not be able to receive and handle the future flows. The high level of pollution due to un-proper level of treatment of wastewater received by the WWTP as well as the current sludge treatment and handling shall increase and consequently the level of pollution reaches the Lake Maryout and ultimately reaches the Mediterranean Sea shall also increase. This level of pollution shall affect the human health as well as the limited available water resources.

Considering the serious environmental and socio-economic currently attributed by the poor treatment efficiency of the WWTP the upgrade and extension project is essential, especially with view of improvements in human health, water resources and energy efficiency.

4 Legal and Institutional Framework

This section addresses the legislative and institutional framework relating to ESIA development, specifically relevant to the wastewater treatment plant upgrade and expansion works and the environmental and social impact assessment associated with this type of projects. For this project the ESIA has been prepared under specific consideration of the:

- Environmental and Social Standards of the EIB,
- Core labour standards of the International Labour Organisation (ILO).

The national framework considers environmental laws and regulations of the Government of Egypt, in particular, the Environmental Protection Law No.4/1994 amended by law 9/2009 and law 105/2015 and their executive regulations and in Regulation No. 37 on Environmental Impact Assessments guidelines issued in the year 2005.

4.1 Donor Safeguard Requirements and Applicable Standards

4.1.1 EIB Environmental and Social Practices Handbook

The EIB Environmental and Social Practices Handbook, last amended in the year 2013 describe the processes and practices of the Bank to ensure that all financing activities are consistent with its environmental policy. Volume I of the handbook outlines 10 standards that may have significance for the ESIA study. With reference to the Alexandria West WWTP Project all standards are considered as applicable.

- Standard 1: Assessment and Management of Environmental and Social Impacts and Risks

  The overall objective of this Standard is to outline the promoter's responsibilities in the process of assessing, managing and monitoring environmental and social impacts and risks associated with the operations.

- Standard 2: Pollution Prevention and Abatement

  The objectives of this Standard are:

  - Avoidance of any deterioration in the quality of human health or the environment, and any loss of biodiversity, by avoiding, reducing and, if possible, compensating/remedying significant adverse effects of projects supported by the EIB;
  - Support to the EU aims of reducing greenhouse gas emissions and enhancing resource efficiency, that will ease pressures on the environment and bring increased competitiveness through cost savings from improved efficiency, commercialization of innovations and better management of resources over their whole life cycle; and,
  - Promotion of an integrated approach to prevention and control of emissions into air, water and soil, to waste management, to energy efficiency and to accident prevention for the protection of the environment as a whole and therefore, avoiding the shift of pollution from one environmental medium to another.

- Standard 3: Biodiversity and Ecosystems
- Standard 4: Climate-related Standards
- Standard 5: Cultural Heritage

  The objective of this Standard is to outline the promoter's responsibilities in terms of cultural heritage management, involving the actions taken to identify, assess, decide and enact decisions regarding the impact on cultural heritage associated with operations supported by the EIB.

- Standard 6: Involuntary Resettlement

  The objectives of this Standard are:

  - Avoid or, at least minimize, project-induced resettlement whenever feasible by exploring alternative project designs;
  - Avoid and/or prevent forced evictions and provide effective remedy to minimize their negative impacts should prevention fail;

- Ensure that any eviction which may be exceptionally required is carried out lawfully, respects the rights to life, dignity, liberty and security of those affected who must have access to an effective remedy against arbitrary evictions;
- Respect individuals', groups' and communities' right to adequate housing and to an adequate standard of living, as well as other rights that may be impacted by resettlement;
- Respect right to property of all affected people and communities and mitigate any adverse impacts arising from their loss of assets, or access to assets and/or restrictions of land use, whether temporary or permanent, direct or indirect, partial or in their totality. Assist all displaced persons to improve, or at least restore, their former livelihoods and living standards and adequately compensate for incurred losses, regardless of the character of existing land tenure arrangements (including title holders and those without the title) or income-earning and subsistence strategies;
- Uphold the right to adequate housing, promoting security of tenure at resettlement sites;
- Ensure that resettlement measures are designed and implemented through the informed and meaningful consultation and participation of the project-affected people throughout the resettlement process; and
- Give particular attention to vulnerable groups, including women and minorities, who may require special assistance and whose participation should be vigilantly promoted.

- Standard 7: Rights and Interests of Vulnerable Groups

  Standard sets out to avoid or minimize, or otherwise mitigate and remedy potential harmful effects of EIB operations to vulnerable individuals and groups whilst seeking that these populations duly benefit from such operations. As a means to foster those project outcomes, Standard 7 proposes a framework and tools to address inequalities and other factors contributing to vulnerability, and, as appropriate, to allow for equal access to and enjoyment of project benefits for those individuals and groups.

- Standard 8: Labour Standards

  With the present standards, the responsibilities of the promoter are defined to ensure that the project embraces the principles of International Labor Standards.

- Standard 9: Occupational And Public Health, Safety And Security

  In compliance with ILO's Guidelines on occupational safety and health management systems the EU's decent work agenda the OSH Framework Directive as well as the UN Guidelines on Business and Human Rights, the EIB stresses the employers' duty of care towards project workers and society, in safeguarding occupational and public health, safety and wellbeing within the area of influence of their operations and at associated facilities.

- Standard 10: Stakeholder Engagement

  As a public institution, the EIB actively promotes the right to access to information, as well as public consultation and participation; the right to access to remedy, including through grievance resolution, is equally acknowledged and actively promoted by the EIB. Standard 10 affirms the EIB's expectation that promoters uphold an open, transparent and accountable dialogue with all relevant stakeholders at the local level targeted by its EIB operations. This Standard stresses the value of public participation in the decision-making process throughout the preparation, implementation and monitoring phases of a project.

4.2 Core Labour Standards (CLS) of the International Labour Organisation

The International Labour Organisation (ILO) is a tripartite organisation consisting of trade unions, governments and companies, and is part of the United Nations system. In 1998, the ILO produced the Declaration on Fundamental Principles and Rights at Work. In the Declaration, ILO member states agreed that they should all respect, promote, and realise Core Labour Standards (whether or not they have ratified them).

The core labour standards consist of four standards, laid out in eight conventions:

- Freedom of association and the effective recognition of the right to collective bargaining (Convention No. 87 & No. 98).
- The elimination of all forms of forced and compulsory labour (Convention No. 29 & No. 105).

- The effective abolition of child labour (Convention No. 138 & No. 182).
- The elimination of discrimination in respect of employment and occupation (Convention No. 100 & No. 111).

Today all International Financing Institutions including EIB have fully adopted CLS in their activities.

Egypt has ratified all core labour standards mentioned before and set into force.

4.3 Relevant National Legislative and Regulatory Framework

Within Egypt there are 3 levels of legal assignment. These include Presidential Decrees, as issued by the Egyptian President; Ministerial Decrees, as issued by the relevant Minister; and finally statutory instruments and laws as prepared by the Egyptian Government and enacted through the People's Assembly.

The institutional framework for effective environmental management and enforcement in Egypt was implemented in the late 1990's, when the Government sought to implement mechanisms more conducive to the ideals of sustainable development.

Law No. 4 of 1994 established the Egyptian Environmental Affairs Agency (EEAA) as the Country's central coordinating authority. The EEAA coordinates its local and regional activities through environmental management units (EMUs) based in each of the country's 26 governorates. The EEAA has also established a number of regional branch offices, each with the jurisdiction of 3 to 5 governorates.

The Law No. 4 of 1994 has been amended by Law No. 9 of 2009 and Law No. 105 of 2015 and their executive regulations.

Wastewater projects are regulated by the EEAA's GUIDELINES FOR MUNICIPAL WASTE WATER TREATMENT WORKS. Guidelines for conducting an ESIA of municipal waste water treatment plants are available in Egypt and detail the content, format, approach and likely impacts that would need to be addressed. The relevant EEAA Guidelines were published in 1999 amended in 2005 as well as the General Guidelines for the preparation of a full ESIA study for different sectors issued 2010, and outline the environmental management requirements of such projects, and propose mitigation measures and strategies to reduce potentially adverse environmental impacts. The Guidelines establish that, following the EIA process, a Monitoring Plan should be designed and adopted based upon the ESIA findings and recommendations.

According to the EEAA regulations and classifications, new wastewater treatment projects can be classified as Category B (projects with relatively large environmental impacts) or Category C (projects with substantial environmental impacts). The categorisation of WWTPs depends on their treatment capacity as defined in Law No. 4/1994 amended by Law No. 9/2009 and 105/2015, which stipulates that WWTPs with a capacity below 150,000m^3/d are Category B whereas, if the capacity exceeds 150,000 m^3/d then the project is classified as Category C. This has been recently amended by the "Protocol for Cooperation between the Ministry of Environment and the Ministry of Housing, Utilities, and Urban Communities for the Application of Criteria and Environmental Conditions for Wastewater Projects" which sets the threshold between the two categories to 1,000,000 population equivalent served.

Within EEAA, the Environmental Impact Assessment (EIA) Department is responsible for the review and approval of Form B for wastewater projects less than 20,000 m^3/day, scoped ESIA for wastewater projects from 20,000 m^3/day to 150,000 ^{3}m/day, and full ESIA reports for larger size projects (the procedural application form that summarizes the proposed development). The EEAA has also established central laboratories for air and water quality which act as reference laboratories, carry out emission monitoring and are the main sources of published information on air and marine water quality. The Egyptian Water Regulatory Authority (EWRA), established in 2004, has duties to regulate the water and waste water sector in Egypt.

For the purposes of this project, and according to the relevant EEAA classifications from the WWTP size, it is likely that the project would be classified as a 'Class C Listed Project', requiring a full detailed ESIA study.

However, as the project concerns the expansion and upgrade of an existing wastewater treatment plant on an existing site, rather than the construction of a new plant, it could also be classified as 'Class B listed Project" under section 5.2 of the "Guidelines of Principles and Procedures for Environmental Impact Assessment" referring to special cases and in particular expansions of existing facilities/projects.

As the final decision on the categorisation of the project rests with the EEAA, the present ESIA has been carried out in respect of the Egyptian standards and safeguards in accordance with the principles required

for either Form B or C but not considering a specific categorisation. The final ESIA document will require revision on the basis of the detailed design specifications before submission to the EEAA in Arabic Language. In addition, the detailed engineering design should be submitted to the EEAA for approval and permitting. The EEAA would then provide its acceptance or comments on the ESIA in accordance with their procedures.

Category C projects require two compulsory rounds of public consultation, one at scoping stage and one before submission of the draft final ESIA to the competent authority for approval. One consultation has been carried out, with EEAA participation, during this study, as documented herein. The second shall be carried out with the final ESIA. As the environmental approval is time limited and is based on the final design, the second consultation must be carried out during the final design phase.

4.3.1 Relevant Egyptian Environmental Legislations

Natural Protectorates – Biodiversity Law No 102 of 1983 for Nature Protectorates

It is forbidden to commit activities which will lead to the destruction or deterioration of the natural environment or harm the biota (terrestrial, marine or fresh water), or which will detract from the aesthetic standards within protected areas. It is forbidden to undertake activities in the areas surrounding designated protectorates, which will have an effect on the protectorate's environment and natures, except with the permission of the concerned Administrative Body.

Land Use, Geology and Soils Law 116/1983

Egypt has undertaken a number of measures to promote sustainable land management. It has developed land-use maps and has plans to curb industrial and urban encroachment on arable lands. Nurseries have been established for the improvement of plantings along roads and for the establishment and maintenance of gardens. Areas of sand dunes are also being stabilized through tree planting.

Egyptian Code for Reuse of Treated Sewage water in irrigation and Use of Sludge in agriculture 501/2015

This Code allows for the disposal of treated effluents to agricultural land based on three categories of treated waste – that from public treatment facilities, from private treatment facilities and lastly where the effluent is from an industrial source. A range of conditions and criteria are set and a permit is required from the Ministry of Health prior to application. The receiving land shall not be within 3km from built up areas and there are constraints on the types of agriculture for which the effluent can be used.

Parameter	Class A	Class B	Class C	Class D
TSS (mg/l)	15	30	50	300
Turbidity (NTU)	5	Undefined	Undefined	Undefined
BOD (mg/l)	15	30	80	350
E.Coli Count (Org/100ml)	20	100	1000	Undefined
Nematodes (no. of cells or eggs/l)	1	Undefined	Undefined	Undefined

Table 9: Effluent quality for treated wastewater as per Code 501/2015

Environmental Impact Assessment – Process: Law No 4/1994 amended by Law 9/2009 and Law 105/2015

According to the EEAA classifications, the current project would be classified as C Type project which require full detailed EIA study. Guidelines for the conducting of EIAs for municipal waste water treatment plants detail the content, format, approach and likely impacts that would need to be addressed.

The full detailed EIA study to be carried out by the project sponsor has to be submitted to the EEAA in Arabic language along with Form B for Wastewater Treatment Plants. The EEAA should provide its comments for EIA study improvement, adjustment and or rejection within 30 days from date of submission.

Environmental Law No. 4/1994 as amended by Law No. 9/2009 and its Executive Regulation are the main legislation governing environmental protection in Egypt. The Environmental Law stipulates that an

environmental impact assessment should be prepared for development projects as a precondition for obtaining a license. Detailed analysis of the impacts during construction and operation phases in normal operation and emergency situations has to be carried out in an EIA. The EEAA is required to furnish the competent administrative authority or the licensing authority with its opinion on the EIA within 30 days from receiving the assessment otherwise the assessment shall be deemed accepted by the EEAA. In the event the project has been accepted, the Environmental Law obliges the project proponent to keep an environmental record to document the environmental performance of the project. The EIA system classifies the projects into three categories (A, B or C) based on different levels of EIA requirements according to severity of possible environmental impacts and location of the establishment and its proximity to residential settlements, as follows:

- Category A – projects with minimum environmental impacts.
- Category B – projects with potential adverse environmental impacts yet less adverse than category C.
- Category C – projects which have highly adverse impacts.

EEAA Guidelines of EIAs of Wastewater Treatment Works (2005) identified three categories of WWTPs corresponding to different levels of details in the EIA required. However, in 2009 revised guidelines of EIA were issued by EEAA which indicate that compact water treatment plants should be considered (and probably rehabilitation works) as Category B projects while wastewater treatment plants including sanitation systems and public/central construction of water treatment as Category C projects.

It is worth noting that the EIA Guidelines of 2009 includes requirements for carrying out consultations with the public and concerned stakeholders of the projects under Category C. The Guidelines defines the following concerned parties that should be involved in the consultation, as a minimum:

- EEAA and Regional Branch Offices
- Competent administrative authorities, according to the type of project and location
- The Governorate
- The Local People Council
- Representatives from neighbouring sites and affected communities
- Local NGOs
- Local universities

The Guidelines indicate that at least two public consultation sessions should be carried out, one during the scoping phase and the other after the preparation of the draft EIA, the Guidelines provides details of the procedures that should be followed for advertising, discussion points, documentation and disclosure.

According to the Amendment Law No. 9/2009 "Any leakage, effusion, emission, draining or disposal of any kind of pollutants into the waters of the Nile river, the waterways, the territorial sea, the exclusive economic zone, the sea, taking into consideration the levels determined for certain substances in the executive regulations. These shall be determined by a decision issued by the EEAA in agreement with the competent administrative authority".

The Environmental Law regulates the handling of hazardous substances and wastes which may only be performed after obtaining a license from the competent administrative authority. Chlorine, which is used in WTPs and WWTPs for disinfection of drinking water and treated effluent, is a toxic material and will require a license. Other potentially hazardous materials used on WTPs and WWTPs may include fuels, lubricating oils and laboratory chemicals. The Executive Regulation of the Environmental Law provides limits for noise levels in the working environment, which will apply to excavation/construction activities and operation of pumping stations and WTP/WWTPs.

Environmental Management

EEAA Guidelines for the conducting of EIAs for municipal waste water treatment plants that were published in January 2005 define the outline for the environmental management for such projects: The Guidelines propose mitigation measures and strategies to reduce negative impacts on different sectors of the environment. A Monitoring Plan should be carefully designed and related to the predictions made in the EIA and the key environmental indicators.

Surface Water and Groundwater – Quality, Abstractions/Discharges, Licensing, Monitoring

Law No 48/1982 prohibits the discharge into the Nile River, irrigation canals, drains, lakes and groundwater without a license issued by the Ministry of Water Resources and Irrigation. It is forbidden to discharge solid waste and or wastewater (industrial, domestic, sewage, or from any other source) to open streams or open water bodies or to the groundwater aquifers unless a permit is obtained from the MWRI according to the standards defined by the MWRI and the Ministry of Health. Law No 48/1982 is only applicable to inland waters.

Parameter	Allowable limit	Parameter	Allowable limit
pH	6-9	Sulphates (mg/l)	1
Temperature (°C)	35	Cyanides (mg/l)	-
BOD (mg/l)	60	Phosphates (mg/l)	-
COD (mg/l)	80	Nitrates (mg/l)	50
DO (mg/l)	>4	Fluorides (mg/l)	-
O&G (mg/l)	10	Phenols (mg/l)	-
TDS (mg/l)	2,000	Total heavy metals (mg/l)	1
TSS (mg/l)	50	Pesticides	nil
Colour	nil	Total coliforms (MPN/100 ml)	5,000

Table 10: Discharge Limits of wastewater to drains according to Law 48/1982

Law No 4/1994 concerns the environment deals with seawater pollution and controls the effluent to be disposed to marine environment as indicated in the following **Table 11**.

Item	**Maximum limits of criteria and specifications** (mg/l unless otherwise indicated)
Temperature	Not to exceed 10 degrees over the prevailing rate.
PH	6 - 9
Colour	Free of colouring materials
Biochemical Oxygen Demand	60
Chemical Oxgyen Demand	100
Total Dissolved Solids	2000
Volatile Solids	1800
Suspended materials	60
Turbidity	NTU 50
Sulphides	1
Oil and Greases	15
Hydrocarbons of oil origin	0.5
Phosphates	5
Nitrates	40
Phenolates	1
Fluoride	1
Aluminium	3
Ammonia (nitrogen)	3
Mercury	0.005
Lead	0.5

Cadmium	0.05
Arsenic	0.05
Chromium	1
Copper	1.5
Nickel	0.1
Iron	1.5
Manganese	1
Zinc	5
Silver	0.1
Barium	2
Cobalt	2
Pesticides	0.2
Cyanide	0.1
Estimated Fecal Coliform Count in 100 cm^3	5000

Table 11: Discharge limits to marine water according to Law 4/1994

Law No 124/1983 prohibits disposing any industrial wastes, insecticides, and other materials in the Egyptian waters (Not considered relevant for this project).

Drinking water standards are set by the Ministry of Housing. Drinking water standards were adjusted in 1998.

Law No 93 of 1962 refers to wastewater disposal in sewage systems concerns the discharge of liquid waste into public sewerage systems.

- Establishments that discharge wastewaters with high contents of solids (such as bakeries, mills, etc), shall install settlement chambers prior to discharging wastewater to the sewer.
- Establishments that discharge high loads of oils and fats in their wastewaters (e.g. car parks, services stations, etc.) shall install oil separators prior discharging the wastewater to the sewers.
- It is prohibited to dilute wastewaters.
- Wastewaters should comply with the standards indicated in the table below, before it may be discharged to public sewers.

Climate and Air Quality - Outdoor Air pollution, Emissions, Noise: Law No 4 of 1994

The Environmental Law sets standards for ambient air quality and gas emissions from point sources for specific gases and particulate matter. All fuel combustion machines, such as generators in pumping stations, WTPs and WWTPs should comply with emission standards indicated in Table below.

The site on which a project is established must be suitable for the project activity to ensure that the permissible levels of air pollutants are not exceeded, and that the total pollution emitted by all the establishments in one area is within the permissible levels. Law No. 4/1994 defines the suitable and the limits for air quality parameters, permissible noise levels, and permissible emission levels in different working environments as indicated in **Table 12** to **Table 14**

Pollutant	Maximum Limit	Exposure Period
Sulphur Dioxide	350 150 60	1 hr 24 hrs 1 year
Carbon Monoxide	30 10	1 hr 8 hr
Nitrogen Dioxide	400 150	1 hr 24 hrs
Ozone	200 120	1 hr 8 hr

Suspended Particles Measured as Black Smokes	150 60	24 hrs 1 year
Total Suspended Particles (TSP)	230 90	24 hrs 1 year
Respirable Particles (Pm 10)	70	24 hrs
Lead	1	1 year

Table 12: Maximum limits of outdoor air pollutants as per Law 4/1994

Pollutant	Maximum Limit for Emissions (mg/m3 from exhaust)
Aldehydes (measured as Formaldehyde)	20
Antimony	20
Carbon Monoxide	500 Existing 250 New
Sulphur Dioxide	
Burning Coke and Petroleum	4,000 Existing 2,500 New
Non-ferrous Industries	3,000
Sulphuric Acid Industry & other sources	1,500
Sulphur trioxide in addition to sulphuric acid	150
Nitric Acid	
Nitric Acid Industry	2,000
Hydrochloric Acid (Hydrogen Chloride)	100
Hydrofluoric Acid (Hydrogen Fluoride)	15
Lead	20
Mercury	15
Arsenic	20
Heavy elements (total)	25
Silicon Fluoride	10
Fluorine	20

Table 13: Permissible limits of air pollutants in emissions as per Law 4/1994

No.	Type of Place and Activity	Maximum Permissible Noise (Decibel [A])
1.	Work place with up to 8 hour shifts and aiming to limit noise hazards on sense of hearing	90
2.	Work place where acoustic signals and good audibility are required	80
3.	Work rooms for the follow up, measurement and adjustment of high performance operations	65
4.	Work rooms for computers, typewriters or similar equipment	70
5.	Work rooms for activities requiring routine mental concentration	60

Table 14: Permissible limits of sound intensity and safe exposure period as per Law 4/1994

Solid Waste Management: Law 31 of 1976

This law regulates the collection and disposal of waste from residential areas, commercial and industrial establishment and public places. The Ministry of Housing and Utilities is responsible for the implementation of the law however solid waste management is the responsibility of the municipalities

Disposal of hazardous waste shall be in accordance with the conditions and criteria set forth in the executive regulations of this Law.

The EEAA has recently issued the guidelines for handling, management and treatment of hazardous materials. These guidelines are not yet enforced.

Sludge - Sludge Reuse in agricultural applications

Egyptian Code for Reuse of Treated Sewage water in irrigation and Sludge in agriculture (Ministry of Housing, Utilities and New communities: Ministerial decree 288/2000 and 329/2001): (Under review)

This code covers the safe usage and controls the use of sludge resulting from the treatment process including all relevant aspects to this process (production and usage/disposal of sludge including the safe production of sludge (including the establishment of limits of various heavy metals), sludge production control, handling and sites not to be utilised and the need for producers and carriers of the sludge to obtain an appropriate license).

The decree was followed and updated by the Ministerial Decrees 288/2000 and 329/2001 through issue of an Egyptian Code for Reuse of Treated Sewage water in irrigation and Use of Sludge in agriculture.

The decree provides a definition of sludge according to wastewater treatment and refers to US Environmental Protection Agency (EPA) criteria as the basis for determining safe use without referring to any particular standards. It provides recommendations for the periodic follow up and analysis to prevent build-up of heavy metals and sets limits for heavy metal content in sludge as shown in **Table 15**.

Parameter	Allowable limit (mg/kg ds)	Parameter	Allowable limit (mg/m^3)
Zinc (Zn)	2800	Mercury (Hg)	17
Copper (Cu)	1500	Chromium (Cr)	1200
Nickel (Ni)	420	Molybdenum (Mo)	18
Cadmium (Cd)	39	Selenium (Se)	36
Lead (Pb)	300	Arsenic (As)	41

Table 15: Permissible Limits of safe use of treated sludge in agricultural applications

Cultural Heritage - Protection of Cultural Heritage and Antiquities sites: Law 117/1983

This Law defines criteria for designation of historical structures, protection of antiquities and regulation of excavation in historical sites.

It is forbidden to do any kind of work by any means beside, under or close to the sites which represent historic, cultural and or antiquities value. It is also forbidden to rehabilitate, remodel, reshape, these structures without authorization from relevant governmental authorities.

During construction if any sign appears of any monuments, all construction must be stopped at once and the relevant governmental authorities are notified. The works can only be resumed upon written approval from relevant authorities.

Engineering Codes of Practice

The engineering design and construction specifications for water and wastewater facilities are regulated by several engineering codes of practice issued from the Minister of Housing. These include some environmental conditions and specifications for different engineering works. The relevant codes of Practice are:

- Egyptian Code for Design and Execution of Water Supply and Wastewater Piping Networks.
- Egyptian Code for Wastewater Pumping Stations.
- Egyptian Code of Practice for Wastewater Treatment Works.
- Egyptian Code of Practice for Soil Mechanics and Foundations.
- Egyptian Code of Practice for Structural Design of Concrete Structures.

- Egyptian Code of Practice for Electrical Design of Infrastructures.

The following diagram illustrates the discharge and possible means of reuse of wastewater in relation to the laws and standards.

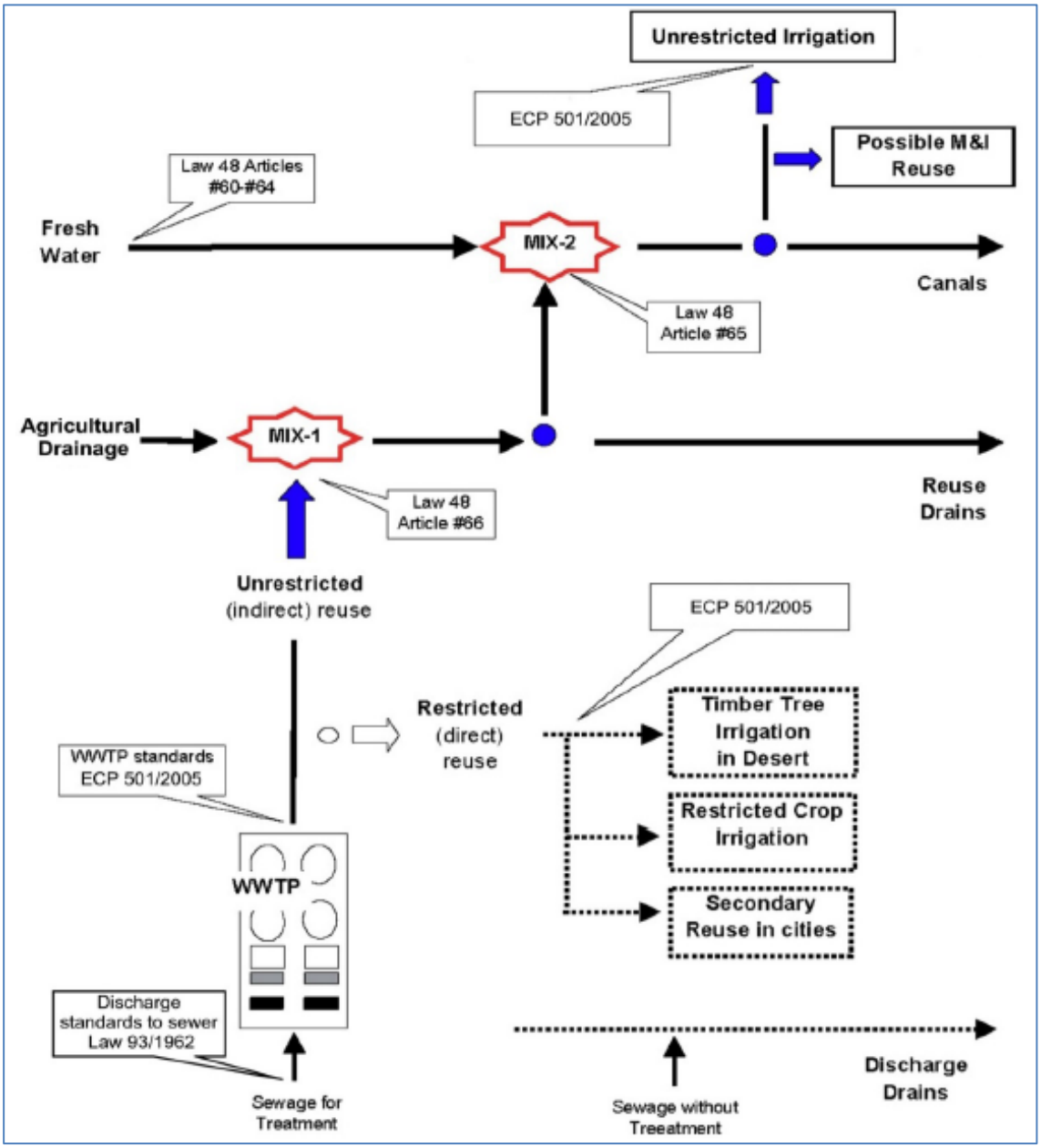

Figure 14: Disposal and reuse of treated wastewater in relation to local Egyptian Laws and Standards

4.3.2 Relevant Egyptian Social Legislations

Egyptian social legislation and regulations relevant to project have been reviewed. These include:

- Egyptian Constitution;
- Environment Law no 4 of 1994;
- Non-Governmental Organizations' Law and its executive regulations;
- Law no 94 of 2003 on establishing the National Council for Human rights; and
- Labour Law no 12 of 2003.

The Egyptian social legislation and regulations have been reviewed. Main relevant issues were identified as follows:

- impact assessment of natural and socio cultural resources and accountability;
- public participation and consultation;
- disclosure, accessibility of information and transparency;
- grievance and facilitation of community's concerns;
- inclusivity of vulnerable groups; and
- sustainability, other less relevant issues were also identified, but briefly discussed

Impact assessment of natural and socio-cultural resources and accountability is required for all development projects in the three sets of regulations and guidance reviewed.

Social Management Systems (SMS) as well as alternative social plans are not addressed in either the Egyptian Environment Law nor in EU Directives and guidelines.

Public participation and consultation through engaging of community based stakeholders, Government ministries and agencies, and international and national NGOs are explicitly addressed in Egyptian Environment Law and it is mandatory by law especially for large sensitive infrastructure and wastewater projects.

EU regulations emphasize that public participation and consultation should be undertaken with affected communities whereby concerned people are given the opportunity to express an opinion before the project is initiated and subsequently, the Project Sponsor should consider and respond to comments received.

5 Environmental and Social Baseline Conditions

This section describes the baseline environment at and around the site of Alexandria West WWTP from a social and environmental basis. The establishment of site and surrounding conditions is an essential element of the assessment process as it allows subsequently the prediction of impacts on that baseline to be undertaken.

The following sections present and describe the site environment and baseline information in terms of the physical, biological and socio-economic environment and conditions.

Knowing the nature of the surrounding environment and the inhabitant's response to the new project construction and operation will assist in evaluating the negative environmental impacts on the surrounding nature as well as the project itself. The following sections will describe the surrounding environment.

5.1 Physical Environment

Information relating to the existing site environment and baseline conditions has been collected from a variety sources and reviewed, summarized as follows:

- published reports from previous studies on the conceptual design of WWTP and the assessment of Alexandria West WWTP;
- public domain information (e.g. relevant websites);
- several site visits and investigations performed during the course of this study; and
- interviews with relevant authorities such as the Alexandria Wastewater Company and the Construction Authority of Potable Water and Wastewater Projects (CAPW).

5.1.1 Topography

The site of the Alexandria West WWTP is considerably flat site with no variation in the level more than 2 meters. The level of the site is almost 1.0 m above the water level in the discharge canal and in the surrounding drains. Within the course of the current feasibility study a detailed site topographic survey has been performed. The details of the site survey can be found in the Topographic Site Survey Report. **Figure 15** indicates some elevations within the WWTP site.

Figure 15: Spot levels in the WWTP site from topographical survey

5.1.2 Geology

Within the course of the current feasibility study detailed soil investigations has been performed. Details of the soil investigation can be found in the Preliminary Geotechnical Report for Site Investigation and Geotechnical Recommendations Report issued May 2018. Bore holes up to a depth of 40m has been performed within the site with mechanical drilling. The geological profile consists of very large thick deposits (up to 30 m depth) from coastal sand with considerable content of silt and clay. Due to the considerable number of open water bodies within the site (open drains and lake Maryout) and the high level of ground water which is connected with these surface water bodies, the soil is very loose. This may lead to special precaution in the design of the foundations of the upgrade and extension structures.

The soil within the WWTP site and its surroundings is alluvial-clayey soil, similar to the rest of the delta, which is formed from sediments deposited by the River Nile during the annual floods. Fill soils are observed as fill layer in all boreholes to depth of 2.5-3.0 m. Soft to medium sand is encountered to depth ranges from 2.5-6.0m. Medium fine sand is observed from depth 6.0m to 15.0 m. Stiff to very stiff clay is observed from depth of 15 to 21m. Medium to fine sand is then observed from depth of 21 m to 30-35m depth. Below 35.0 m, very stiff to hard clay is observed.

The seismic investigations performed by NARSS identified the site to be located in a second degree earthquake zone (on the National Egyptian Seismic Map where most of the earthquakes in the area are within the range of 3-6.5 on the Richter scale. Structural design of each structure should therefore take this into consideration, and deep pile foundation with soil replacement below footings are recommended for all major structures.

5.1.3 Climate and Meteorology

The mean annual water temperature in Alexandria Governorate is 25.8 °C which is higher by 4-5 °C than most westerly shores of the North African Mediterranean. The mean monthly temperatures of the surface water ranges between 10°C in February and 30 °C in August. In general, water temperature off the Egyptian coast of the Mediterranean is generally considered warm to moderately cold.

Significant rainfall only occurs during the winter season. The annual rainfall at the coast varies from about 110 mm to 190 mm.

Mean annual values of wind speed are homogenous through the region with small increasing trend from west to east according to the annual wind rose recorded at Alexandria Airport weather station. Surface wind system over north-west Egypt is from north-north west direction at the coast with a deviation to a more north to north-east direction further inland. Winds in the project area are generally light, and the prevailing direction is northwest. The area is subject during spring months to the Khamasien hot storms, which blow from the southeast. Winds blow strongly during winter and early spring with an average velocity of about 20-23 km/hr. The end of summer is characterized by many calm days where the average wind speed drops to less than 15 km/hr.

Tidal amplitude at Egyptian coast of the Mediterranean is generally very small or almost negligible, fluctuating between 20 cm and 40 cm.

Relative humidity: The monthly mean relative humidity is usually higher in summer than in winter. It ranges between 51% in November at Dekheila to 73% in July at Alexandria Airport weather station. The variations of relative humidity along the western coast of Egypt are generally small.

Evapotranspiration: This climatic element plays an important role in the amount of recharge of ground water aquifers as well as groundwater quality. The distribution map of evapotranspiration shows it attains maximum values towards the south as the temperature becomes higher. This, in turn indicates that the climatic aridity increases rapidly from the coast southwards.

Month	Average Minimum Temperature (^{o}C)	Average Maximum Temperature (^{o}C)	Average Monthly Rainfall (mm)	Average Number of Rain Days	Potential Evaporation (mm)
Jan	9.0	18.9	5.0	3.5	22
Feb	9.7	20.4	3.8	2.7	26
Mar	11.6	23.5	3.8	1.9	48

Apr	14.6	28.3	1.1	0.9	82
May	17.7	32.0	0.5	0.5	142
June	20.1	33.9	0.1	0.1	168
July	22.0	34.7	0	0	184
Aug	22.1	34.2	0	0	173
Sep	20.5	32.6	0	0	136
Oct	17.4	29.2	0.7	0.5	61
Nov	14.1	24.8	3.8	1.3	61
Dec	10.4	20.3	5.9	2.8	23

Table 16 is providing a meteorological profile around Alexandria West WWTP.

Month	Average Minimum Temperature (°C)	Average Maximum Temperature (°C)	Average Monthly Rainfall (mm)	Average Number of Rain Days	Potential Evaporation (mm)
Jan	9.0	18.9	5.0	3.5	22
Feb	9.7	20.4	3.8	2.7	26
Mar	11.6	23.5	3.8	1.9	48
Apr	14.6	28.3	1.1	0.9	82
May	17.7	32.0	0.5	0.5	142
June	20.1	33.9	0.1	0.1	168
July	22.0	34.7	0	0	184
Aug	22.1	34.2	0	0	173
Sep	20.5	32.6	0	0	136
Oct	17.4	29.2	0.7	0.5	61
Nov	14.1	24.8	3.8	1.3	61
Dec	10.4	20.3	5.9	2.8	23

Table 16: Temperature and other meteorological profile of Alexandria West WWTP area

5.1.4 Water Resources

Surface Water Resources

The surface water available within the site surroundings of the WWTP are represented by the El-Qalaa drain which carries the effluent of the East WWTP recently upgraded from primary treatment to secondary treatment and El-Omoum drain that carries the agricultural drainage and wastewater drainage of major parts in Alexandria Governorate as well as Behaira Governorate. Both El-Qalaa and El-Omoum drains discharge into Lake Mariout and ultimately to the Mediterranean Sea via El-Max drainage pumping station. Both El-Qalaa and El-Omoum drains are very heavily polluted from industrial effluents, domestic effluent as well as agricultural effluents.

Marine water

Marine water exists around the WWTP site represented by Lake Maryout and the Mediterranean Sea. Further information on Lake Maryout are provided in Chapter 5.2.1.

Groundwater

The groundwater around the WWTP site comes from seepage from the drains as well as Lake Maryout and the Mediterranean Sea. The quality of the groundwater within the site is high polluted saline water.

From the soil investigation performed within the course of the FS of the project, groundwater table was encountered within the site at the ground level. Chemical analysis shows the chemical characteristics of the groundwater. TDS is 1900 ppm (Sodium Carbonate 240 ppm, Sodium Chloride 870 ppm and Sulphur Trioxide 630 ppm). The results of the chemical analysis show that the groundwater is moderately aggressive.

Agricultural Drains

Agricultural drains are represented by El-Qalaa and El-Omoum drains as already introduced in the section of 'Surface Water' before.

Figure 16 is providing a layout of surface water bodies around the WWTP site.

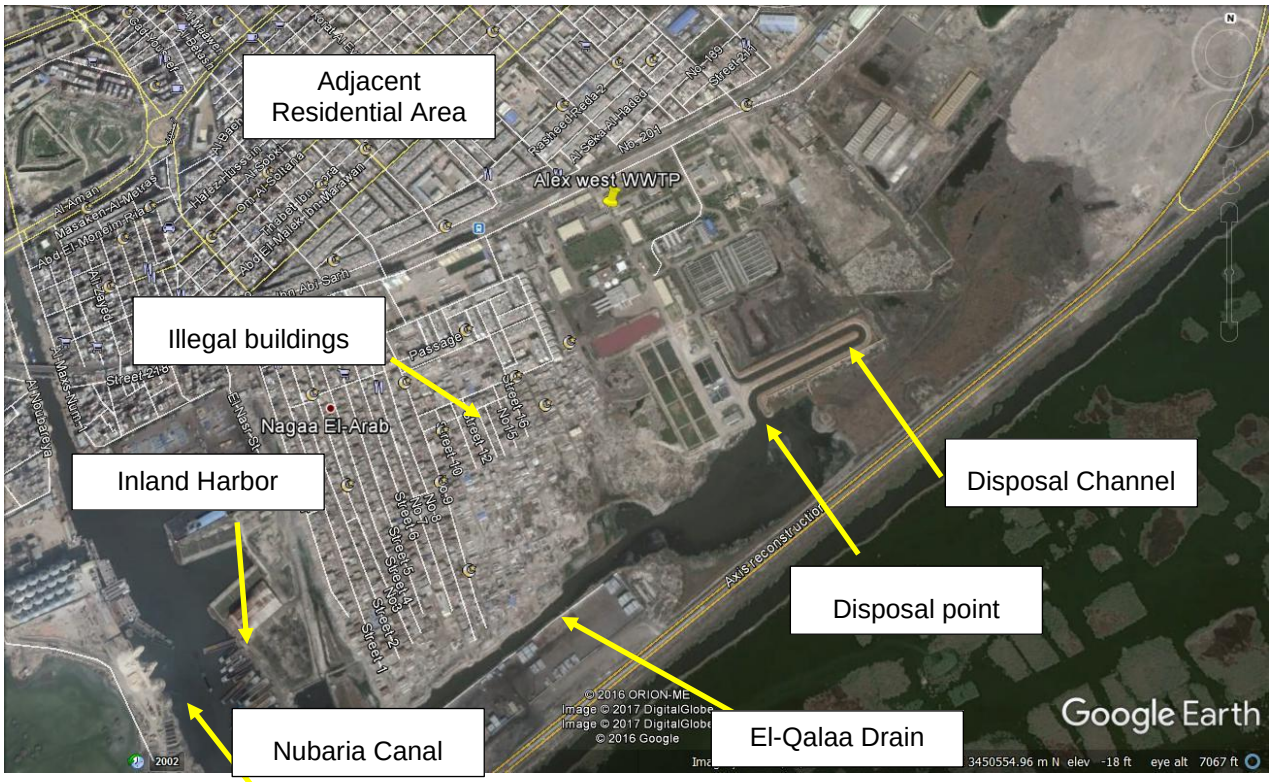

Figure 16: Alexandria West WWTP – layout of surface water bodies surroundings

5.1.5 Air Quality

No data on air quality within the region of the WWTP location and its surroundings are available. From time to time, due to sand storms and the movement of heavy construction equipment and trucks, some temporary deterioration in air quality will occur. Air quality is however likely to be good due to the absence of any significant sources of air pollution in the vicinity.

5.1.6 Noise and Vibration

No data on noise and vibration within the WWTP site are available. Minor noise may occur in the site due to the movement of heavy equipment on the road south of the drain. However, their effect shall be negligible. No major source of noise and vibration in the vicinity of the site could be detected.

5.1.7 Risks and Hazards within the WWTP Site

No major risks or hazards exist within the site of the WWTP.

5.2 Biological Environment

5.2.1 Flora, Fauna, Habitats

Due to its long term use as WWTP site the area has been significantly degraded. No important and significant species of fauna has been noticed or recognized in the WWTP area during site visits. The usual rodents, cats, dogs, etc. have been noticed in the surrounding environment.

Major flora noticed within the site area is the aquatic weed infestations within the surrounding area. Many, up to 11 species of aquatic weeds are detected and recorded within the Lake Maryout area mainly consisting of floating, submerged, and emerged weeds. (Source: Drainage Research Institute DRI Environmental Survey of Lake Maryout 2005).

The floating weed Eichhorniaa crassipes was scattered frequently along the drain especially near the stagnant zone. The biomass of the submerged species was low because of the high turbidity of the water, which represented by low transparency. The total submerged standing crop made up 5 species (Potamogeton pectinatus, P. nodosus, P. crispus, Najas armata and Myriophyllum spicatum). Concerning the emerged weeds, the total standing crop made up 5 species (Cyperus articulatus, C. alopecuroides, Pragmites australis, Echinocloa stagninum and Conyza dioscoridis) (Source: Drainage Research Institute DRI Environmental Survey of Lake Maryout 2005).

5.2.1 Lake Maryout Ecological System

Maryout lake is large shallow lake (24 Km long and 2 Km wide) located at South Western of Alexandria. The water level is maintained at 2.8 m below sea level by a pumping station at El-Max, which constitutes the only outflow to the Mediterranean Sea. This lake receives two different types of input water: (1) the main fresh water inflows are through the Nubaria Canal and (2) drainage water from two main drains are the El-Omoum and Qalaa drains. Several sources of domestic and industrial wastewater are dumped into the lake either directly or indirectly through the drains. Within the current of work, it hard to estimate the aquatic weed infested areas and their infested percentage because it hard to monitor the lake by observations.

To estimate the areas of aquatic weed infestations exactly along the lake (GPS) technology and (GIS) are recommended. However, the lake is characterized by its swampy condition. This notable feature provides an existence to certain community of weeds that resist fluctuation of light intensity and both water and sediment compositions especially in the presence of intensive external nutrient loading. Moreover, the shallowness of the lake causes limitation to the distribution of the aquatic weeds in certain zones and creates a dense weed cover in another zone.

Based on the observation, the most common associated swampy emerged weeds are Phragmites australis, Typha domingensis, Paspalum distichum and Echinocloa stgnium and submerged weeds are Ceratophylum demersum, Najas armata and Myriophyllum spicatum. The floating weed, Eichhorniaa crassipes is also detected along the lake where it establishes near the shoreline as well as within the shallow and stagnant water of the lake. Concerning the two main drains, the El-Omoum and Qalaa, monitoring the aquatic weeds along them indicated that those drains were slightly infested by different type of aquatic weeds (floating, submerged and emerged weeds). The percentage of emerged weed infestations along the drains was low and ranged between 2 and 10% and their common prevailing types were Typha domingensis, Echinocloa stgnium, Phrgmites australis, Cyperus alpecuroids and polygonum salicifolium. (Source: Drainage Research Institute DRI Environmental Survey of Lake Maryout 2005)

The percentage of submerged weed infestations ranged between 0 and 1% and their common prevailing types were Potamogeton nodosus, and Myriophyllum spicatum that especially located near the villages. Also, the floating weed, Eichhorniaa crassipes was detected in few patches and a lot of them were seen drifting with the water current.

5.3 Socio-economic Conditions

The surrounding environment around the Alexandria West WWTP consists of residential area of approximately 45,000 capita. The inhabitants are mostly fishermen, workers and some small scale sellers. The distance between the WWTP and the Mediterranean coast is about 1,800-2,000 meters. The area is characterized as low income, low education area with moderate infrastructures and public services. The area has moderate sewage services and all the houses discharge their sewage waste directly or indirectly to the streams either upstream or downstream the WWTP.

Within the premises of the WWTP, illegal settlements and buildings have been constructed in the past few years since 2011. According to the national standards of census and statistics published in 2016 , these illegal settlements and buildings are characterized by low income and modest social pattern. Most of the inhabitants are not educated or have basic education and work on temporary basis in unstable moderate works. Although actions have been initiated to more and relocate these inhabitants in new areas, it is not planned to include this into the project scope since the re-settlement is against the EIB policy. This task shall be left to government of Egypt GoE efforts in the future.

On the west side of the El-Omoum Drain, the El-Qalaa Harbour exists which receives significant volume of trade and goods from abroad, for example about 60% of the imported wheat to Egypt. Also it contains 4 new silos constructed for strategic storage of wheat and 4 numbers of silos are also being constructed). The harbour is currently affected by the low quality of water that is drained from the WWTPs (East and West) as

well as the original drain water. The harbour is affected also by the effluent as it causes disturbance to the barges and ships that uses the docking facilities in the harbour.

5.3.1 Population Profile

5.3.2 General Social

According to the national standards of census and statistics published in 2016 , the illegal settlements and buildings are characterized by low income and modest social pattern. Most of the inhabitants are not educated or have basic education and work on temporary basis in unstable moderate works.

5.3.3 Economic Profile Activities and Livelihoods

The inhabitants are mostly fishermen, workers, and some small scale sellers with an average annual income ranging between 4,000 to 6,000 EGP.

5.3.4 Water Supply Service

Steady water supply is available to the surrounding environment of the WWTP through public water networks from the Alexandria Water Company. However, some squatter areas are supplied from shallow wells.

5.3.5 Sanitation Services

The area has moderate sewage services and all the houses discharge their sewage directly or indirectly to the streams either upstream or downstream the WWTP.

5.3.6 Infrastructure Services

Other infrastructure services such as public moderate paved roads, telephone services, etc. are available in the surrounding area of the WWTP from the north side.

No records are available for the infrastructure services for the illegal buildings and settlements within the WWTP premises.

5.3.7 Human Health

No records are available for the general human health within the WWTP area. However, no records for major epidemic diseases are spread within the area.

5.3.8 Education

In the North surrounding area of the WWTP live mainly fishermen, workers, and some small scale sellers who may have some education. However, no record for the inhabitants in the illegal buildings within WWTP premises.

5.3.9 Antiquities and Sites of Cultural and Historical Importance

Within the site of the WWTP, no records of cultural and historical sites are available. However, many historical sites are available in Alexandria City itself several kilometres distance from the location of the WWTP.

6 Outcome of the Public Participation and Stakeholder Engagement Process

Both Egyptian legislation and EIB safeguards state clearly that public and stakeholder engagement is mandatory to give the opportunity to the public, stakeholders and surrounding community to collect information about the project and allowing to express their opinion. The outcomes of the PCM may sometimes lead to signification modifications to the project design, location, use of technologies, etc. to consider the community needs and concerns.

6.1 Methodology

To achieve this issue, the Consultant arranged and planned a Public Consultation Meeting; the following actions have been performed.

Invitation letters have been sent out to all stakeholders, including the civil community and local residents' representatives, as well as relevant governmental departments including EEAA, Local Departments of the Ministry of Water Resources and Irrigation, Ministry of Agriculture and Land Reclamation and the Ministry of Health.

A presentation has been prepared to summarize ESIA methodology, expected impacts, corresponding mitigation measures and Environmental & Social Management Plan. Documentation of the PCM has been performed by attendance sheets for the participants and video recording which shall be submitted on DVD as attachment to the ESIA report. The attendance sheets are presented as **Annex 1.**

6.2 Organisation of Public Consultation

The PCM has been held on Tuesday 29 May 2018 in the Alexandria Wastewater Company Headquarters. The meeting has been chaired by the Chairman of Alexandria Wastewater Company with the presence of: the Chairman advisor, design engineers, environmental engineer of the company as well as representatives of EEAA, MRWI, MOLAR, Ministry of Health and El-Qlaa Harbour Company.

6.3 Major Outcomes

The following points are the major and important comments and remarks raised by the stakeholders attending the PCM:

- Alexandria Wastewater Company (chairman and advisor) discussed the issue of the effluent and sludge reuse and insisted that the effluent must be reused in agricultural applications. They refused the effluent being disposed into Maryout Lake and eventually pumped and disposed to the Mediterranean Sea.

  The consultant's technical team has illustrated that, although the effluent reuse and sludge reuse are very important to be applied for many reasons such as resources utilization and environmental preservation, the required reuse scheme is beyond the scope of the current project and they should be proposed separately as an independent project. No further requirements have been raised from the Alexandria Wastewater Company side or the stakeholders.
- Alexandria Wastewater Company mentioned that the upgrade and extension project of Alexandria West WWTP should be extended to include the execution of the reuse application scheme in irrigation for the effluents from East and West WWTPs (Alternatives 1, 2 or 3) as discussed in section 3.5 in the current report.

  It was agreed that this needed to be addressed as a matter of priority but was outside the scope of the current investment project. According to the terms of reference for the project, options for reuse were to be studied but were not included in the scope of the investment. It was agreed that there was not detriment in considering the reuse as a separate project due to funding requirement. No further comments have been raised.
- Alexandria Wastewater Company also requested the design consultant to review the feasibility of the sludge digesters (especially in view to experience collected from Gabal El-Asfar WWTP) before proposing it into the upgrade and extension design.

  This was agreed and has been done. The economic assessment confirms that under the current economic climate and projected electricity tariffs, digesters and energy recovery is justified and viable. No further requirements have been raised from the Alexandria Wastewater Company side.

- Mitigation measure for odour control from the proposed treatment units should be applied since new residential buildings are being constructed within 100 m from the WWTP site. The design consultant has illustrated that the primary treatment and secondary treatment units usually do not produce odour. Odour usually comes from the inlet works which shall be equipped with odour control mechanisms in the upgrade and extension.

  The consultant's technical team has clearly stated that odour control measures shall be included in the detailed design including the Inlet Works and all areas dealing with primary sludge. No further comment has been raised from the EEAA's representative side.
- The representative of El-Qlaa Harbour discussed the issue of the current disposal location and future disposal location of the effluent. The current effluent disposal location causes disturbance to the barges and ships that navigate and use the inland harbour through the last reach of Nubaria Canal. It has been requested taking into consideration the navigation passage and docking facilities inland harbour when selecting the location of the effluent disposal after the upgrade and extension.

  In response, it was confirmed that the final design will consider the outfall from the WWTP to the lake to ensure that it had adequate capacity and did not cause hydraulic problems. The consultant's technical team has requested from El-Qalaa Harbour's representative to provide the master plan of the harbour to consider it during the selection of the effluent disposal and to perform the required studies including hydrodynamic modelling if required. No further requirements have been raised from Al-Qalaa Harbour's representative.
- Al-Qalaa Harbour representative requested also restoration and reshaping the last reach of El-Qalaa Drain to its design cross section.

  The consultant's technical team as well as Alexandria Wastewater Company engineers replied that this wide area shall be used for future upgrade and extension anyway and that it would be upgraded. No further comment has been raised from Al-Qalaa Harbour's representative.
- The EEAA Representative explained that, according to their regulations, the ESIA shall be presented for approval in Arabic. The Consultant explained that this was the scoping PCM and confirmed that the final ESIA will be presented in Arabic. This was accepted by the EEAA Representative.

7 Impact Identification and Analysis

This section of the ESIA (ESIA) sets out the approach and methodology and identifies the potential environmental impacts of the proposed project. The potential environmental impacts have been separated into those occurring during the construction phase and those occurring during the operational and maintenance phase.

As the project is at concept design stage, the environmental assessment of impacts in this ESIA has focused on potential impacts only and, where appropriate, identifies the need for further assessment during the detailed design stage and preparation of the final ESIA. Impact assessment here is qualitative throughout and aims to identify the potential for an impact to allow subsequent quantitative analysis once detailed design has commenced.

The report is ensuring that no major and or serious negative impact shall be associated with the project construction/implementation/operation and maintenance. The overall environmental and social impacts shall be positive from operation of the project.

7.1 Impact Significance Assessment

There will be primarily localised short-term impacts during the construction phase due to the implementation of the WWTP.

The overall significance of impacts has been determined by combining the perceived 'Likelihood of occurrence' of the source of the impact in combination with the corresponding impact 'Consequence' describing the severity of the impact as indicated in **Table 17**.

Other potential classification factors (positive-negative; extent, duration and/or timing) have been excluded considering the conditions described before (impacts > localised > primarily construction phase).

Impact criterion	Effect on environment	Classification of effect	
		Expression	Effect description
Likelihood of occurrence	What certainty of occurrence is associated with impact?	Unlikely	Probably will not occur
		Likely	May occur
		Certain	Will occur
Consequence	How severe the impact will be?	Marginal	Little impact
		Critical	Moderate impact
		Severe	High impact
Significance	How important is impact in Project design?	Low	Impact of little importance, needs limited mitigation
		Medium	Impact has influence and requires mitigation
		High	Impact of great importance, mitigation a must
Spatial influence	How the impact shall be extended spatially?	Local	Within the site premises
		Regional	Within the surrounding area of the project
		Global	Extends beyond the surrounding area
Temporal influence	How the impact shall extend over time?	Short term	The impact shall last short period of time
		Medium term	The impact shall last medium period of time
		permeant	The impact shall be permeant

Reversibility	Does the influence of the impact can be removed once the impact end or the influence will remain?	Reversible	The influence of the impact can be reversed
		Irreversible	The influence of the impact cannot be reversed and shall be permanent

Table 17: Significance of impacts

7.2 Potential Impacts during WWTP Construction Phase

Since no detailed design information or construction plans are available at the present time, the following section has been based upon initial concept design information as prepared by the Consultant, and on consultant's professional experience of similar construction projects of a similar magnitude.

No details are as yet available as to the construction methodologies to be used, the duration of works, the number of plant required on site at any one time or the numbers of people involved. Construction works of this type however are fairly standard and as such subsequent prediction of impacts is possible based on the in-country experience of the consultant's team.

Given the scale of the proposed development and based upon Consultant's past experience, the construction phase is envisaged to extend over period of 18 to 24 months. Deep piling is anticipated, with the proposed development requiring deep foundations due to the loose soil in the WWTP location. A concrete batching plant would be located on-site for the duration of the construction phase, and a temporary area adjacent to the site would be required for material and plant storage.

It is anticipated that the proposed development would employ in the region about 500 workers during the construction phase, none of which would reside on site during this period. Delivery of all construction material, plant and equipment will be via the existing Ring Road highway (Mehwar El-Tameer) and local service roads. While the site is approximately level, excavations and ground levelling will be required. As noted below, the proposed upgrade and extension shall be within the same footprint of the existing Alexandria West WWTP. However, due to existence of illegal settlements on part of the land assigned to Alexandria West WWTP, adjacent piece of land (approximately 22 Feddans) shall be assigned to the area of the WWTP to avoid re-location of the illegal settlements.

7.2.1 Physical Environment

Air Quality , Dust and Emissions

Air pollution is likely to be the most significant potential environmental impact during the construction phase. On-site vehicles (lorry, excavators, earth moving machines) will result in the generation of dust and fugitive emissions. Dust emissions are likely to be high due to the prevailing arid climate and the clayey soil within the WWTP site.

Significance of this impact will depend on a number of factors, such as the type of activities taking place, wind speed and location of adjacent properties in relation to the construction site.

This could result in an adverse impact on the working conditions of workers on the site as well as those working adjacent to the construction site. However, this dust and emission impact is not likely to extend to the surrounding residential areas since these areas are located within 100m or more from the proposed construction site in the WWTP site. The affected receptors shall only be the workers within the site.

Due to the relatively moderate number of vehicles trips (anticipated during construction period) on the surrounding roads connecting the WWTP site with relative current traffic volume, the generated dust and emission shall only be during their motion and shall disappear within minutes after occurrence. Therefore, the impact will be low, short-term and local. The potential impact of air pollution by fugitive emissions and dust can be considered the same for the temporary work areas that will be required during the construction phase.

The scale of these impacts will be assessed in detail in the final ESIA, once further details on the construction activities are known. **Table 18** is summarising the expected impact significance of air quality, dust and emissions.

Phase	**Construction Phase**		
Impact	**Air Quality, Dust and Emission**		
Impact criterion	**Effect on environment**	**Classification of effect**	
		Expression	**Effect description**
Likelihood of occurrence	Dust and emission from construction activities and equipment shall affect the work environment within the WWTP site Dust and emission from moving vehicles on surrounding roads shall affect surrounding residential area	Certain	Will occur
Consequence	Affect work environment and workers' health in the construction site Affect human in surrounding areas	Critical	Moderate impact
Significance	Mitigation and good site management shall be needed	High	Impact of great importance, mitigation a must
Spatial influence	The influence of the impact shall be contained within the construction site and shall not extend beyond the surrounding areas	Local	Within the site premises
Temporal influence	The influence of the impact shall be short term and ends once the construction/excavation ends The influence of the impact shall be short term and ends once the construction vehicles pass the road	Short term	The impact shall last short period of time
Reversibility	Air Quality of the site and its surroundings shall return to normal condition once construction activities end.	Reversible	The influence of the impact can be reversed

Table 18: Impact of dust and emission on air quality during construction phase

Noise

During the construction phase, activities on site and traffic movements (lorry, excavators, earth moving machines) will result in the generation of noise impacts. Due to the relatively small number of vehicles that are anticipated during construction relative to the current traffic volume on the service road and near-by highway and the lack of nearby receptors, the impact of any environmental noise generated is expected to be low, short term and local. The potential noise impact will be the same in the temporary work areas that will be required during the construction phase.

The scale of these impacts will be assessed in detail in the final ESIA, once further details on the construction activities are known.

The site preparation activities such as earth moving, site excavation, transportation of equipment and materials to and from the site through the surrounding road network and the WWTP construction works will contribute to the generation of noise that would impact adjacent facilities and local communities. However, noise exceedances from the construction vehicles, machinery and equipment will be limited to the construction period and will be of short-term.

It is likely that some construction activities may overlap and cause increased noise nuisance.

Egyptian allowable noise limits are presented in **Table 19**. While, the noise levels of construction equipment and machinery listed in **Table 20** are likely to exceed the noise allowable limits mainly at trenching locations.

This may cause noise disturbances to local users and identified sensitive receptors such as schools, mosques, medical clinics etc. only during daytime construction hours. The recorded levels, though, are known to decrease with distance from the sources.

TYPE OF AREA	PERMISSIBLE LIMIT FOR NOISE INTENSITY DECIBEL (a)					
	DAY		EVENING		NIGHT	
	From	To	From	To	From	To
Commercial, administrative and downtown areas	55	65	50	60	45	55
Residential areas in which can be found some workshops or commercial establishments or which are located on a main road	50	60	45	55	40	50
Residential areas in the city	45	55	40	50	35	45
Residential suburbs with low traffic	40	50	35	45	30	40
Residential rural areas, hospitals and gardens	35	45	30	40	25	35
Industrial areas (heavy industries)	60	70	55	65	50	60

Table 19: Egyptian Noise Limits as imposed by Law 4/1994

Typical construction equipment	Average of typical noise level generated (dB)
Asphalt pavers	101
Rollers (compactors)	90
Scrappers	96
Trenchers	121
Excavators	87
Graders	<85
Front end loaders	88
Bulldozers	96
Heavy trucks	86
Forklifts	89
Jack-hammer	100
Cranes	100
Bob-cat	93
Saws	88
Water tankers	71
Power generators	<85

Table 20: Average noise levels generated by potential machineries used on site

Source: Workers compensation Board of British Columbia, 2000 (BS 5228: 1997 Noise and Vibration Control on Construction and Open Sites)

The construction contractor will take into consideration all nearby sensitive receptors identified with any other additional receptors identified by the contractor on site such as schools, mosques, medical clinics, churches, etc. and will try to schedule the more noise-intense activities for less intrusive times such as midmorning or afternoon to avoid complaints and potential annoyance to people living or working adjacent to the construction site.

Construction activities will occur under normal operating conditions, and is expected to have a localized effect with repeated breaches of statutory or prescribed limits mainly causing noise impacts within the neighbourhoods.

As the impact consequence is Critical and likelihood is Certain, the impact significance is assessed as High. **Table 21** is summarising the expected impact significance of noise during construction phase.

Phase	**Construction Phase**		
Impact	**Noise on Air Quality and on surrounding receptors**		
Impact criterion	**Effect on environment**	**Classification of effect**	
		Expression	**Effect description**
Likelihood of occurrence	Noise from construction activities and equipment shall affect the work environment within the WWTP site Noise from moving vehicles on surrounding roads shall affect surrounding residential area	Certain	Will occur
Consequence	Affect work environment and workers' health in the construction site Affect human health in surrounding areas	Critical	Moderate impact
Significance	Mitigation and good site management shall be needed	High	Impact of great importance, mitigation a must
Spatial influence	The influence of the impact shall be contained within the construction site and shall not extend beyond the surrounding areas	Local	Within the site premises
Temporal influence	The influence of the impact shall be short term and ends once the construction/excavation ends The influence of the impact shall be short term and ends once the construction vehicles pass the road	Short term	The impact shall last short period of time
Reversibility	Air Quality of the site and its surroundings shall return to normal condition once construction activities end.	Reversible	The influence of the impact can be reversed

Table 21: Impact of noise on air quality during construction phase

Land and Soil

Construction works of the Alexandria West WWTP can have an impact on soil and geology through soil compaction, soil sealing, and the excavation of soft sediments and virgin soil. During the construction period the soil will be excavated and stored within the construction site boundary. The soil on the proposed site is clayey soil and has low sensitivity to compaction.

Geology on the site has not been identified as having any particular value. All soils removed and stored during the construction phase should be handled in accordance with best practice. The potential impact on soil as a result of soil compaction, excavation, loosening, filling and sealing is considered to be low, short term and local. The potential impact will be the same in the temporary work areas that will be required during the construction phase.

Soil pollution may occur by from accidental leakage of chemicals, fuel or oil products from construction equipment or moving vehicles.

Phase	**Construction Phase**		
Impact	**Land and Soil**		
Impact criterion	**Effect on environment**	**Classification of effect**	
		Expression	**Effect description**
Likelihood of occurrence	Soil disturbance due to excavation and construction works Soil pollution from construction equipment and construction vehicles within the site	Certain	Will occur
Consequence	Soil disturbance, potential compaction and settlement, effect on surrounding adjacent buildings Surface soil pollution and consequently surface water pollution and groundwater pollution	Critical	Moderate impact
Significance	Mitigation and good site management shall be needed	High	Impact of great importance, mitigation a must
Spatial influence	The influence of the impact shall be contained within the construction site and shall not extend beyond the surrounding areas	Local	Within the site premises
Temporal influence	The influence of the impact shall be permeant	Permeant	The impact shall be permeant
Reversibility	Impact of construction activities on soil is irreversible	Irreversible	The influence of the impact cannot be reversed

Table 22: Impact on soil and land during construction phase

Water Resources

Construction works shall have significant impact on the open surface water resources within the site (Nubaria Canal – El-Omoum drain, El-Qalaa drain, effluent discharge channel, Lake Maryout and eventually the Mediterranean Sea) as well as on groundwater. Direct pollution from the work activities, construction camps and generated liquid waste from it, construction equipment as well as the pollution from the construction activities itself. Direct dispose to surface water may cause pollution while direct spills on ground surface can cause direct pollution to groundwater.

The open water sources that are highly subjected to pollution during construction shall be El-Qalaa drain as well as the effluent discharge channel of the WWTP.

Nubaria Lake, Lake Maryout, the Mediterranean Sea are distant from the construction activities and unlikely to be affected by the construction activities.
Groundwater pollution shall occur from direct spills on ground surface. The impact significance shall be Critical and High. However, with good management practice on site during construction activities potential risks can be minimised. **Table 23** is summarising the expected impact significance of water resources during construction phase.

Phase	Construction Phase		
Impact	Surface water and groundwater		
Impact criterion	Effect on environment	Classification of effect	
		Expression	Effect description
Likelihood of occurrence	Surface water pollution occurs due to construction activities Groundwater pollution occurs due to direct spill of waste on ground surface	Likely	May occur
Consequence	Pollution of surface water from construction activities may reach Lake Maryout and ultimately the Mediterranean Sea It may extend to the other locations and facilities (e.g. El-Max PS).	Critical	Moderate impact
Significance	Mitigation and good site management shall be needed	High	Impact of great importance, mitigation a must
Spatial influence	The influence of the impact shall be not be contained within the construction site and shall extend beyond the surrounding areas	regional	Extends beyond the surrounding area
Temporal influence	The influence of the impact shall be permeant	Medium term	The impact shall last medium period of time
Reversibility	Impact of construction activities on surface water is reversible Impact of construction activities on ground water is irreversible	reversible Irreversible	

Table 23: Impact on surface water and groundwater during construction phase

7.2.1.1 Climate and Atmosphere (climate check)

Baseline Criteria and Assumptions

Direct greenhouse gases are e.g. CO_2, CH_4 or N_2O, indirect greenhouse gases (GHG), amongst others, are SO_2 and NOx. For wastewater treatment, two major greenhouse gas emissions have to be considered: on the one hand the energy demand for the different processes and therefore the CO_2 emissions, and on the other hand CH_4 emissions resulting from anaerobic digestions. Yet, the emission of N_2O may also play an important role in the case of malfunction during the treatment processes. The following assumptions have been made:

- Emissions at the reference year 2050 for the relevant options 1, 1a, 2 and 3 are considered.
- All relevant facilities where the wastewater and sludge at the WWTP site is treated are considered in all options. While, emissions of the sludge transfer and/or further treatment at Site 9N are not considered.
- Power is exclusively sourced from the Egyptian electricity grid (no off-grid power plants).
- Recovered electrical energy will be re-used in the treatment processes, for example the heating of the digesters.
- The amount of produced methane in the anaerobic digesting process is not relevant if it will be transformed during ‘heated combustion’ (heating of digesters) of biogas to CO_2.
- Consideration of Nitrous Oxide (N_2O) is based on the population equivalents (PE) as calculated by the Consultant for the reference year 2050, here considered to be 4,000,000 PE.
- Generated sludge is considered largely inert due to the anaerobic digesting process.

Consideration of Carbon Dioxide

Following the UNFCCC[3], a conservative default value of 1.3 t CO_2/MWh has been applied for project power consumption sources versus the corresponding CO_2 generation.In this context, Option 2 would have a rather moderate CO_2 generation rate as indicated in **Table 24**.

	Current*	Option 1	Option 1a	Option 2	Option 3
Total energy demand (MWh/year)	20,250	83,319	79,487	80,188	83,804
Electrical energy recovery (MWh/year)	0	-67,478	0	-67,478	-67,478
Net energy demand (MWh/year)	20,250	15,842	79,487	12,711	16,326
CO_2 emission (t/year) for energy consumption	**-**	**20,594**	**103,333**	**16,524**	**21,224**

Table 24: Energy consumption and CO_2 generation in the reference year 2050

Source: Consultant, internal calculation, June 2018

Consideration of Methane

Methane has an enormous global warming potential since it is 21 times as effective as CO_2.

The possibility of gas utilization is provided when the produced excess sludge is anaerobically digested, resulting in the methane production to be processed into electrical and/or heat energy. This process enables a reduction of energy demand in terms of partial self-supply - thus reducing CO_2 emissions as shown in the previous chapter.

The digester captures biogas and utilizes the methane as a fuel for the treatment process. The energy can therefore be recovered.

Consideration of Nitrous Oxide

N_2O can be an intermediate product during nitrification and denitrification but is more often associated with denitrification. Approximately **7 grams N_2O** is generated per capita per year if wastewater treatment includes intentional nitrification and denitrification. Under the consideration of the Global Warming Potential of N_2O at 296 t CO_2 e/t N_2O[4] the associated generation is shown in **Table 25**.

With regard to sludge, Nitrous oxide emissions are assumed to be negligible for all project options, except Option 1 and need not be accounted for assuming that the sludge is:

- treated in an anaerobic digestion process and the residues from the anaerobic digester are dewatered before final disposal and/or reuse.
- dried/converted under controlled and aerobic conditions, and then disposed of and/or reused.

Comparison of GHG Emissions of Options

For comparison of results, the **global warming potential (GWP)** has to be considered. It is a measure of how much a given mass of GHG is estimated to contribute to global warming. Carbon dioxide has a GWP of exactly 1, since it is the baseline unit to which all other greenhouse gases are compared. The GWP of methane is 21 and that of Nitrous N_2O oxide even 296. The determined CH_4 has been converted to the CO_2 equivalent to allow for direct comparison of the values.

In this context Option 2 has the lowest global warming potential generating a total of 16,619 tons CO_2e emission in the reference year 2050.

[3] - UNFCCC: Tool to calculate baseline, project and/or leakage emissions from electricity consumption., p.4

[4] - UNFCCC (2009): Approved baseline and monitoring methodology AM0080 “Mitigation of greenhouse gases emissions with treatment of wastewater in aerobic wastewater treatment plants”; www.cdm.unfccc.int

	Option 1	Option 1a	Option 2	Option 3
CO_2 emission for energy demand	108.315	103.333	104.245	108.945
CO_2 emission reduction by gas utilisation	87.721	0	87.721	87.721
CO_2 equivalent for Dinitrous Oxide	95	95	95	95
TOTAL CO_2e emission (t/year)	**20.689**	**103.428**	**16.619**	**21.319**

Table 25: Total CO_2 equivalent emission in t/year in the reference year 2050

Source: Consultant, internal calculation, June 2018

Waste Generation and Disposal

The following wastes are likely to be generated at the site:

- Clearance and excavation wastes: removal of soils, inert construction materials residues and spoil.
- General construction wastes: reject and excess material, drainage from wastewater and site run-off, containers.
- Hazardous wastes: spillages from construction equipment.
- Other wastes: from offices, food preparation wastes and sanitation

The volume of these wastes, and how they will be addressed, will be determined during the detailed design stage but it is envisaged that the impact will be no more than low, short term and local. **Table 26** is summarising the expected impact significance of water resources during construction phase.

Phase	**Construction Phase**		
Impact	**Waste Generation and Disposal**		
Impact criterion	**Effect on environment**	**Classification of effect**	
		Expression	**Effect description**
Likelihood of occurrence	Improper management of hazardous and non-hazardous waste generated at site	Likely	May occur
Consequence	Impact on soil, water and visual environment and health and safety of construction workers and public	Critical	Moderate impact
Significance	Mitigation and good site management shall be needed	High	Impact of great importance, mitigation a must
Spatial influence	The influence of the impact shall be contained within the construction site and shall not extend beyond the surrounding areas	Local	Within the site premises
Temporal influence	The influence of the impact shall be short term and ends once the construction/excavation ends	Short term	The impact shall last short period of time
Reversibility	Air Quality of the site and its surroundings shall return to normal condition once construction activities end.	Reversible	The influence of the impact can be reversed

Table 26: Impact of waste generation and disposal during construction phase

Material Assets and Infrastructures within the WWTP Site and Surroundings

Within the proposed WWTP site there are a number of material assets, including paved roads, electricity cables, infrastructure facilities (water networks, sewage networks), etc. The impact on these assets can be negative, for example if the project results in the damage to these assets from construction traffic, or it can

be positive, for example if these assets are reconstructed to higher specifications following the construction period. The extent of the impact on these assets will be determined in the detailed design stage, but are likely to be low, short term and local.

The construction activities shall not have any significant impact on the infrastructures facilities and material assets outside the premises of the WWTP. Traffic of the construction equipment and material moving trucks shall have minor impact of the quality of the paved roads in the surrounding area of the site. The expected impact of the construction activities shall be very minor and can be negligible.

The impact of the construction activities on the assets and infrastructures within the WWTP site shall be significant; however most of these assets and infrastructures shall be rehabilitated or re-constructed with the upgrade and extension process.

Construction activities shall also include cut and removal of some trees and shrubs in the empty land within the WWTP site. These trees and shrubs are few (from the site visits observations) and have no significant value. So the impact shall be insignificant.

Phase	**Construction Phase**		
Impact	**Material Assets and Infrastructures Facilities**		
Impact criterion	**Effect on environment**	**Classification of effect**	
		Expression	**Effect description**
Likelihood of occurrence	Effect on material assets and infrastructures facilities in surrounding areas Effect on material assets and infrastructures in the WWTP site itself	Unlikely	Probably will not occur
Consequence	No significant impact is expected	Marginal	Little impact
Significance	Mitigation and good site management shall be needed	Low	Impact of little importance, needs limited mitigation
Spatial influence	The influence of the impact shall be contained within the construction site	Local	Within the site premises
Temporal influence	The influence of the impact shall last along the construction period and end with the end of the construction activities	Medium term	The impact shall last medium period of time
Reversibility	Impact of construction activities on material assets and infrastructure facilities	Irreversible	

Table 27: Impact on material assets and infrastructure facilities during construction phase

Cultural Heritage and Archaeological Sites within the WWTP Site and Surroundings

There is no record of the existence of cultural heritage or archaeological sites in or adjacent to the site area, therefore, it is predicted at this stage that the proposed project will have no impact on archaeological, historical and cultural sites.

7.2.2 Biological Environment

Flora, Fauna, Habitats

No flora or fauna has been identified during site visits to the proposed WWTP site. While not seen during the site visit, the fauna that may be present or near to the site may include wild dogs, rats, cats, desert foxes and birds.

None of the species that may be present on or around the site are protected or endangered. As a result, it is considered that the potential impact of the project during the construction phase on flora and fauna will be none, short-term and local. The potential impact will be the same in the temporary work areas that will be

required during the construction phase. **Table 28** is summarising the expected impact significance on flora and fauna during construction phase.

Phase	**Construction Phase**		
Impact	**Fauna and Flora**		
Impact criterion	**Effect on environment**	**Classification of effect**	
		Expression	**Effect description**
Likelihood of occurrence	No existence of fauna and flora with the WWTP site and its surroundings	Unlikely	Probably will not occur
Consequence	No significant impact is expected	No impact	No impact
Significance	negligible	negligible	Impact of little importance, no need for mitigation

Table 28: Impact on fauna and flora during construction phase

Lake Maryout Ecological System

Since the site of the WWTP is away by few hundred meters from the Lake Maryout as well as the Mediterranean Sea, it is unlikely that the ecological system of Lake Maryout shall be directly affected by the construction activities of the upgrade and extension of the Alexandria West WWTP.

Phase	**Construction Phase**		
Impact	**Lake Maryout and Ecological System**		
Impact criterion	**Effect on environment**	**Classification of effect**	
		Expression	**Effect description**
Likelihood of occurrence	No significant impact shall be expected on the lake Maryout and its ecological system from WWTP construction	Unlikely	Probably will not occur
Consequence	No significant impact is expected	No impact	No impact
Significance	negligible	negligible	Impact of little importance, no need for mitigation

Table 29: Impact on Lake Maryout and ecological system during construction phase

7.2.3 Potential Social and Health Impacts

Health and Safety Impact Assessment

Construction activities can have a negative impact on human health as a result of air pollution, noise and material and waste transport related impacts. The handling and management of wastes can also have an impact on human health.

The impacts of air pollution and noise have been considered above. These impacts result in an adverse severe impact on the working and living conditions of workers on the site. The impact of air pollution from dust, emission and noise is very minor on the surrounding residential areas due to distance between proposed construction sites and these surrounding residential areas.

Due to the relatively moderate number of vehicles trips (anticipated during construction period) on the surrounding roads connecting the WWTP site with relative current traffic volume, the generated dust and emission shall only be during their motion and shall disappear within minutes after occurrence. Therefore, the impact will be low, short-term and local. The potential impact of air pollution by fugitive emissions and

dust can be considered the same for the temporary work areas that will be required during the construction phase.

Normal usage Construction chemicals (paints, resins, insulation materials, etc.) and accidental chemical spills can have direct severe negative impact on worker's health within the construction site and on surrounding human health in case of mismanagement of construction solid waste. For the common types of chemicals and the amounts expected to be used during the construction phase, the impact can be classified as severe impact but short term and local.

Accidents within the construction sites (fires, workers falling from heights, etc.) as well as accidents between construction equipment/material moving vehicles within the surrounding roads can have severe impact on human health however their possibility of occurrence and impact are moderate and local and short term.

These impacts should be re-assessed as part of the detailed final ESIA once further information on the detailed design and hence construction activities are known. **Table 30** is summarising the expected impact significance on health and safety during construction phase.

Phase	**Construction Phase**		
Impact	**Health and Safety**		
Impact criterion	**Effect on environment**	**Classification of effect**	
		Expression	**Effect description**
Likelihood of occurrence	Construction chemical usage and accidental spills Mismanagement of construction chemicals waste Accidents within the site premises and within surrounding areas	Likely	May occur
Consequence	Severe health and safety impacts are expected	Severe	High impact
Significance	Mitigation and good site management shall be needed	High	Impact of great importance, mitigation a must
Spatial influence	The influence of the impact shall be contained within the construction site	Local	Within the site premises
Temporal influence	The influence of the impact shall last short duration	Short term	The impact shall last short period of time

Table 30: Impact on Health and Safety during construction phase

Permanent and Temporary Land Acquisition

The landscape within surrounding areas of the WWTP shall not be affected during construction period since all construction activities even material storage shall be within the current footprint of Alexandria West WWTP as well as in the new allocated area (22 Feddan) for the upgrade and extension project (shown in Figure 13). So no use of extra land during construction activities shall be required. The permanent land take (on which the WWTP upgrade and extension shall be constructed) are within the current footprint and within the new allocated area to the WWTP.

Phase	Construction Phase		
Impact	**Permanent and Temporary Land Acquisition**		
Impact criterion	**Effect on environment**	**Classification of effect**	
		Expression	**Effect description**
Likelihood of occurrence	Temporary land acquisition due to construction activities and material storage Permanent land acquisition due to construction of new facilities	Certain	Will occur
Consequence	Land use change	Severe	High impact
Significance	Mitigation and good site management shall be needed	Low	Impact of little importance, needs limited mitigation
Spatial influence	The influence of the impact shall be contained within the construction site	Local	Within the site premises
Temporal influence	The influence of the impact shall be permanent	Permeant	The impact shall be permeant
Reversibility	The influence of the impact cannot be removed once the impact end or the influence will remain	Irreversible	The influence of the impact cannot be reversed and shall be permanent

Table 31: Impact on permanent and temporary land acquisition during construction phase

(Involuntary) Resettlement

Within the premises of the WWTP, illegal settlements and buildings have been constructed in the past few years since 2011. According to the national standards of census and statistics published in 2016 , the illegal settlements and buildings are characterized by low income and modest social pattern. Most of the inhabitants are not educated or have basic education and work on temporary basis in unstable moderate works. Although actions have been initiated to relocate these inhabitants in new areas, it is not required for the project. Therefore, the resettlement is independent of the project and outside of the scope of this ESIA. Given the described status before the significance of the impact squatter areas and resettlement is considered as Low as indicated in **Table 34**.

Phase	Construction Phase		
Impact	**Squatter Areas and Resettlement**		
Impact criterion	**Effect on environment**	**Classification of effect**	
		Expression	**Effect description**
Likelihood of occurrence	Relocation of the illegal settlements within the WWTP premises	Unlikely	will not occur
Consequence	Illegal settlements shall remain as they are however a barrier fence is proposed to avoid more intrusion activities to inside the WWTP site	Critical	Moderate impact
Significance	The existence of these illegal settlements and the area that they occupy are not considered in the design	Low	Impact of little importance, needs limited mitigation

Table 32: Impact on squatter areas and resettlement during construction phase

7.3 Potential Impacts during WWTP Operation Phase

7.3.1 Physical Environment

Air Quality and Dust

The proposed WWTP is located approximately few tens of meters from existing middle to low class residential areas North of the WWTP. Odour in WWTP can be noticed only at inlet works and grit chambers. Other treatment facilities (primary and secondary) usually do not emit any odour. Odour arising from inlet works operational activities will be extracted by extraction fans and filtered in soil filter beds. As the WWTP will be located away from the sensitive receptors and odour on the WWTP site will be controlled during operation, the proposed project should not result in any significant odour issues to the surrounding residential areas

Upgrading the WWTP from primary to secondary treatment shall enhance the current existing situation baseline of the WWTP and therefore, the odour impact on the surrounding areas shall be reduced.

The impact of air pollution (dust and fugitive emissions) is anticipated to be minor during the operation and maintenance phase of the WWTP, as a relatively small number of vehicles will be required during this phase relative to the current traffic volume on the service road from the proposed site. In addition, there are few other sources of existing air pollution in the area as indicated in **Table 33**

Phase	**Operational Phase**		
Impact	**Dust and Emission on Air Quality**		
Impact criterion	**Effect on environment**	**Classification of effect**	
		Expression	**Effect description**
Likelihood of occurrence	Dust unlikely to be generated during operation Emission from inlet works only	Certain	Will occur
Consequence	Affect work environment and workers' health in the construction site Affect human in surrounding areas	Critical	Moderate impact
Significance	Mitigation and good site management shall be needed	High	Impact of great importance, mitigation a must
Spatial influence	The influence of the impact shall be contained within the construction site and shall not extend beyond the surrounding areas	Local	Within the site premises
Temporal influence	The influence of the impact shall be long term and remain with the operation of the WWTP	Permeant	The impact shall be permeant
Reversibility	Air Quality of the site and its surroundings shall return to normal condition once WWTP is off	Reversible	The influence of the impact can be reversed

Table 33: Impact on dust and emission on air quality during operation phase

Noise

Noise impact on workers within the WWTP location from the operation of the WWTP shall be significant and severe in some places where blowers are operated continuously. This impact shall need to be mitigated.

No.	TYPE OF PLACE AND ACTIVITY	MAXIMUM PERMISSIBLE NOISE [level equivalent to decibel (A)]
1.	Work place with up to 8 hour shifts and aiming to limit noise hazards on sense of hearing	90
2.	Work place where acoustic signals and good audibility are required	80
3.	Work rooms for the follow up, measurement and adjustment of high performance operations	65
4.	Work rooms for computers, type writers or similar equipment	70
5.	Work rooms for activities requiring routine mental concentration	60

Table 34: Egyptian noise limits in work spaces imposed by Law 4/1994

The noise impact from continuous operation of the blowers in some places in the WWTP shall not exceed the premises of the WWTP and shall not extend outside the WWTP premises and shall not affect the surrounding residential areas. The impact on external receivers during the operation and maintenance phase are considered to be low, local and short term due to the location of the proposed WWTP away from sensitive receptors.

Noise impact from moving vehicles to and from the WWTP on the surrounding residential area shall be low, local and short term.

If appropriate, international health and safety noise limits shall be applied to all site equipment. The impact of the noise in this case is expected to be low, short term and insignificant.

The impact of the proposed project on noise will need to be assessed in greater detail once a preferred option has been selected and on site processes determined.

Phase	**Operational Phase**		
Impact	**Noise on Air Quality**		
Impact criterion	**Effect on environment**	**Classification of effect**	
		Expression	**Effect description**
Likelihood of occurrence	Noise from blowers and other equipment in some places within the WWTP and their impact on: Workers in WWTP premises Surrounding residential areas	Certain	Will occur
Consequence	Affect work environment and workers' health in the WWTP site No effect human in surrounding areas	Critical	Moderate impact
Significance	Mitigation shall be needed	High	Impact of great importance, mitigation a must
Spatial influence	The influence of the impact shall be contained within the construction site and shall not extend beyond the surrounding areas	Local	Within the site premises
Temporal influence	The influence of the impact shall be long term and remain with the operation of the WWTP	Permeant	The impact shall be permeant

Reversibility	Noise within the WWTP site and its surroundings shall return to normal condition once WWTP is off	Reversible	The influence of the impact can be reversed

Table 35: Impact of noise on air quality during operation phase

Land and Soil

The land and soil of the Alexandria West WWTP has no other use in the future except being a WWTP. So no change in the land use of this area. No impact is expected.

The land identified for the WWTP and the upgrade and extension does not support any important biological features, cultural heritage or historical features.

The soil and land area within the WWTP allocated to store the dried dewatered sludge and allocated also to receive dumped wastewater emergency cases, the quality of soil in this area shall be enhanced since the quality of the sludge shall be enhanced due to efficient treatment and due to prevention of spillage of dumped wastewater in this area (qualitative assessment). **Table 36** is summarising the expected impact significance on land and soil during WWTP operation phase.

Phase	**Operational Phase**		
Impact	**Land and Soil**		
Impact criterion	**Effect on environment**	**Classification of effect**	
		Expression	**Effect description**
Likelihood of occurrence	Prevention of dumping wastewater in some areas in the WWTP Enhancement of the sludge quality	Certain	Will occur
Consequence	Enhancement of soil quality	Positive	Moderate impact
Significance	Enhancement of soil quality	Low	Impact of little importance, needs limited mitigation
Spatial influence	The influence of the impact shall be contained within the construction site and shall not extend beyond the surrounding areas	Local	Within the site premises
Temporal influence	The influence of the impact shall be long term and remain with the operation of the WWTP	Permeant	The impact shall be permeant
Reversibility	Enhancement of the soil and land quality can decrease or deteriorate if spillage returns to occur	Reversible	The influence of the impact can be reversed

Table 36: Impact on land and soil during operation phase

Surface Water and Groundwater Resources

The project of upgrading the Alexandria West WWTP from primary to secondary treatment shall significantly enhance the effluent quality. The effluent from east WWTP has also been upgraded from primary to secondary treatment. Therefore, the project shall enhance the quality of the water to be disposed to El-Qalaa Drain and to Maryout Lake and ultimately to the Mediterranean Sea. Therefore, the operation of the project has positive impact on the water quality in the project area (drain water, lake water and marine water).

On the long run enhancement of groundwater shall occur due to enhancement of the surface water quality and reduction of pollution loads as indicated in **Table 37**.

WWTP Malfunction and Emergency Response shall be discussed in the ERP Emergency Response Plan section.

Phase	Operational Phase		
Impact	Surface water and groundwater resources		
Impact criterion	Effect on environment	Classification of effect	
		Expression	Effect description
Likelihood of occurrence	Enhancement of the effluent quality from West WWTP and East WWTP shall enhance the quality of surface water within the site surrounding Enhancement of surface water shall on the long run enhance the groundwater quality	Certain	Will occur
Consequence	Enhancement of lake Maryout WQ Depollution of Lake Maryout Reducing disposal loads to the Mediterranean Sea	Positive	Moderate impact
Significance	Significant positive impact	Positive	Impact of great importance
Spatial influence	The influence of the impact shall extend beyond the WWTP premises	Regional / Global	Extends beyond the surrounding area
Temporal influence	The influence of the impact shall be long term and remain with the operation of the WWTP	Permeant	The impact shall be permeant

Table 37: Impact on surface water and groundwater resources during operation phase

7.3.2 Biological Environment

Lake Maryout Ecological System

The project of upgrading the Alexandria West WWTP from primary to secondary treatment shall significantly enhance the effluent quality. The effluent from east WWTP has also been upgraded from primary to secondary treatment. Therefore, the project shall enhance the quality of the water to be disposed to El-Qalaa Drain and to Maryout Lake and ultimately to the Mediterranean Sea. Therefore, the operation of the project has positive impact on the water quality in the project area (drain water, lake water and marine water).

The enhancement of the effluent quality shall improve depollution of Lake Maryout and the whole ecological system of the area. Depollution of Lake Maryout can be improved if the treated effluent from East and West WWTPs are re-used in desert areas west of Alexandria Governorate (as discussed previously in reuse options).

On a regional scale, depending on the choses option this project will support the depollution of Lake Maryout and the Mediterranean Sea and provide an additional source of water; thus improve the economic situation for fishery, agriculture/forestry and tourism in the area. Also, this project will improve the health and environmental situation of the population living in the Governorate of Alexandria.

Table 38 is summarising the expected impact significance on the Lake Maryout Ecological System during WWTP operation phase.

Phase	Operational Phase		
Impact	Lake Maryout Ecological System		
Impact criterion	Effect on environment	Classification of effect	
		Expression	Effect description
Likelihood of occurrence	Enhancement of the effluent quality from West WWTP and East WWTP shall enhance the quality of surface water within the site surrounding	Certain	Will occur

Consequence	Enhancement of lake Maryout WQ Depollution of Lake Maryout Reducing disposal loads to the Mediterranean Sea	Positive	Moderate impact
Significance	Significant positive impact	Positive	Impact of great importance
Spatial influence	The influence of the impact shall extend beyond the WWTP premises	Regional / Global	Extends beyond the surrounding area
Temporal influence	The influence of the impact shall be long term and remain with the operation of the WWTP	Permeant	The impact shall be permeant

Table 38: Impact on surface water and groundwater resources during operation phase

7.3.3 Potential Social and Health Impacts

Health and Safety Impact Assessment

Sanitation and potable water supply are considered to be the most important determinates of public health. Poor sanitation provision increases health risks substantially and can lead to a multitude of health problems. The proposed WWTP upgrade would result in a positive social impact by improving the general public health conditions in the region than if it were not present. This is in line with the Millennium Development Goal Target 10 which aims to substantially increase the number of population who have a sustainable access to safe sanitation.

In general, WWTP upgrade and operation enhances the general health of inhabitants due to the proper handling of the wastewater as well as sludge and reduction of human exposure to poor treated wastewater and sludge. Upgrading the WWTP from primary to secondary treatment shall enhance the quality of the effluent as well as the sludge which resulting in less negative impact on human health in surrounding areas.

Regarding the WWTP workers and operators, during the operation and maintenance phase, chemical use should where possible be minimized through the use of monitoring equipment to optimize chemical dosing and reduce the risk of possible accidental chemical spills. For the common types of chemicals and their amounts expected to be used during the operation and maintenance phase (noting that no Chlorine will be used, and that UV technology will be adopted for disinfection), the potential impact can be expected to be low, short term and local.

Solid and liquid wastes will be generated during the operation and maintenance phase. Depending on the type of project activity carried out, the following waste types are expected to be generated: Waste caused by screenings cleaning, treated effluent, sludge, and bio-compost. Also fuel, lubricants, raw materials and hazardous waste are also expected. With the application of a waste management plan during operation and maintenance phase by the operator of the WWTP the expected potential impact of waste during this phase is expected to be low, short term and local.

Additionally, the proposed development will also have secondary benefits in stimulating social economic development resulting in improved living conditions for the local community.

Providing adequate sanitation is expected to achieve improved social development for residents in targeted communities in a number of ways. These include:

- Improvement of health conditions,
- Increase of welfare,
- Elevation of socioeconomic conditions,
- Achievement of direct economic benefits due to potential investment creation opportunities;
- Expansion of facilities and amenities for various social, human, cultural and recreational activities and events; and
- Increase of economic revenues for the Alexandria Wastewater Company as a result of the reuse enhanced secondary treated wastewater as well as the sludge.

Phase	Operational Phase		
Impact	**Health and Safety**		
Impact criterion	**Effect on environment**	**Classification of effect**	
		Expression	**Effect description**
Likelihood of occurrence	Impact on health and safety on workers of the WWTP (significant impact) Impact on health and safety of inhabitants in surrounding residential areas (no impact)	Certain	Will occur
Consequence	Health problems to workers within the WWTP	Critical	Moderate impact
Significance	Significant positive impact	High	Impact of great importance, mitigation a must
Spatial influence	The influence of the impact shall not extend beyond the WWTP premises	Local	Within the site premises
Temporal influence	The influence of the impact shall be long term and remain with the operation of the WWTP	Permeant	The impact shall be permeant

Table 39: Summary of health and safety impacts during WWTP operation

Sludge and Effluent Disposal and/or Reuse

Discharging the secondary treated wastewater into the open drains shall increase the limited water resources within the area with good quality which can be used for different purposes locally within the surrounding areas of the WWTP or to be pumped 70 Km to the western desert. The HCWW and the Alexandria Wastewater Company can charge fees to the Ministry of Water Resources and Irrigation (MWRI) for this treated effluent if reused in irrigation purposes.

Also increasing the level of the sludge treatment shall have positive impact on the quality of the produced fertilizer generated at site 9N and consequently increase the selling price of this sludge to farmers.

Phase	Operational Phase		
Impact	**Effluent Reuse and Sludge Reuse**		
Impact criterion	**Effect on environment**	**Classification of effect**	
		Expression	**Effect description**
Likelihood of occurrence	Enhancement of effluent quality Enhancement of sludge quality	Certain	Will occur
Consequence	Better water quality of the effluent increasing the usable water resources / positive economic impact Stabilized and better quality sludge that can be reused as fertilizer or as fuel / positive economic impact	Positive	Positive impact
Significance	Significant positive impact	Positive	Impact of great importance
Spatial influence	The influence of the impact shall extend beyond the WWTP premises	Regional / Global	Extends beyond the surrounding area
Temporal influence	The influence of the impact shall be long term and remain with the operation of the WWTP	Permeant	The impact shall be permeant

Table 40: Summary of Health and Safety Impacts for Sludge & Effluent Reuse

7.4 Summary of Impacts

In general, the environmental and social impacts from the WWTP upgrade are considered as positive. However, minor negative impacts shall occur during construction works which shall be local and temporary limited and can be easily mitigated through effective and low cost mitigation measures and good construction site management.

Table 41 and **Table 42** summarise the findings and outcomes of the environmental and social impact assessment.

No.	Resource Area	Potential Impact(s)	Likelihood	Consequence	Impact Significance
Construction Phase					
1	Air Quality and Dust	Local degradation to air quality due to exhaust emissions from construction activities	Certain	Critical	High
		Local degradation to air quality due to dust generation from construction activities.	Certain	Critical	High
2	Noise	Noise pollution due to construction activities such as trenching, excavation, etc. and use to heavy machineries, vehicle and equipment operation.	Certain	Critical	High
3	Land and Soil	Removal / compaction / filling of soil due to construction activities	Certain	Critical	Medium
		Contamination of soil due to accidental spillage/leakage of chemicals or oils stored on site or used during construction or rupture of fuel storage tanks in construction site. Potential contamination of soil and land surface and consequently groundwater from wastewater generated in construction camps if leakage occur or direct spill on soil surface	Likely	Severe	Medium
		Local degradation of soil quality due to potential sewage generation from construction camps	Unlikely	Critical	Medium
4	Water Resources	Increased surface water runoff leading to erosion and sedimentation during and after significant rainfall events.	Likely	Critical	Medium
		Local degradation of surface water quality due to accidental spillage/leakage of oil, chemicals or liquid fuels.	Unlikely	Critical	Medium
		Surface water pollution due to disposal of construction wastes / liquid wastewater / solid waste into open water surface	Unlikely	Marginal	Medium
5	Fauna and Flora	No significant existence of Fauna and Flora with the WWTP site or its surrounding	Unlikely	No impact	Low
	Lake Maryout ecological syste	Impact of construction activities on the ecological system of Lake Maryout and on marine water No potential impact is expected	Unlikely	No impact	Low
6	Waste Generation and Disposal	Improper management of hazardous and non-hazardous waste generated at site leading to impacts on soil, water and visual environment and health and safety of construction workers and public	Likely	Marginal	High
7	Material Assets and Infrastructures Facilities	Visual intrusion and aesthetic interference due to potential generation of waste (spoil) and littering in the project area.	unlikely	Marginal	Low
		Impact on available material assets and infrastructure facilities within the site	unlikely	Marginal	Low

		Impact on available material assets and infrastructure facilities in the surrounding areas of the site	Likely	Marginal	Low
		Potential road disturbance due to excavation of trenches.	Very Likely	Marginal	Medium
8	Socio-economic Issues	Permanent and temporary land acquisition due to WWTP construction of dust and bad odour from construction works which may cause nuisance to local community and businesses in the area.	Likely	Marginal	Low
		Potential outrages in utilities due to accidents (concern to households and businesses).	Unlikely	Critical	Low
		Squatter areas and resettlement	Unlikely	Critical	Low
		Workforce employment (men and women)	Certain	Positive	Positive
9	Health and Safety	Impact to public due to dust generation, noise generation, traffic accidents due to road blocks, etc.	Likely	Critical	Low
		Risk to occupational health and safety from construction activities such as trenching, excavation, improper shoring, confined space entry, handling of hazardous materials and chemicals, manoeuvring of construction equipment and machinery, risk of exposure to injuries. Potential accidents from open trenches, obstructed pedestrian and vehicular access, lack of sufficient signage barricades, warning, lights and other safety precautions that are required by the contractor.	Likely	Severe	High
10	Land Acquisition	Need for Land Acquisition and/or Right of Way	certain	Severe	Low
11	Squatter and resettlements	Need to relocate inhabitants in squatter	Unlikely	Critical	Low

Table 41: Summary of environmental and socio-economic impacts during construction phase

No.	Resource Area	Potential Impact(s)	Likelihood	Consequence	Impact Significance
Operation Phase					
1	Air Quality and Dust	Impact of odour and fume immersion from WWTP inlet works and treatment works on Air quality within the WWTP site	Certain	Critical	High
		Impact of odour and fume immersion from WWTP inlet works and treatment works on Air quality on the surrounding areas of the WWTP site	Unlikely	Marginal	Low
2	Noise	Noise pollution due to operation of pumps / blowers / etc… in some areas and places within the WWTP site and their effect on workers	Certain	Critical	High
		Noise pollution due to operation of pumps / blowers / etc… in some areas and places within the WWTP site	Unlikely	Marginal	Low
3	Land and Soil	Enhancement of soil quality due to enhancement of the treated sludge	Certain	Positive	Low
		Enhancement of soil quality due to stoppage of dumping raw sewage from outside the WWTP	Certain	Positive	Low
4	Surface water and Groundwater Resources	Enhancement of WQ of treated effluent and consequently enhancement of Lake Maryout WQ and the disposed water to the Mediterranean Sea	Certain	Positive	Positive
		Enhancement of groundwater WQ on the long run	Certain	Positive	Positive
		Availability of more water resources for the reuse / or enhancement of WQ of Lake Maryout	Certain	Positive	Positive
5	Ecological system of Lake Maryout	Potential positive impact is expected due to operation of the WWTP and enhancement of the effluent WQ	Certain	Positive	Positive
6	Waste Generation and Disposal	Generation of stabilized treated sludge with good quality that can be used in fertilizer manufacturing process or can be used as fuel source for cement factory	Likely	Positive	Positive
7	Material Assets and Infrastructures Facilities	Impact of WWTP operation of material assets and infrastructures in surrounding areas of the WWTP site	Unlikely	Marginal	Low
8	Socio-economic Issues	Enhancement of the human health within catchment area and in surrounding environment	Likely	Marginal	Positive
		Availability of excess water resources to be reused and more economic revenue for Alexandria Wastewater Company	Likely	Positive	Positive
		Availability of treated sludge to be reused and more economic revenue for Alexandria Wastewater Company	Likely	Positive	Positive
		Workforce employment (men and women)	Likely	Positive	Positive
9	Health and Safety	Impact on health and safety on workers in WWTP site during operation	Certain	Critical	Low

		Impact on health and safety on inhabitants in surrounding environment of the WWTP site during operation	Likely	Positive	Positive
10	Land Acquisition	The area allocated for the WWTP original site as well as for the extension and upgrade have no other potential use except for the WWTP.	Unlikely	Marginal	Low

Table 42: Summary of environmental and socio-economic impacts during operation phase

8 Environmental and Social Management Plan

The Environmental and Social Management Plan (ESMP) identifies mitigation measures to reduce / remedy / eliminate any potential adverse / negative environmental and socio-economic impacts that might occur during the construction (here rehabilitation and upgrading) and subsequent operation of Alexandria West WWTP upgrade and extension. Where possible positive impacts may also be maximized by other actions. The Environmental and Social Management Plan (ESMP) identifies measures to address any potential adverse environmental and socio-economic impacts that might occur during the construction of the WWTP and the subsequent operation phase.

Responding to the environmental and socio-economic impacts detailed mitigation measures have to be identified and evaluated in order to avoid, reduce or remedy the impacts from the WWTP implementation during the construction and operation phases.

The objective of this ESMP is to ensure the integration of environmental and social requirements and proposed mitigation and monitoring measures into the construction contractor's obligations.

The ESMP shall be fully integrated in the construction activities, hereby addressing the responsibilities of the construction contractor (the Contractor), the Engineer and the Employer.

Responding adequately to the complex nature of the envisaged WWTP implementation the ESMP is referring to the following issues:

- Environmental and Social Mitigation Measures during Demolition and Construction phase,
- Environmental and Social Mitigation Measures during Operation,
- Environmental and Social Quality Monitoring during Demolition and Construction phase, and
- Obligations, roles and responsibilities amongst concerned parties.

8.1 Environmental and Social Mitigation during WWTP Construction

The mainly short-term negative environmental impacts, which inevitably occur during the demolition and construction works will be minimized by proper planning and application of preventive measures, and will be mitigated by restorative actions after the works are completed as listed in **Table 41**.

In practise, proper planning means that environmental and social requirements become an integrative part of the construction contractor's obligations and have to be approved by the supervision engineer and competent authority/ies prior to any construction works.

In the following reference is made to mitigation measures in accordance with the Egyptian legislative provisions.

Air Quality

- Wetting the construction area in case of high dust generation.
- Construction equipment and machinery as well as material transporting vehicles will be required to meet Egyptian emission standards. Regular emission check and maintenance of vehicles and equipment will be required.
- Provide workers with safety tools (e.g. masks) while working in very dusty conditions in the site.

Noise

- Where possible provide construction equipment (e.g. generators etc…) with silencer.
- Provide workers with safety tools (e.g. ear muffs) while working in very high noise levels within the site.

Flora, Fauna, and Natural Habitat

The impacts of the WWTP on the flora, fauna and natural habitat during the construction phase will be low, insignificant and short term due to the absence of any identified ecological values. No mitigation is considered necessary.

Soil and Land

- Temporary storage of sanitary and cleaning wastes in containers. Disposal of such wastes will occur at sites approved by the Management Unit of the Protectorate or the appropriate local authorities.

- Tanks for fuel storage shall be leak-proof and installed on impermeable surfaces. Fuel storage tanks shall be checked daily and in case of leakage will be replaced or repaired. Fuel storage facilities should be protected from damage such as from reversing trucks.
- A procedure for storage and handling of non-hazardous wastes and raw materials shall be provided in the contractors' waste management plan.
- No disposal of any kind of waste on the soil surface. No storage of any kind of waste directly on soil surface (waste containers must be used).

Surface Water and Groundwater

The following mitigation can be proposed to reduce the impact on surface water (El-Qalaa Drain and the discharge channel) and groundwater resources within the site and in its surroundings during the construction phase:

- Construction activities must be within a safe distance from open water surface. A fence and signs must be placed within the construction site to keep the construction activities at a distant from the surface water bodies.
- Prohibition of disposal of any kind of waste to open water bodies. Waste management within the site is required to store waste into containers and not to dispose them into surface water bodies (El-Qlaa Drain or disposal channel) and not to dispose them onto soil surface to prevent groundwater contamination.

Material Assets and Infrastructures Facilities

The following mitigation is proposed to reduce the impact on surface water and groundwater resources within the site and in its surroundings during the construction phase:

- Coordination with the local traffic department when moving heavy construction equipment to the construction site or from the site.
- Any damage to the local roads, any spill of material on the roads from the moving of the material transport trucks or construction equipment shall be remedied on the contractor's expenses.
- The construction activities should be contained within the current WWTP premises and not to extend to the surrounding areas.
- All infrastructures facilities within the WWTP shall be rehabilitated properly.
- No excavation outside the existing WWTP premises.
- Contractor have to submit the construction management plan showing all his activities, equipment list, etc. for review and approval before construction activities commencing.

Archaeological, Historical and Cultural Sites

No existence of archaeological, historical and cultural sites within the site or its surroundings. No mitigation is required.

Traffic

The following mitigation is proposed to reduce the impact on traffic and roads in the surrounding areas of the WWTP within the site and in its surroundings during the construction phase:

- Coordination with the local traffic department when moving heavy construction equipment to the construction site or from the site.
- Construction activities should be scheduled carefully in order to minimize the impacts, resulting in successful mitigation.

Squatter Areas and Resettlements

- No action shall be taken towards the relocation and resettlements of the inhabitants in squatter areas within the WWTP site.

- However, prevention of more Infringement is required by providing fence around the site from the squatter areas and wherever required to present more infringement.

Occupational Health and Safety

The contractor shall prepare and implement specific health and safety measures, and present these in a Health and Safety Plan as part of his documents for revision and approval. Mitigation measures shall include but not be restricted to:

- Use of personal protection equipment by employees, workers, engineers and all personals within the construction site.
- Adequate health and safety training of all employees, including training on specific procedures as appropriate to various individual staff groups.
- Provision of rescue equipment and designated medical first-aid facilities.
- Firefighting equipment should be provided into the construction site and should be checked and inspected regularly.
- Medical emergency evacuation plans for different types of incidents and injuries that might occur.
- Provision of adequate sanitary facilities at the construction site.
- Procedures for working with heavy equipment, in confined spaces, for the handling and use of dangerous substances and wastes including asbestos waste material, for excavations and for heavy lifting.
- Provision of adequate waste and material storage facilities.

In addition, the following measures should be considered to minimize hygiene and health problems at construction site:

- Implementation of adequate solid waste management practices.
- Provision of adequate sanitary facilities at the construction site.
- Avoidance of standing water on the construction site through the proper maintenance of the site and through the removal of water from ditches.

The following **Table 43** shows additional mitigation measures that should be considered by the Contractor to reduce the negative impacts during demolition and construction period.

No.	Aspect	Mitigation measures	Responsibility
1.	General	• The provisions listed hereafter shall apply to and be binding upon the Contractor for any part of the works on the site and the subcontractors. The main contractor is responsible to instruct sub-contractors accordingly and to supervise compliance. The Contractor shall ensure that proper and adequate provisions to this end are included in all subcontracts. • The Contractor shall employ appropriate construction methods and carry out the works in a manner as to minimize any adverse impacts on environmental and social media listed hereafter within or outside any construction sites during the contract implementation. • The Contractor shall submit an Environmental and Social Management Plan (CESMP) for the Engineer's approval indicating how the Contractor will comply with the contract requirements for execution of the works. The CESMP shall be properly implemented by the Contractor during the contract. • A grievance mechanism for concerned stakeholders and workers has to be in place.	Contractor Engineer
2.	Air and Dust	• The Contractor shall use heavy equipment, machinery, and fuels in compliance with national regulations. The contractor shall perform regular maintenance on all equipment, vehicle and machinery to prevent air emissions. • The Contractor shall limit idling of engines when not in use.	Contractor

No.	Aspect	Mitigation measures	Responsibility
		• The Contractor shall make sure that any vehicle or equipment leaving the project area is cleaned of loose debris. • The Contractor shall use dust suppression measures on unpaved roads, excavations, stockpiles, and for transport of excavated material to reduce airborne particulates areas and/or sensitive receptors during windy conditions and when needed. • The Contractor shall store cement, sand, or other such fine-grained material in manner to prevent wind erosion and dust. • Construction vehicles shall comply with speed limits. Speed limits for heavy vehicles within construction site shall be restricted to 20 km/hr. • Vehicle and machinery movements during construction shall be restricted to designated routes at all times where practicable. • No stockpiling of fine material is allowed within the construction sites. • Spillage of materials on roads or pathways shall be cleaned up promptly in accordance with the spill prevention and response plan that shall be developed by the Contractor as part of the CESMP.	
3.	Noise and Vibration	• The Contractor shall use heavy equipment, machinery, and fuels in compliance with national regulations. The contractor shall perform regular maintenance on all equipment, vehicle and machinery to prevent noise emissions. • The Contractor shall limit idling of engines when not in use to reduce its contribution to noise emissions. • Contractor shall take reasonable measures, such as installing acoustic screens or close barricades, to maintain noise levels within the national requirements at all construction sites. If such measures are not reasonable, the contractor shall try to minimize disruption through other means such as scheduling noisy activity during less sensitive times or using alternative techniques that create less noise. • Contractor shall restrict work activities between 8 am to 5 pm on weekdays and shall avoid work on Fridays (weekend) in residential areas. • If applicable, the Contractor shall provide 24 hours advance notification of construction schedule and activities with potential disturbance to nearest residences and public facilities (i.e. schools, hospitals, mosques etc.) which are abutting to the proposed alignment. • The Contractor shall take responsibility for rectifying damages caused by vibration generated from or by the use of any equipment, machinery, and haulage vehicles.	Contractor

No.	Aspect	Mitigation measures	Responsibility
4.	Land and Soil	• The Contractor shall adopt soil conservation methods to reduce the area of destruction during demolition/trenching/excavation works. • Upon completion of construction works, the Contractor shall restore disturbed areas to their original condition. • Machineries and equipment shall be checked by the Contractor on daily basis to ensure that there is no leak of oil, fuel, greases or other liquids. If leaks are detected, machineries and equipment shall not be operated until repaired. • Contractors shall use impervious drip trays under portable equipment such as mobile generators and pumps to contain any spills or leaks. Contractor shall carry out all re-fueling in designated areas with impervious surface. Contractor shall ensure no spills of fuel. • All chemicals shall be stored in dedicated areas in tightly closed containers and shall be protected from adverse weather condition. • A spill prevention and response plan shall be prepared by the contractor as part of the CESMP in order to control any inadvertent leakage or spillage. Spill response measures shall be implemented (as necessary) to contain and clean up any contaminated soil. • Any spilled chemical shall be immediately collected and disposed of in accordance with Spill Prevention and Response Plan. • Contractor shall ensure that a spill kit and adequate personal protective equipment (PPE) is available at the site for emergency clean-up activities in case of chemical/oil spillage. • Contactor shall ensure that fuels and oil are stored in designated location with curbing and impervious surface. • The Contractor shall maintain all work areas in a clean and organized fashion at all times. Solid wastes shall be disposed of in a secured area for trash. • Contractor has to provide his workforce with appropriate sanitation facilities to avoid land contamination from any human wastes. This has to be documented in the CESMP.	Contractor

No.	Aspect	Mitigation measures	Responsibility
5.	Water Resources	• The contractor shall use barriers or other measures to ensure that sediments and any other contaminant do not come into contact with, or are transported off-site in surface water run-off, especially during demolition works. Work shall be stopped in the event of heavy rains and subsequent runoff periods. • Contractor shall ensure fuel containers are sealed after use and stored in an area with impervious surface. • All chemicals shall be stored in dedicated areas in tightly closed containers and shall be protected from adverse weather condition. • A spill prevention and response plan shall be prepared by the Contractor as part of the CESMP in order to control any inadvertent leakage or spillage. Spill response measures shall be implemented (as necessary) to contain and clean up any contaminated soil. • Any spilled chemical shall be immediately collected and disposed of in accordance with Spill Prevention and Response Plan. • Contractor shall direct contaminated wastewater from washing/maintenance to a drain pit in the construction workshop, collected by a vacuum truck and transported to the nearest approved municipal waste facility. • Contractor shall provide workers with and inform them of nearby available sanitation facilities to avoid contamination from any human wastes.	Contractor
6.	Waste Generation and Disposal	• A dedicated waste management plan shall be developed and implemented based on a minimization approach and high quality housekeeping practices. • The Contractor shall segregate storage for different types of wastes, such as hazardous, non-hazardous recyclable construction material, plastic, paper, etc. to facilitate proper disposal as per waste management plan. • If applicable, the Contractor shall provide a separate storage area for hazardous materials. The hazardous materials/products must be labelled with proper identification of its hazardous properties. • Chemical waste shall be stored in accordance with the provisions of Material Safety Data Sheets (MSDS). The Contractor shall keep MSDS onsite. • Contractor shall provide trash bins within each construction site so as to prevent littering in the project area and surrounding areas. • The Contractor shall establish regular intervals for waste collection and disposal as per waste management plan. • The sanitary and organic wastes shall be collected and disposed daily. • Inert waste generated from excavation activities shall be recycled to the extent possible, sold to contractors or disposed of to a designated landfill. • The Contractor shall provide adequate toilet facilities at the site. Fixed or portable chemical toilets shall be provided wherever needed. Wastewater shall be collected in a septic tank to be installed on site and removed after the completion of construction activities of that specific area.	Contractor

No.	Aspect	Mitigation measures	Responsibility
7.	Visual and Aesthetic	• Contractor shall ensure general cleanliness and good housekeeping practice at construction sites at all times. • Littering in the project area and surrounding areas shall be prohibited. Contractor shall provide trash bins within each construction site so as to prevent littering in the project area and surrounding areas. • The contractor shall progressively rehabilitate disturbed areas; repave streets to the full width as far as appropriate. Contractors shall stabilize and plant any disturbed areas. All these activities shall be conducted at the Contractor's own expense.	Contractor
8.	Flora	• Clearing of vegetation shall be confined to that necessary for the establishment of required infrastructure and lay down areas. • Trees, shrubs, or other flora on pathways and/or access roads are to be protected by appropriate means. • Removed vegetation shall be replaced at Contractor's own expense by re-planting indigenous species. • The loss of trees has to be compensated at replacement value.	Contractor
9.	Socio-economic Issues	• The construction works shall be carried out while avoiding inconvenience as far as possible to the owners and occupants of properties adjacent to the works (e.g. farming community). Costs for any measures provided in this regard shall be borne by the Contractor. • If applicable, the Contractor shall be committed to provide a method for restoration that shall be agreed with the Engineer and relevant authorities. If applicable, the Contractor shall repave the entire (access) road where the construction damage affects more than 50% of the road width surface. • Water shall be sprayed regularly or complaints will be raised by individuals or (farming) community leaders. • The Contractor shall ensure that concerned stakeholders (area residents, land users, government agencies and NGOs) are aware of the project activities and provided with all information and measures necessary to prevent or minimize any potential impacts that could arise from the project within their area of concern, and also ensure full compliance with the laws and standards governing those activities. • Stakeholders' concerns and information requirements shall be monitored in line with the project progresses. • Respond to telephone inquiries and written correspondence in a timely and accurate manner (grievance mechanism). • Necessary measures shall be taken to ensure that presence and demeanour of construction workers is not sexually or physically threatening to women and children under any circumstance. This shall include sensitization of the workers and the community on appropriate behaviours, expectations, and disciplinary actions against workers who do not follow the established protocol. • Encourage local employment from the nearby areas; pro-actively support women's candidatures throughout the construction and operation phases.	Contractor

No.	Aspect	Mitigation measures	Responsibility
10.	Occupational Health and Safety	• The Contractor has to ensure that all workers have access to protective measures, particularly (as a minimum): • The Contractor shall nominate a qualified H&S Engineer dedicated for the site. The H&S Engineer and the Contractor shall be responsible for ensuring of that a safety plan is prepared, adhered to and shall co-ordinate with the sub-contractors and or other persons required to be working on or near the site for proper implementation during the execution of the works. • Workers shall be briefed regularly on occupational health and safety regulations. • Workers exposure shall be reduced with the use of and proper care of protective clothing and equipment (PPE). • The Contractor shall provide sufficient drinking water for worker and, locations where protection against sun would be provided during breaks. • Traffic control measures, including road signs and flag persons to warn of dangerous conditions shall be implemented. • The Contractor shall install fences, barriers, dangerous warning/prohibition signs around the construction area in order to protect the workers. • Ground movement shall be controlled and collapse prevented by systematically shoring, sloping, benching, etc., as appropriate. • The Contractor shall prepare specific measures for deep (trench) excavation sections such as proper pre-construction activities and the use of protective systems where appropriate. • The Contractor shall develop and implement appropriate fire precautionary measures as per the H&S Plan in accordance with the requirements of the appropriate Local Standards for Construction.	Contractor
11.	Traffic Control	• The Contractor shall comply with all the applicable laws with regard to road safety and transport. The Contractor shall instruct its drivers and equipment operators that vehicles will be expected to comply with all road ordinances, such as speed limits, roadworthiness, load securing and covering. • The Contractor's vehicles shall be permitted only within the designated work sites or on existing roads, as would be required to complete their specific tasks. Vehicles are not permitted on re-vegetated areas, and site traffic shall be limited to prevent unnecessary damage to the natural environment. • The Contractor shall avoid the blockage of fire hydrants by any type of vehicles and or material. • If applicable, existing public access roads used by the Contractor in connection with the execution of the contract shall be maintained by the Contractor.	Contractor

Table 43: Environmental and social mitigation measures during demolition and construction phase

8.2 Environmental and Social Monitoring during WWTP Construction

The monitoring scheme should cover monitoring of the construction program to ensure the implementation of the mitigation measures; monitoring of the operation and performance of the WWTP, and monitoring of the impacts from the WWTP on the surrounding environment to assess the suitability and efficiency of the mitigation measures. This can be split into two areas – construction and operation. Monitoring activities shall

be recorded in the Environmental Register during construction which shall record daily all activities related to environmental issues and potential pollution.

8.3 Environmental and Social Mitigation during WWTP Operation

Air Quality

The following mitigation can be proposed to reduce the impact of dust and emission on air quality in the operation phase:

- Operation of fans and ventilation equipment to prevent any odour from the inlet works and other treatment works. Odour shall be mitigated by extraction fans and filtered in soil filter beds.
- Construction equipment and machinery as well as material transporting vehicles will be required to meet Egyptian emission standards. Regular emission checks and maintenance of vehicles and equipment will be required.
- Provide workers with safety tools (e.g. masks) while working in very confined areas with considerable amount of odours.

Noise

- Where possible provide equipment with high level of noise (e.g. generators, blowers, fans, pumping rooms, etc.) with silencer. Also provide their buildings with sound insulation wherever applicable and possible.
- Provide workers with safety tools (e.g. ear muffs) while working in very high noise levels within the WWTP site.

Flora, Fauna, and Natural Habitats

- No mitigation is required.

Soil and Land

- Good site practice is recommended for tanks for fuel storage; these should be leak-proof and installed on impermeable surfaces. Fuel storage tanks shall be checked daily and, in case of leakage, be replaced until repaired. These should be protected from damage as well – from reversing trucks.
- Procedures for storage and handling of non-hazardous waste and raw materials shall be described in the contractors' waste management plan.

Surface Water and Groundwater

The operation of the Alexandria West WWTP shall have a positive impact on the surface water quality and on the long run on groundwater quality due to enhancement of the effluent quality to be disposed to surface water. The following mitigation can be proposed to maximize the benefit of the reuse of the treated effluent in the operation phase:

- Planning and construction of the reuse scheme facilities to be used in agricultural applications in the desert areas west of Alexandria Governorate (e.g. pumping transmission pipelines) to maximize the benefit of the treated effluent and not to waste water resources and disposing them into lake Maryout and finally to the Mediterranean Sea.
- In case of mal-functioning of the WWTP as well as the off-specification of the treated effluent, mitigation measures shall be taken into consideration in the design of the WWTP to handle these circumstances. This shall be discussed in further details in the Emergency Response Plan section.

Material Assets and Infrastructures Facilities

- The upgrade and extension shall have positive impact on the infrastructure facilities and material assets within the WWTP site in the operation phase. All material assets and infrastructures facilities shall be rehabilitated or re-constructed.
- No mitigation shall be required for the infrastructures facilities and material assets in the surrounding areas.
- In case that damage occurs due to any material asset or infrastructure facility due to traffic activities from or to the WWTP site, this shall be remedy on the cost of the WWTP operator.

Sludge Handling and Reuse

- Providing workers within the MDF with the personal safety tools and equipment.
- Area used to store the dried sludge before transporting to N9 site should be restricted to humans and worker with warning signs.
- The sludge should be transported to N9 site in closed container with warning signs on the vehicles about their content.
- Sludge quality should be tested regularly specially that is used in fertilizer manufacturing process.

The following Table 42 shows additional mitigation measures that should be considered by the WWTP operator to reduce the negative impacts during operation and maintenance period.

	Aspect	Mitigation measures	Responsibility
1.	Air and Dust	• Careful planning and implementation of operation and maintenance activities. • Appropriate preventive maintenance, inspection and cleaning program shall be developed and implemented to maintain equipment in good working condition. When practicable proper landscaping, tree planting around the facility may serve as a natural windbreaker and minimize potential odour dispersions. • Maintenance of pumps, screens and equipment shall be undertaken regularly to avoid/minimise malfunction of the WWTP. • Proper procedures shall be prepared and communicated to operation personnel to ensure no spills of sewage and related odour issues. Operating personnel shall wear appropriate PPE during such operations to avoid health issues related to inhaling (hazardous) gases. If appropriate, to avoid public nuisance anti odour sprays shall be sprayed in adjoining areas, if applicable). • Non-hazardous waste generated at the plant will be regularly removed, temporarily collected and finally disposed of at the Alexandria solid waste landfill. • Providing covers to equipment and containers that are likely to cause odour nuisance (sludge, waste, grit material). • Screens will be cleaned regularly. Transport of screenings / grit material is to be carried by closed-top trucks.	ASDCO
2.	Noise and Vibration	• Careful planning and implementation of operation and maintenance procedures. • Low noise generating equipment shall be selected during design. All equipment shall be inspected and maintained regularly. • Generator set should be supplied as super-silent version.	ASDCO
3.	Land and Soil	• All operation and maintenance staff shall be trained and/or experienced and competent to operate the equipment. Operating procedures for all type of equipment (pumps, blowers, etc.) shall be updated and communicated to all operation and maintenance staff. Regular inspection and maintenance plan for WWTP equipment shall be developed considering manufacturer's recommendations. • Proper training and implementation of safety control measures and regular checking of WWTP equipment.	ASDCO
4.	Water Resources	• In general wastewater treatment according to Egyptian standard and confirmed quality parameters.	ASDCO

	Aspect	Mitigation measures	Responsibility
		• Ensure appropriate and safe storage of contaminants such as fuels, construction materials and wastes. Provide absorbent and intervention materials in sufficient quantities and at relevant locations for intervention in case of leakages/spills. • Contingency plan shall be developed for situation when sewage overflows into the Lake Maryout. • Regular WWTP inspection shall include the inspection in order to detect spills or leakages. • Regular monitoring of effluent quality according to Egyptian standard and confirmed quality parameters. • Capacity building, training and awareness of WWTP management and operational staff. • In case of accidental failure or malfunction respective users of the effluent for irrigation should be informed in order to increase their safety measures to avoid any health risk. • Provision of generator set allowing WWTP during cut off of public power supply.	
5.	Waste Generation and Disposal	• WWTP operator will be required to prepare a waste management plan including emergency response procedures. • Collect and segregate wastes and ensure safe storage and in line with legal requirements. • Screen/grit wastes shall be collected in skips and stored in a separate enclosed area. • Screen/grit wastes shall be disposed to municipal waste disposal site on a weekly basis to avoid odour issues. • If applicable, ensure disposal through waste contractors licensed for treatment/removal/recycling of each of the waste types.	ASDCO
6.	Visual and Aesthetic	• Landscaping including growing tall trees and plants around the pump station facility to reduce visual impact to public and farming community.	ASDCO
7.	Occupational Health & Safety	• Capacity building, training and awareness of WWTP management and operational staff. • The WWTP shall be equipped with an emergency power generator to supply power during periods of power outage. This generator shall automatically be operated if main power supply is not available. These measures shall eliminate sewage overflows in the event of power failure. • Suitable personal protective equipment shall be provided to maintenance personnel that includes waterproof/abrasion-resistant gloves, footwear, eye and respiratory protection. Face visors are particularly effective against splashes. • Regularly monitor completeness and functionality of necessary fire prevention equipment on site in line with applicable regulations.	ASDCO
8.	Pollution prevention (sludge disposal)	• Sludge treatment according to Egyptian standard to be defined/imposed. • Capacity building, training and awareness raising campaigns to WWTP staff and potential user. • Design and implementation of Sludge Management Plan / Procedure. • If applicable, regular monitoring of agricultural parameter (nutrients) and heavy metal concentration.	ASDCO

	Aspect	Mitigation measures	Responsibility
		• If applicable, regular monitoring of sanitary quality (nematodes, coliforms, pathogens) of treated sludge. • Transportation of treated sludge in closed containers.	

Table 44: Environmental and social mitigation measures during operation phase

8.4 Environmental and Social Monitoring during WWTP Operation

Permanent monitoring of the plant operation itself is required to ensure compliance with the performance specification. A well-functioning monitoring scheme will include (but not be limited to) the following:

- On-line monitoring will ensure that the quality of treated wastewater water remains in specification which will be suitable for irrigation and agricultural purposes.
- Carrying out of regular inspections of the entire WWTP facility,
- Regular maintenance of pumping facilities and reservoirs.
- Performing regular chemical and biological analysis of the inflow wastewater treated wastewater as well as the output sludge according to national and international standards.
- Selection of responsible and qualified personnel for operation and maintenance and providing training to them.
- Documentation of the results of the inspections in an inspection report.

Monitoring of the impacts from the facility on its surrounding environment (noise, air, water, soil, fauna and flora ecology, landscape, human health, traffic) to assess the suitability and efficiency of the mitigation measures - for example the quality of the soil at the effluent disposal site should be periodically monitored to ensure that the deterioration of the soil quality at this location is controlled. Visual monitoring could also be utilized to confirm the acceptability of the landscaping.

8.5 Emergency Response Plan

The ERP should describe the appropriate procedures that should be followed and performed in case of sudden and unexpected incidences which may impact on the environment. Fire, spillage, workers' accidents shall be described and mitigated in the ERP.

Among the emergency incidents, the sudden failure of a major components of the WWTP or mal-functioning of the WWTP which may result in off specification effluent. The detailed design engineering shall consider this situation into the design and mitigation measures shall be proposed among them:

- Storage of off-specification wastewater until it can be returned to the WWTP for more treatment.
- Bypass the off-specification (environmentally not accepted).
- Dilution of the off-specification effluent until they can meet the regulations.

8.6 Implementation Plan

The detailed Implementation Plan should describe and address all the required and necessary steps to be performed to implement each of the suggested mitigation measures, i.e. address when and how to be performed, and who will be responsible for their implementation and at what cost. This will ensure sound implementation of the mitigation.

For example, to mitigate the negative impact of the construction of the WWTP on the land use and landscape, it is suggested that the WWTP should be constructed using authentic materials and in regionally typical colours and in conjunction with the adjacent facility. The implementation scheme should advise that the contractor would be responsible for this.

Another example, to mitigate the impact of the disposal of the effluent into the desert, the quality of the disposed effluent should comply with the Egyptian standards for disposal. The IP should advise that the operator of the WWTP will periodically check the quality of the effluent (by water quality sampling and testing) and by checking the performance and efficiency of all the components of the WWTP.

9 References

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- Environmental Management Plan EMP for El-Max Drainage Pumping Station, Performed by DRI Drainage Research Institute, National Water Research Centre MRWI, 2007.
- Ecological Assessment of the Lake Maryout as part of Egyptian Northern Lakes Assessment, Performed by DRI Drainage Research Institute, National Water Research Centre MRWI, 2005
- Preliminary Environmental and Social Impact Assessment for New Cairo Wastewater Treatment Plant, prepared for European Commission Delegation in Egypt and Technically supervised by IFC WBG, Feb. 2008.

Annex 1 – List of Invited Stakeholders to the Public Consultation Meeting

List of Invited Stakeholders

- Alexandria Wastewater Company Staff
- HCWW staff
- Alexandria Health Department representative
- Alexandria Irrigation and drainage department representative
- Alexandria Agriculture Department Representative
- SPA shoreline protection Authority representative
- EEAA headquarters staff / Local EEAA staff (ESIA Sector Head)
- Local inhabitants' representatives
- Al-Qalaa Local Harbour representative
- Montazah Association for Environment and Development in Alexandria (NGO)
- Arab Society for Public Health and Environmental Protection(NGO)
- Environment Leaders Association in Alexandria (NGO)
- Egyptian Association for Industry and Environment – Alexandria (NGO)
- Alexandria Governorate – General Secretary
- Local Council members
- Representative of inhabitants in adjacent neighbourhood

Annex 2 – Attendance sheets of the Public Consultation Meeting

Name of Meeting: ESIA Public Consultation Meeting for Alexandria west WWTP upgrade and Extension Project
Place (city/country): ASDC- Alexandria, Egypt
Date: 29th of May 2018

	Name	Representing organization	Position/ Title
	Farouk Fahmy	Alexandria Sanitary Drainage Company (ASDC)	Manager of Alex-west WWTP
	Mostafa Abdel-Wahab	Alexandria Sanitary Drainage Company (ASDC)	Manager of Maamoura WWTP/ Alexandria
	Mahmoud El-Sayed Mahmoud	Alexandria Sanitary Drainage Company (ASDC)	Supervisor of Khorshid and Maamoura WWTPs/ Alexandria
	Heba Nagy	Alexandria Sanitary Drainage Company (ASDC)	Manager of Laboratory of Khorshid WWTP/ Alexandria
	Asmaa Abdel-Hamid	Alexandria Sanitary Drainage Company (ASDC)	Manager of Ebes WWTP/Alexandria
	Ayat Gohar	Alexandria Sanitary Drainage Company (ASDC)	Head of the Technical office
	Amal Ahmed Shaker	Alexandria Sanitary Drainage Company (ASDC)	Member of the Technical office
	Ahmed Attya Abdel Moniem	Alexandria Sanitary Drainage Company (ASDC)	Manager of follow-up department
	Elham Mostaf Mohamed Hassan	Alexandria Sanitary Drainage Company (ASDC)	Manager of Environmental Affairs department
	Osama Youssef Barghesh	Alexandria Sanitary Drainage Company (ASDC)	Manager of Technical affairs and projects sector
	Manal Galal	Alexandria Sanitary Drainage Company (ASDC)	Head of Planning Sector
	Helaly Abdel-Hady	Alexandria Sanitary Drainage Company (ASDC)	Head of wastewater and sludge management sector
	Abdel Al Wakeel Al Sherby	Alexandria Sanitary Drainage Company (ASDC)	Manager of Alex-east WWTP
	Khamis Hasanien Mohamed	Alexandria Sanitary Drainage Company (ASDC)	Manager of Sludge dewatering unit
	Ibrahim Abdel-Hafez	Alexandria Sanitary Drainage Company (ASDC)	Manager of O&M Department Alex-west WWTP
	Faouzia Mohamed	Alexandria Sanitary Drainage Company (ASDC)	Manager of Laboratories of Alex-west WWTP and sludge dewatering unit
	Yassin Hassan Mohamed	Alexandria Sanitary Drainage Company (ASDC)	Environmental Affairs department
	Ahmed Hamed	Alexandria Sanitary Drainage Company (ASDC)	General Manager of West WWTPs
	Ahmed Ahmed Moursy	Alexandria Sanitary Drainage Company (ASDC)	Manager of operation department of Alex-west WWTP.

	Name	Representing organization	Position/ Title
	Lamiaa Mostafa Mahmoud	Alexandria Sanitary Drainage Company (ASDC)	Manager of Environmental Awareness Unit
	Ibrahim Hassan	Alexandria Sanitary Drainage Company (ASDC)	Manager of EIA unit
	Asmaa othman	Egyptian Environmental Affairs Agency (EEAA)	EIA department
	Mohamed Elsherbiny	Ministry of Health	Manager of environmental unit
	Ibrahim Abdel Monem	Ministry of water resource and Irrigation (MWRI)	Environmental Affairs unit
	Ayman Sharafeldin	National Company for Ports management	Environmental Consultant
	Tarek Mohamed Sonboul	National Company for Ports management	Consultant
	Keith Brooke	Dorsch Consult	Project Director
	Ruth Dornseifer	Dorsch Consult	Environmental Advisor
	Natasha Sim	Dorsch Consult	Technical Expert
	Hisham A. Halim	Enviroconsult	Technical Advisor
	Tarek Salah El-Din	Dorsch Consult	Environmental Expert
	Ahmed Ramzy	Infra Engineering	Environmental Engineer