ACWA Power Zarqa CCGT Project

Zarqa, Jordan

Updated Environmental and Social Impact Assessment

Volume 2 - Main text, Tables, Figures & Plates

Prepared for:

ACWA Power

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List of Abbreviations

Abbreviation	Meaning
ACWA Power	International Company for Water and Power Projects
AERMOD	The American Meteorological Society/Environmental Protection Agency Regulatory Model
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CEGCO	Central Electricity Generating Company
CESMP	Construction Environmental & Social Management Plan
CEMS	Continuous Emission Monitoring System
DA	Degraded Air shed
dB(A)	A-weighted decibels
dB(C)	C-weighted decibels
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
ESMMP	Environmental and Social Management & Monitoring Plan
EPs	Equator Principles
EPC	Engineering, Procurement and Construction (Contractor)
EPFIs	The Equator Principle Financial Institutions
ESIA	Environmental & Social Impact Assessment
ESS	Environmental Scoping Study
GT	Gas Turbine
HFO	Heavy Fuel Oil
HRSG	Heat Recovery Steam Generator
HTPS	Hussein Thermal Power Station (previous HFO plant)
IFC	International Finance Corporation
IPP	Independent Power Plant
LAeq	A-weighted Equivalent Continuous Sound Level
LAmax	A-weighted Maximum Sound Level
LCpeak	C-weighted Peak Sound Pressure
MoE	Ministry of Environment
MW	Megawatt
NEPCO	National Electric Power Company
NDA	Non-Degraded Air shed
OESMP	Operational Environmental & Social Management Plan
OHTL	Overhead Transmission Line
O&M	Operation and Maintenance
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than 2.5 micrometers.
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 micrometers.
PPA	Power Purchase Agreement
PR	Performance Requirements (EBRD)
PS	Performance Standards (IFC)
ST	Steam Turbine
UNESCO	United Nations Educational, Scientific and Cultural Organization
WAJ	Water Authority of Jordan
WB	World Bank
WHO	World Health Organisation
5 Capitals	5 Capitals Environment and Management Consultancy

1 INTRODUCTION

1.1 The Project

ACWA Power is proposing to develop a new 485MW (net) gas fired power plant within the existing landholding of the Hussein Thermal Power Station (HTPS), located in Zarqa, Jordan. The 'ACWA Power Zarqa CCGT Project' will therefore be developed as a new project on a brownfield site. The project will be situated in a largely industrial/commercial area to the north of Zarqa, in close proximity to a petrochemical refinery, steelworks and other commercial activity.

The proposed project will be operated and maintained by the Central Electricity Generating Company (CEGCO), with the output energy being supplied to the National Electricity Power Company of Jordan (NEPCO), under a 25-year Power Purchase Agreement.

The HTPS was built in 4 stages between 1973 & 1984 and consisted of 7 steam turbines, operating on Heavy Fuel Oil (HFO), at an efficiency of 28%. The plant ceased to operate in December 2015 and is to be decommissioned under a separate contract in the future. The proposed project will therefore be constructed on available brownfield land within the HTPS' landholding, on a land lease agreement from CEGCO. No additional project land take is required for the main facilities.

Construction of the proposed project is expected to last 20 months from the Engineering Procurement and Construction (EPC) Contractors Notice to Proceed (1st October 2016) to the full commercial operation of the combined cycle plant on 1st June 2018. Commercial operation of the plant under simple cycle operation will occur from 1st December 2017 and will run concurrently with the remainder of the combined cycle construction works.

5 Capitals Environmental and Management Consulting (5 Capitals) has been commissioned by ACWA Power to undertake the Environmental Impact Assessment (EIA) process required for the approval of the Jordanian Ministry of Environment in accordance with the "EIA Regulation No. (37) of the year 2005". In addition, a similar Environmental & Social Impact Assessment (ESIA) is required for the acceptance of the prospective international lenders for the provision of project finance.

It is important to note that the requirements of the MoE and the projects prospective lenders have been covered by this 'ESIA' package. The MoE requirements for EIA is covered by the lenders ESIA requirements, and as such, this assessment has been referred to throughout as an ESIA. This updated ESIA includes additional assessment from the MoE ESIA, for social and economic aspects of the project.

In order to ensure compliance with local Ministry of Environment submission requirements, 5 Capitals has partnered with ECO Consult who are a registered environmental consultant in Jordan. ECO Consult, have provided valuable support locally in Jordan which included undertaking the scoping session for the project and assistance in some baseline studies.

Please note: Prior to this issue of the Updated ESIA, the project has received approval from the Jordanian Ministry of Environment for the EIA submitted in April 2016. The approval certificate is presented in Appendix N. The current EIA approval certificate was provided in Arabic under the projects former name (Hussein Thermal Power Plant Power Generation Project), the project company is in the process of obtaining an updated approval in line with the updated project name 'ACWA Power Zarqa CCGT Project'. The EIA approval from the MoE will not be materially different, and will simply reflect a change in name related to the project.

1.2 Project Information and ESIA Team

Table 1-1 Key Project Information

Project Title	ACWA Power Zarqa CCGT Project
Project Developer	ACWA Power
Point of Contact	Adrian Rizza (Director – Business Development) arizza@acwapower.com
Project Company	Al Zarqa Power Plant for Energy Generation (P.S.C) شركة محطة الزرقاء لتوليد الطاقة الكهربائية (م.خ.م)
EPC Contractor	SEPCO III Electric Power Construction Corporation (SEPCO III)
Operational and Maintenance Company	Central Electrical Generating Company (CEGCO)
Environmental Consultant	5 Capitals Environmental and Management Consulting (5 Capitals) Dubai – UAE
	ECO Consult Amman – Jordan
Environmental Consultant Point of Contact	Ken Wade - Director Environmental Planning Email: Ken.wade@5capitals-group.com
	Max Burrow – Senior Consultant Email: max.burrow@5capitals-group.com
	Ibrahim Masri – Senior Consultant

1.3 Assessment Objectives

This updated ESIA document has several objectives in relation to its preparation, use and application for the proposed project. Such objectives include and are not limited to the following:

- The assessment of baseline conditions prior to development;
- The assessment of potential impacts of the project during construction and operation;
- Ensuring that potential impacts are avoided or minimised to acceptable level through the recommendation of Mitigation & management measures;
- Inclusion, information and consultation with the public, public bodies and local populations regarding the project;
- Assessment of the projects key environmental and social risks/impacts and mitigation & management measures against the IFC Performance Standards and EBRD Performance Requirements.

Exploration of alternatives that can be used for the project leading to greater social and environmental gains.

The analysis of the physical, natural and social environment has considered the immediate site as well as a well-defined buffer surrounding the project site, relating to the likely extent of project impacts.

It should be noted that the decommissioning phase of the proposed project has only been discussed in general terms, since the project is contracted under a 25-year BOOT scheme (Build-Own-Operate-Transfer). Therefore, the ownership of the project will be handed over to NEPCO at the end of the 25-year period and consequently the responsibilities for the decommissioning of the plant will fall under the responsibility of NEPCO.

Decommissioning impacts of the existing Hussein TPS are not specifically assessed, as this is not part of the project. However, an assessment in regard to the cumulative impacts of the decommissioning process in line with the operation of the proposed project has been included in appropriate chapters.

1.4 Report Structure

In order to comply with the requirements for environmental & social assessment and international best practice, this report is presented in the following format:

Volume 1: Non-Technical Summary

Volume 2: Main Text, Tables, Figure and Plates

Volume 3: Outline Environmental and Social Management & Monitoring Plan

Volume 4: Appendices

Volume 1 provides an overview summary of the ESIA, including the main outcomes, conclusions and any recommendations.

Volume 2 comprises the main text of the report with the issues identified that the PROJECT may impact upon, each following a similar general structure:

- Introduction;
- Policy, Legal and Administrative Framework;
- Project Description;
- ESIA Methodology;
- Air Quality; *(the following subchapters are repeated for all environmental and social issues*)
  - Introduction
  - Methodology
  - Applicable Regulation and Standards
  - Baseline
  - Potential Impacts (Construction, Commissioning Operation and Cumulative)
  - Mitigation & Management Measures
  - Residual Impacts
- Noise and Vibration
- Soil, Geology and Groundwater;
- Water and Wastewater Management;
- Solid and Hazardous Wastes
- Biodiversity Conservation
- Social and Economic
- Traffic and Transport
- Cultural heritage and Archaeology

Landscape and Visual

Community, Health, Safety and Security

Labour and Worker Conditions

References

Volume 3: provides the framework for the development of the Construction Environmental & Social Management Plan (CESMP) by the EPC Contractor; and the Operational Environmental & Social Management Plan (OESMP) to be developed by the Operation and Maintenance Company (O&M).

Volume 4 comprises all Appendices (i.e. consultation meeting, baseline survey reports, laboratory results, predictive modelling studies and other Technical Studies).

1.5 Project Proponents

Different entities are involved in the planning and implementation of the Project. Responsibilities of each key entity of relevance to the ESIA are listed in the text below along with a general description of their roles.

Table 1-2 Project Proponents

Entity	Role
ACWA Power	Project Developer
Al Zarqa Power Plant for Energy Generation (P.S.C) شركة محطة الزرقاء لتوليد الطاقة الكهربائية (م.خ.م)	Project Company (project owner)
SEPCO III Electric Power Construction Corporation (SEPCO III)	SEPCO III is the EPC Contactor responsible for the overall construction of the project
Central Electrical Generating Company (CEGCO)	The Operational and Maintenance Company
National Electric Power Company (NEPCO)	NEPCO will offtake electoral energy and transfer it to the Jordanian grid. NEPCO will also supply the natural gas an gas pipeline infrastructure for the project.
Water Authority Jordan (WAJ)	WAJ will provide potable water for the project under a water supply agreement. Water will be delivered via a new water line to be constructed by WAJ. Water delivered by WAJ will be used for potable water in the first instance, but will be flexible to supply plant processes if required and if within the Water Supply Agreement.

2 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 Requirements for Environmental & Social Assessment

2.1.1 National Requirements

The environmental clearance for the Project is subject to that of the MoE's requirements and which is governed by the "Environmental Protection Law No. 52 of 2006" and the "Environmental Impact Assessment Regulation No. (37) of 2005".

The "Environmental Impact Assessment Regulation No. (37) for the year 2005" lists the projects which require a full EIA or a Preliminary Environmental Impact Assessment. Any project which may have a significant impact on the environment is classified as Category 1, which refers to projects in Annex 2 of this Regulation. Category 1 projects require the preparation of a comprehensive ESIA before permission to operate (or license to begin construction). Annex 2 of the Regulation requires that any project generating energy/electricity is requested a comprehensive ESIA study.

In accordance with the above, the MoE has officially requested that the Project undertake a comprehensive ESIA study in order to obtain the environmental permit for the project – letter reference 4/7/462 dated 19/1/2016 (presented in Appendix A).

In summary, two successive phases of activities are involved in the completion of a comprehensive ESIA study in Jordan: (i) Scoping Phase which includes the undertaking a scoping session and submission of a Scoping Report/ToR approved by MoE for the ESIA study and (ii) Assessment Phase which includes undertaking the baseline studies, evaluation and assessment of environmental and social impacts, and the development of an Environmental and Social Management Plan.

The scoping phase proceeds with the undertaking of a scoping session as discussed earlier. Once a scoping session is undertaken, a Scoping Report/ToR is submitted to the MoE which most importantly includes a detailed ToR that will present the methodology to be adopted for the ESIA study. This report must be approved by MoE, prior to undertaking the ESIA study.

The scoping session for the Project was held on 24 February 2016, and a scoping report was approved by MoE received on 24th March 2016. The scoping report approval is presented in Appendix B.

The assessment phase and in accordance with the approved ToR by the MoE involves undertaking the baseline studies, impact assessment and development of management plans for various components that are expected to be impacted by the project and its activities. The ESIA document is the output of the assessment, prepared in accordance with the ToR.

Upon submission of the ESIA document, the 'EIA Technical Committee' reviews the report and either approves the study and grants the environmental clearance for the Project or rejects the Project if the study indicates that the implementation of the Project would cause significant impacts on the environment and/or the ESIA fails to identify plans for reducing adverse impacts.

2.1.2 International Requirements

It is understood that ACWA Power is seeking project finance from a consortium of lenders, including the European Bank for Reconstruction and Development (EBRD), International

Finance Corporation (IFC), as well as commercial banks that are likely to be signatories of the Equator Principles.

European Bank for Reconstruction and Development (EBRD)

The European Bank for Reconstruction and Development (EBRD) has adopted an Environmental and Social Policy (2014) and a set of specific Performance Requirement (PRs) covering key areas of environmental and social impacts. These reflect EBRD's commitment to promote EU environmental standards as well as the European Principles for the Environment in their investments. The PRs are outlined below:

PR1: Assessment and Management of Environmental and Social Impacts and Issues;
PR2: Labour and Working Conditions;
PR3: Resource Efficiency and Pollution Prevention and Control;
PR4: Health and Safety;
PR5: Land Acquisition, Involuntary Resettlement and Economic Displacement;
PR6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
PR7: Indigenous People;
PR8: Cultural Heritage;
PR9: Financial Intermediaries, and
PR10: Information Disclosure and Stakeholder Engagement

In line with PR 1, there is a requirement for EBRD financed projects to undertake appropriate Environmental and Social Assessment. The purpose of this ESS is therefore to establish the scope of works required at the ESIA stage.

The EBRD Environmental and Social Policy (2014) categorizes projects into different categories that determine the nature and level of environmental and social investigations, information disclosure and stakeholder engagement required. The ACWA Power Zarqa CCGT Project falls into the following description: Thermal power stations and other combustion installations with a heat output equal or higher than 300 megawatts. Therefore, and prior to confirmation with EBRD, it is assumed that the project will fall into Category A, 'projects with potentially significant adverse future environmental and/or social impacts which require a formalized and participatory environmental and social impact assessment process'.

The ESS has therefore been prepared on the basis of undertaking a full ESIA commensurate with a Category A requirements.

<u>Greenhouse Gases</u>

In accordance with the EBRD environmental and social policy, the ACWA Power Zarqa CCGT Project as a fossil fuelled power plant will contribute to greenhouse gas emissions. In line with the EBRD requirements for projects with significant greenhouse gas emissions, the project shall be subject to a detailed assessment.

<u>EU Standards and Best Available Techniques (BAT)</u>

In line with EBRD's Environmental and Social Policy and Performance Requirements, projects that obtain EBRD finance should include measures to achieve a high level of environmental protection as a whole; by way of Best Available Techniques (BAT). In order to define BAT for various industrial sectors, include power generation, *Bat Reference Documents* (BREFs) have been developed.

A BAT Analysis for the ACWA Power Zarqa CCGT project has been prepared as a stand-alone document to the ESIA (ref: Appendix V). The BAT Analysis was prepared with reference to the European Commission BREF Reference Document on BAT for Large Combustion Plants (July

2006), and the Reference Document on the application of BAT to Industrial Cooling Systems (December 2001).

Efficiency

In general, the project as a modern combined cycle plant ensures the efficient use of natural resources through heat recovery and other techniques. A notable observation however, from the BAT review is that the Project's net electrical efficiency at design stage – 49.60% - falls below the 54-58% guideline. The BAT guideline is reflective of turbine technology (F-class gas turbines) which has been prevalent for the last 10-15 years in mature and large power grid systems.

The Project will be using E-class gas turbines, which due to power demand/grid constraints in Jordan, are more favourable than F-class turbines. This is primarily due to the improved flexibility, starting time and loading rates of E-class turbines – which in the context of Jordanian installed capacity (4,000MW), peak demand (3,000MW) and renewables (approaching 10% installed capacity) – are more favourable than F-class turbines.

Furthermore, it is noted that the Project is adopting Air Cooled Condenser (ACC) technology, which is estimated to have a negative overall impact on efficiency of approx. 1.5%.

In summary, whilst the plant's electrical efficiency is less than may be anticipated, it is considered that – in respect of local constraints and the broader BAT attributes – the Project is considered to generally meet the current BREF requirements.

Air Emissions and Noise

Besides efficiency, the use of modern and Low NOx burners will reduce emissions of NOx and CO, whilst the implementation of various noise abatement measures reduces noise levels above other typical designs (i.e. by use of steam turbine enclosures, low noise ACC fans, stack silencers etc.).

Water Demand and use of ACC's

Water demand is minimized through the re-use of treated process wastewater effluents and the use of ACC's for cooling. ACC's, a dry cooling technique, minimises water consumption compared to 'wet cooling' techniques, which evaporate water to provide cooling, or transfer heat to water; such as in cooling towers and once-through cooling systems. As water availability is an important consideration in Zarqa, the use of ACC's are suitable for the ACWA Zarqa Project. ACC's operate on a closed loop system and do not necessitate water for make-up compared to wet cooling systems, that may require up to 3,000m^3 per hour for cooling capacity.

<u>ESIA – Stakeholder Engagement & Consultation</u>

Effective stakeholder engagement and consultation are a key part of EBRD's Environmental and Social Policy and Performance Requirements. Suitable inclusion of engagement and consultation is required at all stages of the ESIA process in order to align with EBRD lending requirements.

As per EBRD Performance Requirement 10 (Information Disclosure and Stakeholder Engagement), this requires the preparation and implementation of a Stakeholder Engagement Plan (SEP) for projects that are likely to have adverse environmental or social impacts and issues.

<u>ESIA Disclosure</u>

As mentioned above, the proposed project is likely to be categorised as a Category A project due to the project being a Thermal Power Plant >300MW. EBRD Performance Requirement 10 (Information Disclosure and Stakeholder Engagement), outlines the requirements for disclosure and consultation in regard to Category A projects. It is understood that EBRD will likely require a 60-day disclosure of the ESIA, during which time further consultations with identified stakeholders (in line with the SEP) will be required.

International Financial Corporation (IFC)

IFC Performance Standards on Environmental & Social Sustainability

The IFC's Performance Standards were developed for use in projects that were receiving direct investment from the IFC. The Performance Standards have since been widely accepted by the financial industry as a benchmark for establishing environmental & social project risks and as such have been adopted by Equator Principle signatory IFI's and also those IFI's who align with the OECD Common Approaches.

As a prospective lender for the project IFC require an environmental and social assessment process to demonstrate compliance to the IFC's Performance Standards and applicable IFC EHS Guidelines.

The IFC's Performance Standards based on the latest 2012 update are detailed below:

PS 1: Assessment and Management of Environmental and Social Risks and Impacts;
PS 2: Labor and Working Conditions;
PS 3: Resource Efficiency and Pollution Prevention;
PS 4: Community Health, Safety and Security;
PS 5: Land Acquisition and Involuntary Resettlement;
PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
PS 7: Indigenous Peoples;
PS 8: Cultural Heritage.

IFC General EHS Guidelines & EHS Guidelines for Thermal Power Plants

The World Bank Group International Finance Corporation (IFC), Environmental, Health and Safety (EHS) General Guidelines of April 2007 supersede the World Bank Handbook issue of 1998.

The IFC EHS Guidelines 'are technical reference documents with general and industry specific examples of good international industry practice'. In addition to this the EHS Guidelines specify limit values for environmental parameters and pollution sources, upon which quantitative project impacts can be assessed.

The updated EHS Guidelines serve as a technical reference source to support the implementation of the IFC Performance Standards, particularly in those aspects related to Performance Standard 3: Pollution Prevention & Abatement, as well as certain aspects of occupational and community health and safety.

In regard to the proposed project, the IFC General EHS Guidelines and sector specific guidelines for Thermal Power Plants will apply. Where local regulations differ from those presented in the EHS Guidelines, best practice dictates that the Project shall aim to achieve whichever is more stringent.

Project Categorisation and ESIA Disclosure

For each investment, the IFC allocate a project category commensurate to the expected environmental and social risks of that project. The categories are not specifically defined in relation to project types, but are based on the expected interactions of a project within its surrounding environment and the risk of that project resulting in environmental and social impacts to receptors.

The IFC categorisation of the project will not be confirmed until a later stage of the project, and is reliant upon IFC involvement, however for the purpose of outlining a suitable scope of works for the ESIA, it is assumed that the project will likely fall into project Category A, due to anticipated …'significant adverse social and/or environmental impacts that are diverse, irreversible, or unprecedented.'

The categorisation of the project also has a resulting effect on the required period of disclosure of the ESIA. In the case that the project is considered a Category A project, IFC require a minimum 60-day disclosure period of the ESIA.

The Equator Principles

On 4th June 2003, ten banks from seven countries signed up to the Equator Principles (EPs), a voluntary set of guidelines for assessing and managing environmental and social risks in project financing. Currently, over seventy-five major financial institutions from around the world have adopted the EPs. These financial institutions operate in more than 100 countries worldwide. As a result, the Equator Principles have become the project finance industry standard for addressing environmental and social issues in project financing globally. The Equator Principles were updated in 2006 (EP II) to include projects with a capital cost of US$10 million or more across all industry sectors and these are the prevailing applicable conditions for this project.

The Equator Principles Financial Institutions (EPFIs) reviewed the Equator Principles in 2011 and approved the latest version, EP III on April 26th 2013. These became effective from June 4th 2013 and should be fully implemented by December 31st 2013.

It is possible that an EPFI will take part in the financing of some of the activities of ACWA Power or the consortium.

The current Equator Principles consist of the following 10 Principles:

Table 2-1 Equator Principles III (2013)

Equator Principle	Details
Principle 1	Review and Categorisation EPFIs will categorise a project proposed for financing based on the magnitude of its potential impacts and risks in accordance with the environmental and social screening criteria of the International Finance Corporation (IFC). These categories are: **Category A**- Projects with potential significant adverse social and environmental risks and/or impacts that are diverse, irreversible or unprecedented; **Category B** – Projects with potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures; and **Category C** – Projects with minimal or no social and environmental risks and/or impacts.
Principle 2	Social and Environmental Assessment

	For all Category A and Category B Projects, the EPFI will require the client to conduct an Assessment process to address, to the EPFI's satisfaction, the relevant environmental and social risks and impacts of the proposed Project (which may include the illustrative list of issues found in Exhibit II). The Assessment Documentation should propose measures to minimise, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the proposed Project. The Assessment Documentation will be an adequate, accurate and objective evaluation and presentation of the environmental and social risks and impacts, whether prepared by the client, consultants or external experts. For Category A, and as appropriate, Category B Projects, the Assessment Documentation includes an Environmental and Social Impact Assessment (ESIA). One or more specialised studies may also need to be undertaken. Furthermore, in limited high risk circumstances, it may be appropriate for the client to complement its Assessment Documentation with specific human rights due diligence. For other Projects, a limited or focused environmental or social assessment (e.g. audit), or straight-forward application of environmental siting, pollution standards, design criteria, or construction standards may be carried out. For all Projects, in all locations, when combined Scope 1 and Scope 2 Emissions are expected to be more than 100,000 tonnes of CO_2 equivalent annually, an alternatives analysis will be conducted to evaluate less Greenhouse Gas (GHG) intensive alternatives. Refer to Annex A for alternative analysis requirements.
Principle 3	Applicable Environmental and Social Standards The Assessment process should, in the first instance, address compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues. EPFIs operate in diverse markets: some with robust environmental and social governance, legislation systems and institutional capacity designed to protect their people and the natural environment; and some with evolving technical and institutional capacity to manage environmental and social issues. The EPFI will require that the Assessment process evaluates compliance with the applicable standards as follows: **1.** For Projects located in Non-Designated Countries, the Assessment process evaluates compliance with the then applicable IFC Performance Standards on Environmental and Social Sustainability (Performance Standards) and the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines) (Exhibit III). **2.** For Projects located in Designated Countries, the Assessment process evaluates compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues. Host country laws meet the requirements of environmental and/or social assessments (Principle 2), management systems and plans (Principle 4), Stakeholder Engagement (Principle 5) and, grievance mechanisms (Principle 6). The Assessment process will establish to the EPFI's satisfaction the Project's overall compliance with, or justified deviation from, the applicable standards. The applicable standards (as described above) represent the minimum standards adopted by the EPFI. The EPFI may, at their sole discretion, apply additional requirements.
Principle 4	Environmental and Social Management System and Equator Principles Action Plan For all Category A and Category B Projects, the EPFI will require the client to develop or maintain an Environmental and Social Management System (ESMS). Further, an Environmental and Social Management Plan (ESMP) will be prepared by the client to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards. Where the applicable standards are not met to the EPFI's satisfaction, the client and

	the EPFI will agree an Equator Principles Action Plan (AP). The Equator Principles AP is intended to outline gaps and commitments to meet EPFI requirements in line with the applicable standards.
Principle 5	Stakeholder Engagement For all Category A and Category B Projects, the EPFI will require the client to demonstrate effective Stakeholder Engagement as an ongoing process in a structured and culturally appropriate manner with Affected Communities and, where relevant, Other Stakeholders. For Projects with potentially significant adverse impacts on Affected Communities, the client will conduct an Informed Consultation and Participation process. The client will tailor its consultation process to: the risks and impacts of the Project; the Project's phase of development; the language preferences of the Affected Communities; their decision-making processes; and the needs of disadvantaged and vulnerable groups. This process should be free from external manipulation, interference, coercion and intimidation. To facilitate Stakeholder Engagement, the client will, commensurate to the Project's risks and impacts, make the appropriate Assessment Documentation readily available to the Affected Communities, and where relevant Other Stakeholders, in the local language and in a culturally appropriate manner. The client will take account of, and document, the results of the Stakeholder Engagement process, including any actions agreed resulting from such process. For Projects with environmental or social risks and adverse impacts, disclosure should occur early in the Assessment process, in any event before the Project construction commences, and on an ongoing basis. EPFIs recognise that indigenous peoples may represent vulnerable segments of project-affected communities. Projects affecting indigenous peoples will be subject to a process of Informed Consultation and Participation, and will need to comply with the rights and protections for indigenous peoples contained in relevant national law, including those laws implementing host country obligations under international law. Consistent with the special circumstances described in IFC Performance Standard 7 (when relevant as defined in Principle 3), Projects with adverse impacts on indigenous people will require their Free, Prior and Informed Consent (FPIC).
Principle 6	Grievance Mechanism For all Category A and, as appropriate, Category B Projects, the EPFI will require the client, as part of the ESMS, to establish a grievance mechanism designed to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance. The grievance mechanism is required to be scaled to the risks and impacts of the Project and have Affected Communities as its primary user. It will seek to resolve concerns promptly, using an understandable and transparent consultative process that is culturally appropriate, readily accessible, at no cost, and without retribution to the party that originated the issue or concern. The mechanism should not impede access to judicial or administrative remedies. The client will inform the Affected Communities about the mechanism in the course of the Stakeholder Engagement process.
Principle 7	Independent Review Project Finance For all Category A and, as appropriate, Category B Projects, an Independent Environmental and Social Consultant, not directly associated with the client, will carry out an Independent Review of the Assessment Documentation including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation in order to assist the EPFI's due diligence, and assess Equator Principles compliance.

	The Independent Environmental and Social Consultant will also propose or opine on a suitable Equator Principles AP capable of bringing the Project into compliance with the Equator Principles, or indicate when compliance is not possible. Project-Related Corporate Loans An Independent Review by an Independent Environmental and Social Consultant is required for Projects with potential high risk impacts including, but not limited to, any of the following: • Adverse impacts on indigenous peoples • Critical Habitat impacts • Significant cultural heritage impacts • Large-scale resettlement In other Category A, and as appropriate Category B, Project-Related Corporate Loans, the EPFI may determine whether an Independent Review is appropriate or if internal review by the EPFI is sufficient. This may take into account the due diligence performed by a multilateral or bilateral financial institution or an OECD Export Credit Agency, if relevant.
Principle 8	Covenants An important strength of the Equator Principles is the incorporation of covenants linked to compliance. For all Projects, the client will covenant in the financing documentation to comply with all relevant host country environmental and social laws, regulations and permits in all material respects. Furthermore, for all Category A and Category B Projects, the client will covenant the financial documentation: **a)** to comply with the ESMPs and Equator Principles AP (where applicable) during the construction and operation of the Project in all material respects; and **b)** to provide periodic reports in a format agreed with the EPFI (with the frequency of these reports proportionate to the severity of impacts, or as required by law, but not less than annually), prepared by in-house staff or third party experts, that i) document compliance with the ESMPs and Equator Principles AP (where applicable), and ii) provide representation of compliance with relevant local, state and host country environmental and social laws, regulations and permits; and **c)** to decommission the facilities, where applicable and appropriate, in accordance with an agreed decommissioning plan. Where a client is not in compliance with its environmental and social covenants, the EPFI will work with the client on remedial actions to bring the Project back into compliance to the extent feasible. If the client fails to re-establish compliance within an agreed grace period, the EPFI reserves the right to exercise remedies, as considered appropriate.
Principle 9	Independent Monitoring and Reporting Project Finance To assess Project compliance with the Equator Principles and ensure ongoing monitoring and reporting after Financial Close and over the life of the loan, the EPFI will, for all Category A and, as appropriate, Category B Projects, require the appointment of an Independent Environmental and Social Consultant, or require that the client retain qualified and experienced external experts to verify its monitoring information which would be shared with the EPFI. Project-Related Corporate Loans For Projects where an Independent Review is required under Principle 7, the EPFI will require the appointment of an Independent Environmental and Social Consultant after Financial Close, or require that the client retain qualified and

	experienced external experts to verify its monitoring information which would be shared with the EPFI.
Principle 10	EPFIs Reporting Client Reporting Requirements The following client reporting requirements are in addition to the disclosure requirements in Principle 5. For all Category A and, as appropriate, Category B Projects: • The client will ensure that, at a minimum, a summary of the ESIA is accessible and available online4. • The client will publicly report GHG emission levels (combined Scope 1 and Scope 2 Emissions) during the operational phase for Projects emitting over 100,000 tonnes of CO2 equivalent annually. Refer to Annex A for detailed requirements on GHG emissions reporting. EPFI Reporting Requirements The EPFI will report publicly, at least annually, on transactions that have reached Financial Close and on its Equator Principles implementation processes and experience, taking into account appropriate confidentiality considerations. The EPFI will report according to the minimum reporting requirements detailed in Annex B.

The revised principles detail projects that are classified as Category A or B projects are required to complete and disclose Environmental and Social Impact Assessment (ESIA). This process determines the environmental and social impacts and risks (including labour, health and safety) of a proposed project in its area of influence. The Assessment should also propose mitigation and management measures relevant and appropriate to the nature and scale of the proposed project.

The Categorisation of the ACWA Power Zarqa CCGT Project with regards to the Equator Principles' project categories (consistent with the IFC's project categorisation process) is likely to be considered as a 'Category A' as there is potential significant adverse social or environmental risks and/or impacts that are diverse, irreversible or unprecedented. This ESS and the ESIA has been/will be prepared to ensure a full assessment in line with the requirements of a 'Category A' project.

2.2 Applicable Standards and Guidelines

National

This section lists legislation that is directly related to environmental & social compliance that must be adhered to by all parties involved in the Project throughout the planning and construction and operation phase. These legislations include: (i) those issued by MoE (laws, regulations and instruction), and (ii) the relevant national legislations issued by other line ministries (laws, regulations, instructions, standards).

The table below lists the key legislation and regulator/entity relevant to each of the environmental and social parameter being studied and assessed within this ESIA. Throughout the following Chapters, reference to the requirements set out within legislation is provided under each relevant parameter.

Table 2-2 Jordanian Environmental Regulation and Standards

Parameter	Responsible Regulator/Entity and Relevant Legislations
Air Quality	▪ Ministry of Environment - Environmental Protection Law No. 52 of 2006 - Air Protection Regulation No. 28 for 2005 ▪ Jordan Institution for Standards and Metrology (JISM) - JS 1140-2006 Ambient Air Quality - JS 1189-2006 – Maximum Allowable Limits of Pollutants from Stationary Sources
Noise and Vibration	▪ Ministry of Environment - Environmental Protection Law No. 52 of 2006 - Instruction for Reduction and Prevention of Noise for 2003
Soil, Geology and Groundwater	▪ Ministry of Environment - Environmental Protection Law No. 52 of 2006 - Soil Protection Regulation No. (25) of 2005
Water and Wastewater Management	▪ Ministry of Water and Irrigation - Water Authority Law No. 18 for 1988 and its amendments thereof - Groundwater Control Regulation No. 85 for 2002 and its amendments thereof - Instructions for the Protection of Water Resources Allocated for Drinking Purposes for 2006 ▪ Ministry of Health - Public Health Law No. 47 for 2008 ▪ Jordan Institution for Standards and Metrology (JISM) - JS 202-2007 Water: Industrial Reclaimed Wastewater - JS 893-2006 Water: Reclaimed Domestic Wastewater
Solid and Hazardous Waste	▪ Ministry of Environment - Environmental Protection Law No. 52 of 2006 - Solid Waste Management Regulation No. (27) of 2005 - Management, Transportation, & Handling of Harmful & Hazardous Substances Regulation No. (24) of 2005, - Instruction for Management and Handling of Consumed Oils for 2003, - Instruction for Hazardous Waste Management for the year 2003 ▪ Jordan Institution for Standards and Metrology (JISM) - Jordanian Standard 431/1985 – General Precautionary Requirements for Storage of Hazardous Materials
Ecology and Biodiversity	▪ Ministry of Environment: - Environmental Protection Law No. 52 of 2006 ▪ Ministry of Agriculture - Agriculture Law No. 44 of 2002 Regulation for Categorizing Wild Birds and Animals Banded from Hunting No.43 of 2008
Social and Economic	Not applicable
Traffic and Transport	▪ Ministry of Transport - Traffic Law No. 49 of 2008

	- Regulations for the Registration and Licensing of Vehicles No. 104 for 2008; - Regulation for Maximum Dimensions, Weights and Total Engine Power for Vehicles No. 42 of 2002; and - Instructions for Allowable Speed Limits for 2002.
Cultural Heritage and Archaeology	▪ Department of Antiquities Antiquities Law No. 21 of 1988 and its amendments No. 23 for 2004
Landscape and Visual	Not applicable
Occupational Health and Safety	▪ Ministry of Labour - Labour Law No. 8 for the Year 1996 and its amendments - Regulation of Protection and Safety from Industrial Tools and Machines and Work Sites No. 43 for 1998 and its amendment thereof - Formation of Committees and Supervisors of Occupational Health and Safety Regulation No. 7 for 1998 - Instructions for the Protection of Workers against the Risks of the Work Environment - Regulation for Preventive and Curative Health Care for Workers in Establishments No. 42 for 1998 and its amendments thereof - Regulation for the Fees of Work Permits for Non-Jordanians No. 36 for 1997 and its amendments thereof ▪ Ministry of Health - Public Health Law No. 47 for 2008 - Instructions for Prevention of Health Nuisances from Workers Accommodation No.(1) for the year 2013
Community, Health Safety and Security	▪ Ministry of Environment - Environmental Protection Law No. 52 of 2006 ▪ Ministry of Health Public Health Law No. 47 for 2008

2.2.1 International and Regional Conventions/Protocols Ratified by Jordan

Jordan is party to several international agreements concerning environmental matters, with relevant examples listed below:

- United Nations Framework Convention on Climate Change and the Kyoto Protocol (1997);
- Convention on Biological Diversity (CBD) (1992);
- Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (1994);
- The Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal (1989);
- Montreal Protocol on Substances That Deplete the Ozone Layer (1987);
- Stockholm Convention on Persistent Organic Pollutants (POPs) (2001); and
- Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (1998).

In addition to the above, Jordan contributes to other regional and international organisations that are concerned with the protection of the environment and conservation of natural resources, such as the United Nations Environment Program, World Health Organization, United Nations Food and Agriculture Organization, World Meteorological Organization, and UNESCO.

2.2.2 Lenders Guidelines

EBRD

EBRD is committed to promoting "environmentally sound and sustainable development" (ref: EBRD Environmental & Social Policy, 2014). It is recognised that the EBRD does not specify its own environmental standards/guidelines for projects. However, 'as a signatory to the European Principles for the Environment,' EBRD '*is committed to promoting the adoption of EU environmental principles, practices and substantive standards by EBRD financed projects, where these can be applied at the project level, regardless of their geographical location. When host country regulations differ from EU substantive environmental standards, projects will be expected to meet whichever is more stringent'* (ref: EBRD Environmental & Social Policy, 2014).

EU Standards and Best Available Techniques (BAT)

Clients will structure the projects to meet relevant EU substantive environmental standards, where these can be applied at the project level. Certain projects that, due to their nature and scale, would be subject to the EU Industrial Emissions Directive and will be required to meet EU Best Available Techniques (BAT) and related emission and discharge standards, regardless of location (EBRD, Performance Requirement 3, 2014).

Where EU Standards do not Exist

Where no EU substantive environmental standards at project level exist, the client will identify, in agreement with the EBRD, other appropriate environmental standards in accordance with GIP. In addition, projects will be designed to comply with applicable national law, and will be maintained and operated in accordance with national laws and regulatory requirements. When host country regulations differ from the levels and measures presented in EU environmental requirements or other identified appropriate environmental standards, projects will be expected to meet whichever is more stringent (EBRD, Performance Requirement 3, 2014).

Labour and Working Requirements

Projects involving new facilities and operations are expected to meet EU substantive environmental standards or other agreed environmental standards, and national regulatory requirements from the outset (EBRD, Performance Requirement 3, 2014).

Projects are required to comply, at a minimum, with (i) national labour, social security and occupational health and safety laws, and (ii) the fundamental principles and standards embodied in the ILO conventions (EBRD, Performance Requirement 2, 2014).

IFC EHS Guidelines

In terms of specific guidelines to control environmental externalities (e.g. air emissions, wastewater quality etc.), these have been set out by the IFC in terms of General Guidelines and Sector Specific Guidelines

In summary it should be noted that the following IFC EHS Guidelines are relevant to this project:

General EHS Guidelines, Environmental:

- Air Emissions and Ambient Air Quality;
- Energy Conservation;
- Wastewater and Ambient Water Quality;
- Water Conservation;
- Hazardous Materials Management;
- Waste Management;
- Noise; and
- Contaminated Land.

General EHS Guidelines, Occupational Health & Safety:

- General Facility Design and Operation;
- Communication and Training;
- Physical Hazards;
- Chemical Hazards;
- Biological Hazards;
- Radiological Hazards;
- Personal Protective Equipment (PPE);
- Special Hazard Environment;
- Monitoring

Community Health & Safety:

- Water Quality and Availability
- Structural Safety of Project Infrastructure;
- Life and Fire Safety (L&FS)
- Traffic Safety
- Transport of Hazardous Materials
- Disease prevention
- Emergency Preparedness and Response

Construction and Decommissioning:

- Environment
- Occupation Health & Safety;
- Community Health & Safety.

Industry Sector Guidelines:

- Thermal Power Plants

3 PROJECT DESCRIPTION

3.1 Project Rationale

The requirement for the project is due to the closure of the Hussein TPS and the continued growth in electrical demand in Jordan. The proposed project aligns itself with Jordan's power strategy (established in 1967), which focuses on, '*constructing a modern and reliable power system, based on large central power plants, reliable high voltage networks, electrification of all rural areas and interconnection with neighbouring countries*'.

The proposed project will therefore provide a much cleaner energy source than the previous plant and at a much improved operational efficiency (estimated efficiency will be 49.6% (LHV, net – natural gas operation)). Key changes from the original plant are in the technology (i.e. gas turbines, heat recovery steam generators and steam turbine versus traditional boilers) and the fuel which provides a much cleaner operation on natural gas versus HFO.

The proposal for the project was comprehensively submitted in Nov.2014 which include the existing site layout. The approval from the Ministry of Energy and Mineral Resources (MEMR) and the Cabinet on the project (including the land) was granted in 7th of Jul.2015. Such approval was given after studying the project layout and after NEPCO (off-taker) carried out a demand flow studies based on the location of this project.

3.2 Location of the Project Site

The Project site is located within Zarqa Governorate in the north of Jordan, approximately 31km northeast of the capital city of Amman. The proposed project will be located entirely within existing land belonging to the CEGCO at the HTPS, which has a total area of 282,000m2 (28.2 Hectares). The project includes the development of a CCGT plant on brownfield land.

The project is located approximately 4 Km north east of the centre of Zarqa city (the capital city of Zarqa Governorate), in an area with several industrial and commercial facilities, including a large petrochemical refinery and steelworks facility. The Al-Hashmiyeh area (residential and commercial) is located north of the proposed site area.

Zarqa is well connected to Amman, and the site is immediately adjacent to a key road link which extends from the centre of Zarqa towards the north of Jordan. The project is accessible via the access road from the northbound carriageway of the highway.

Figure 3-1 Project Area: National

Satellite Image Source: Google Earth

Figure 3-2 Project Area: Regional

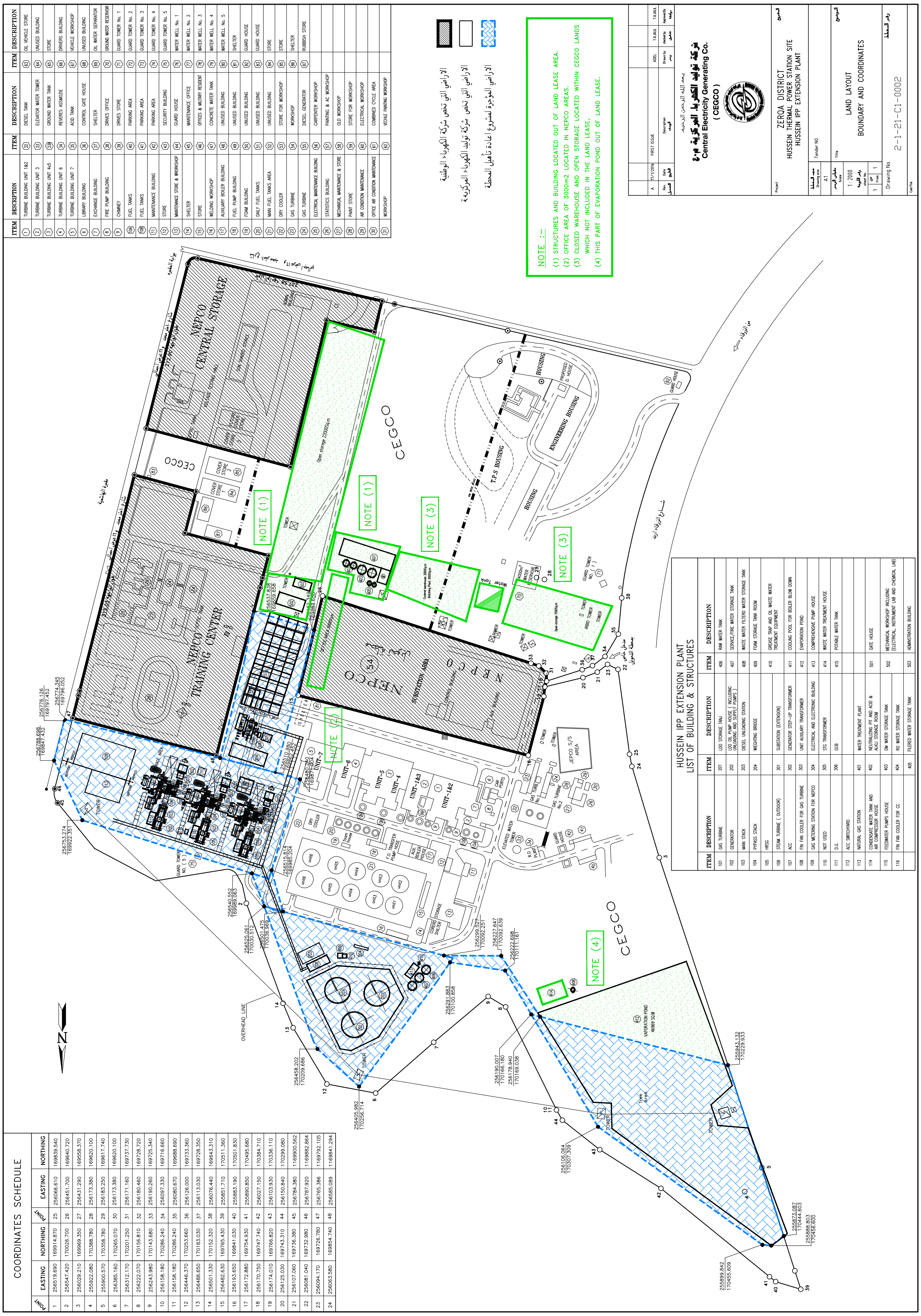
Satellite Image Source: Google Earth

Figure 3-3 Project Co-ordinates

Table 3-1 Project Co-Ordinates

ID	Degrees Minutes, Seconds	
	Latitude	Longitude
1	32° 7'27.26"N	36° 7'12.88"E
2	32° 7'22.27"N	36° 7'21.63"E
3	32° 7'15.87"N	36° 7'26.34"E
4	32° 7'15.50"N	36° 7'28.71"E
5	32° 7'20.45"N	36° 7'33.12"E
6	32° 7'18.91"N	36° 7'35.15"E
7	32° 7'11.75"N	36° 7'38.13"E
8	32° 7'9.44"N	36° 7'46.13"E
9	32° 7'6.94"N	36° 7'47.51"E
10	32° 7'5.34"N	36° 7'47.01"E
11	32° 7'6.99"N	36° 7'39.44"E
12	32° 7'1.70"N	36° 7'37.76"E
13	32° 7'2.25"N	36° 7'35.35"E
14	32° 7'7.88"N	36° 7'35.73"E
15	32° 7'19.28"N	36° 7'15.65"E

Figure 3-4 Project Layout – General (Project in Blue, Construction Areas Green)



3.3 Site Condition and Historical Site Land Use

The proposed plant will be constructed on brownfield land leased from CEGCO. The project will be separated physically and functionally from the HTPS and will be completely stand alone. For instance, it will include provision for a separate entrance, separate fuel and water supplies and separate security. The land for the project will be leased from CEGCO to the project company. The total land area for the project will be 149,992m^2 (See Appendix O for breakdown of land area and plot size).

The site is bordered by the existing HTPS concrete perimeter wall along its northern, eastern and western extents. A wire fence denotes the boundary with the NEPCO training centre along the southern extent. Several security lookout structures are located at strategic positions along the solid boundary line, whilst several existing groundwater wells, pump houses and water pipelines, had been located in the site areas, but have since been capped. The groundwater wells and ancillary facilities were previously used to supply water up to approximately an 80m depth for the HTPS operations. A water pipeline that supplies incoming potable water to the existing plant and local area enters the proposed site areas at the extreme easterly point of the land holding. In addition, there are three overhead transmission line pylons that have their bases located within the project footprint (these will remain in place for the CCGT project).

Further discussion of the baseline environmental and social characteristics of the project area of relevance to the assessment of environmental and social impacts are provided in the latter chapters of this ESIA (Volume 2).

Plate 3-1 Incoming water pipeline along southern boundary of site

Plate 3-2 Two of the three pylons located in the project footprint

The project site can effectively be spilt into four main sections based on the proposed operational uses of these areas. These are listed in line with the satellite image below.

Figure 2 5 Project Site Sections: ACWA Power Zarqa CCGT Project Site in Purple

Satellite Image Source: Google Earth

Site Sections (as per above satellite image):

1. Gas Turbine, HRSG, Steam Turbine and Gas Receiving Station Area
2. Air Cooled Condenser Area
3. Back Up Fuel Oil and Water Storage Tanks
4. Evaporation Pond

Please note: The sectioning of the site in respect to the above numbers has been undertaken only for the ESIA to assist with explanation and understanding of the areas that collectively comprise the project site. The sectioning of the site in this format is not consistent with other design drawings, technical or engineering documents. Any reference to these site sections should only be made in conjunction with the ESIA.

The descriptions below relate to the site sections outlined above, as per the respective numbers and satellite image.

It is noted that the connection corridors between site sections 1 & 3 and 3 & 4 are currently hard standing road surfaces, with no specific features of concern.

Site Section 1

The eastern half of Section 1 has previously been used as a temporary scrap storage area for the existing HTPS. The majority of waste stored in the area is metal, however it was noted in 2012 that the area did contain some hazardous wastes (e.g. empty oil drums, mechanical parts).

During a site walkover conducted in August 2012, this area of the site had been largely cleared and graded, however much waste remained on-site and had been pushed to the edges of the site perimeter. This coincided with a geotechnical survey and also a soil quality survey at this time due to the presence of some identified hazardous wastes stored on the open ground.

Subsequent to 2012, the areas used for non-hazardous scrap storage re-established. However, all scrap was removed by 5th March 2016. Following the removal of the scrap, the top layer of the surface soils was scraped back and stockpiled in the same area. The arising's from the surface soil will be removed from the site, with the top layer of the soil and will be disposed at either the Al Swaqa or Al Ghabawi hazardous waste landfills. Both landfill sites are operated by their respective municipalities and are regulated by the Ministry of Environment. The hazardous waste landfill sites are both lined to provide underlying protection to the soil and groundwater from waste and leachate.

The western half of Site Section 1 has remained clear for several years and was also included in the soil quality survey in 2012. It is noted that the soil quality survey conducted in 2012 did not identify exceedances against the Dutch soil quality action guidelines, although noticeable levels of heavy metals were identified in the soils. In addition, several small spot patches of oil staining from hydrocarbons were visible and remediated at this time.

Site Section 1 has an overhead transmission line pylon in its north-eastern extent, as well as the existing water pipeline that runs along its southern boundary fence line. A security lookout point is located adjacent to the northern boundary wall and a groundwater well and pump house (including water pumping pipeline) had been located in this area, prior to well capping and pipeline removal.

The following image shows the condition of the site in 2010, 2012 and 2016.

Plate 3-3 Photo taken in 2010 of the proposed site (Section 1)

Plate 3-4 Photo taken in 2010 of proposed site (western extent of Section 1)

Plate 3-5 Site Section 1 with view west to the Hussein TPS Power House (2012) that was decommissioned in 2015

Plate 3-6 Overview of Project Site Sections 1 & 2 (within the internal fence line)

Plate 3-7 View in 2016 of western portion of Site Section 1

Plate 3-8 View in March 2016 of Site Section 1 – Following Removal of Scrap

Site Section 2

Site Section 2 is a strip of land located between the existing HTPS plant and switchgear station to the immediate west and the NEPCO training centre to the immediate east. The northern extent of Site Section 2 connects directly to south west of Site Section 1.

This area of land is currently unused and has not been subject to previous visible development. The western section of this strip of land comprises a man-made slope that was built up over 40 years ago to provide a flat base for the existing HTPS and its switch gear station at its summit. A portion of the man-made slope will require cutting as part of the new project and the material will be used as fill elsewhere on the project site.

An existing groundwater well was located at the northern extent of this Site Section. This well has since been capped and the associated pumping infrastructure and water pipeline removed.

Plate 3-9 Overview of Project Site Section 2 (southern extent) - 2016

Plate 3-10 Overview of Project Site Section 2 (northern extent – in foreground) – 2016

Plate 3-11 Man-made Slope at Western extent of Site Section 2 (2016)

Site Section 3

This section of the proposed project site was previously used as a scrap and waste storage area until its clearance and remediation in 2012. As well as the storage of scrap metal, an inspection in 2012 noted several bags of ash on this land, assumed to be from the boiler units of the existing HTPS, which was operational at this time.

Site Section 3 was also included in the soil quality survey in 2012 following clean-up of the wastes to confirm that no contamination remained. The results were similar to those of Site Section 1, whereby no contamination with regard to the Dutch Action standards was identified, however noticeable levels of heavy metals were detectable within the site soils.

Site Section 3 includes an overhead transmission line pylon in it northern extent, as well as a security lookout post and also had included an existing groundwater pumping station and well (now capped and well infrastructure removed). An amount of low-lying shrub and grass vegetation has re-established in this area since its clear up in 2012. Most of the vegetation is located in perimeter areas close to the boundary wall.

Photographs from 2012 and 2016 of this site section are included for reference below.

Plate 3-12 2012 Photograph of Scrap and Waste Temporary Storage at Site Section 3

Plate 3-13 2016 Overview of Project Site Section 3

Site Section 4

The land at Site Section 4 has previously been split between a managed plantation, a small storage area, open ground and a groundwater well (the well has now been capped and pumping infrastructure removed). The majority of this site section comprised of the open ground and the tree plantation.

The storage area located in this area is hard standing with bund/lipped edges to contain any spillages of either stored materials, chemicals and wastes. Secure and covered containment is provided in a small structure on this contained area (as per image below).

In addition an overhead transmission line pylon is located in the north of this section of land. The western boundary of this site section is bordered by the main road to the exterior of the site. The petrochemical refinery is located immediately after the road and is visible from this area.

Plate 3-14 Plantation in Project Site Section 4 (2016 Photograph)

Plate 3-15 Project Site Section 4 with contained chemical storage area (January 2016)

Plate 3-16 Project Site Section 3 – Section of area (March 2016)

3.4 Local Project Surrounds

The project is located in a predominantly industrial area of Zarqa to the north of the city. The area also includes other industries such as the only petrochemical refinery in Jordan, a steel fabrication plant and large wastewater treatment facility.

Upon establishment of the petrochemical refinery and the existing HTPS in the 1970's, the surrounding land use is understood to have been rural and open. From discussions with long standing HTPS staff the growth of Zarqa, local infrastructure and resources around the industrial sector, progressed since its establishment. This has led to the proximal location of sensitive receptors with respect to the site. In particular, there are residences close to the north of the proposed project site and CEGCO staff accommodation in relative proximity to the south within the HTPS landholding.

A review of satellite imagery and information gained during previous site visits has enabled the initial identification of key localities/features in the area. These initially identified features are listed below:

Table 3-2 Local Project Surrounds with Proximity to Proposed Power Block Area

Name	Type	Proximity from Proposed Site
NEPCO Training Centre	Commercial	0.2km South
Nearest Residential Receptor to the Proposed Site (Al Hashmiyeh)	Residential	0.25km North
Zarqa Cemetery	Cultural	0.5km South South East
CEGCO Engineers Accommodation	Residential	0.65km South West
Agricultural Land	Agriculture	1km South East
Petrochemical Refinery	Industrial	1.5km West
Steelworks	Industrial	1.7m South East
Education Centre	Educational	1.75km South West
Residential Cluster (Hashmiyeh)	Residential	1.7km North West
Sports Stadium	Recreational	2.5km South West
North Zarqa (Residential)	Residential	4.1km South West
Wastewater Treatment Facility (Samra)	Industrial	5km North East
Central Zarqa (Residential)	Residential	5.5km South West

Figure 3-5 Local Project Surrounds

The areas surrounding the proposed site form a varied land use pattern. Besides the industrial and commercial facilities, the proposed project site has residential properties to the north (Hashmiyeh) and further to the south west (Zarqa). Areas of agriculture exist further north and also to the south east, as can be seen on the satellite image above.

The nearest residential receptors (Hashmiyeh) north of the site can be viewed in the image below. These receptors form part of the Mixed Residential area shown in the land use map above.

Plate 3-17 Nearest Residential Receptors to the Proposed Project Site

3.5 Project Design

The ACWA Power Zarqa CCGT Project will involve the design, construction, ownership financing, operation and maintenance of a combined cycle thermal power generating facility, with an expected electrical output of 485MW net (gross output is expected to be 505MW). The project will be designed for base load operation, and will be capable of cyclic duty (two shifting). Bypass stacks and associated exhaust gas dampers will allow the combustion turbine generator(s) to revert to simple cycle operation, in the event of an unforeseen prolonged outage of the Heat Recovery Steam Generators (HRSG) or the Steam Turbine Generator (STG).

Fuel used for the operation of the project will be Natural gas, with Light Distillate Oil (LDO) available as back up.

Natural gas will be supplied by NEPCO via a new gas pipeline connection to Jordan's main gas pipeline, which is located approximately 600m to the southeast of the project boundary. NEPCO will construct and operate a spur line from the main line to the eastern extent of the project area, which will run through both public and private land. The public land is a wadi and the private land is open unused land, with no visible signs of use. The gas pipeline will be a 12 inch diameter line and will be sub-surface (between 1-2m depth). The pipeline will not require land acquisition, but rather NEPCO will be required to obtain right of way permissions to construct and maintain the pipeline. The project will include a gas receiving facility within the project land.

Back up fuel will be delivered via an existing fuel oil pipeline emanating from the adjacent petrochemical refinery. The pipeline is a total length of approximately 1,700m and is of a 6-inch diameter. The pipeline is above ground whilst within the petrochemical and proposed project boundaries. An approximate 50m section of the pipeline is sub-surface which is beneath the road to the west of the proposed project site.

The proposed project will include on site storage tanks to ensure 14 days of power production at peak load. The existing pipeline was used at the existing Hussein TPS to convey back up fuel from the same petrochemical facility. A fuel unloading facility will also be constructed for delivery of fuel by road tanker, as a contingency.

The Balance of Plant (BOP) and auxiliary facilities required to support the power production process will include: demineralized water treatment plant, dosing system, make-up water system, fuel storage facilities, and computerized maintenance and management system (CMMS).

The evacuation of electric power generated by the Facility will be through the existing 132kV substation, owned and operated by NEPCO and located within the existing Hussein TPS landholding. The interface point(s) between the Project Company's scope and NEPCO's scope is to be at the 132 kV high voltage bushings of the main power transformers.

3.5.1 Main Complex Facilities

Power Generation Block

The power station will comprise of one (1) power block, consisting of the following units:

Three (3) Gas Turbine Generators (GTG).

Gas Turbines directly combust fuel to generate electricity via the in built turbine and generator.

- Equipped with Low NOx burners;
- Each Gas Turbine will have a bypass stack for emissions during simple cycle operation (when required);
- Equipped with Continuous Emissions Monitoring System (CEMS).

Three (3) Heat Recovery Steam Generators (HRSG).

HRSG's use the hot exhaust gases from the gas turbine to heat water to steam for transfer to the steam turbine.

- Each HRSG will have a main stack for emissions during combined cycle operations;
- Equipped with main stack and CEMS systems for air emissions monitoring;

One (1) Steam Turbine Generator (STG).

The steam turbine uses the steam from the HRSG to turn generate electricity in combined cycle, additional to the GTs, thereby increasing plant efficiency.

Exhaust Gas System & Stack Height

The project will be equipped with six (6) stacks, one per GTG (3) and one per HRSG (3).

Under combined cycle operation, the exhaust gas system will direct hot exhaust gases into the HRSG in order to produce steam for the Steam Turbines. After the exhaust gases have passed through the HRSG boiler, they will be emitted at the stack. The GTG's are also equipped with bypass stacks to enable simple cycle operation when required.

The proposed stack height for the HRSG is 60 meters, whilst the height of the bypass stack is 45 meters. This is as per the EPC design and no further optimisation has been undertaken as the basis for this, due to compliance with the emission standards on natural gas and LDO fuel. Ground level concentrations of pollutants are assessed in the air quality chapter.

Steam Turbine System

The Hussein power plant will comprise of one (1) STG, with a rated maximum power output of 182MW. The HRSG water/steam system will operate on a closed loop cycle where water is heated in the HRSG boiler by the hot exhaust gases from the GTG's to create steam. The superheated steam is then passed through high and low pressure piping systems towards the STG.

After the flow of steam through the STG, and air-cooled condensing system and shell and tube heat exchangers will facilitate the conversion of the steam to condensate water. Condensate extraction pumps will then forward the water back to the HRSG water drum and into the HRSG.

Air Cooled Condenser

Dry Air Cooled Condensers (ACC) will be used for condensation of the steam from the STG, thereby considerably reducing the power stations demand for raw water. The ACC is also used to condense the dump steam during by-pass operation. The ACCs operate on the basis of direct cooling by air only and do not result in water losses due to evaporation, or drift.

The HRSG/boiler and all other plant auxiliaries will operate on a Closed Circuit Cooling Water (CCW) system, and therefore only top up water from blow down loses.

The ACC, consists of several modules of A-shape steel frames supporting the fin tube bundles sitting on a raised steel leg system to allow proper forced draft air intake.

The steam turbine exhausts steam flows through a main steam duct to the inlet of the fin tube bundles and is cooled by air moved by axial fans which are installed on support structures beneath the fin tube bundles. The motor driven fans are located within fan rings and move the cooling air through the fin tube bundles.

Cooling air absorbs the energy from the condensing steam in the fin fan bundles and leaves the installation as warm air at the exit of the fin tube bundles. Condensate from the fin tube bundles is collected in condensate headers located at the bottom end of the fin tube bundles and flows by gravity to the main condensate tank (condensate receiver tank), which is located below the level of the A-frame. The condensate pumps return the condensate to the water cycle.

Among the advantages of air-cooled steam condensers, compared with wet systems, are elimination of:

- Makeup water supply,
- Blowdown disposal,
- Water vapour plumes, and

- Concerns of wastewater discharge.

Also, because of the dry nature of the equipment, lower system-maintenance costs also result. Typically, the system will be cleaned once a year and will consume approximately 20-23m^3 of water per fan. The ACC will comprise of 36 fans.

3.5.2 Emissions Monitoring and Abatement Technologies

In order to ensure that the operation of the plant is compliant with Jordanian, EU IED and IFC EHS guidelines for thermal power plants (Section 2.1, Table 6(B) on Combustion Turbines), the plant will be equipped with Low NOx burners and will have emissions monitoring via Continuous Emissions Monitoring System (CEMS) on each stack.

Low NO_x Burners

Each GTG of the project will be equipped with a Dry Low NOx (DLN) combustor, which is capable of operating on either natural gas or liquid fuel. It comprises multiple gas injection locations, which are used both alone and in combination to optimise performance over the wide range of fuel/air ratios required to operate the gas turbine from ignition to full load.

Other Air Emissions Abatement

Besides the inclusion of Low NO_x burners, the design does not include further emissions abatement based on compliance to applicable emission rates as per the manufacturer specifications and NEPCO fuel specifications.

Continuous Emission Monitoring System (CEMS)

Each stack structure will include flue gas sampling ports and Continuous Emissions Monitoring Systems.

For the CEMS, gas samples will be drawn from the chimney and analysed, on a dry (undiluted) basis the concentration of NO_x, CO, SO_2, O_2 and Particulates.

3.5.3 Fuel

The primary fuel for the Project will be natural gas. In the event that the gas is not available (or an emergency situation), Light Distillate Oil (LDO) will be used as the alternate fuel for no more than 40 days per year (960 hours), and no more than 7 days consecutively in line with the PPA. Whilst the specification in the PPA allows for use of LDO fuel for up to 40 days, the scenario of exceeding 500 hours of LDO usage in a year is highly improbable.

There will be no storage of natural gas on the project site. On-site LDO fuel tanks will have capacity for 14 days of operation. The LDO storage facilities will be constructed with bunding and spillage monitoring & retention devices to ensure at least 110% of any spillage is contained sufficiently, without exposure to the surrounding environment.

The PPA indicates that back-up LDO fuel may be supplied with a sulphur content up to 1.2%, as a worst case. It is understood that current LDO fuel supplied to IPP's in Jordan has a sulphur content below 1%. It is expected that the sulphur content of supplied LDO fuel will be lower than 1%, this would align with the IFC EHS Guideline SO_2 requirements for Non-Degraded Air sheds (for operation of such fuel over 500 hours per annum).

3.5.4 Balance of Plant

In general, the project intends to re-use a portion of treated process wastewater, generated by various aspects of the plant. All water from boiler blowdown, evaporative cooler blowdown and the sampling system shall be returned back to the Raw water tank where it can be re-used in the plant. This is the most efficient way of re utilizing water and reduces waste of water.

Water Utilisation Efficiency

Based on the water balance document presented in Appendix C, the project will have the following water efficiency characteristics, based on expected re-use of wastewater vs. incoming water.

Table 3-3 Water Utilisation Efficiency

Operational Condition	Water Demand	Wastewater to be Re-used	% of wastewater re-use
Natural Gas Summer (Evap Cooler ON)	25.3 m^3/hr	10.24 m^3/hr	40.4%
Natural Gas Summer (Evap Cooler OFF)	8.07 m^3/hr	5.72 m^3/hr	70.8%
LDO Summer (Evap Cooler ON)	67.63 m^3/hr	9.83 m^3/hr	14.5%
LDO Summer (Evap Cooler OFF)	50.40 m^3/hr	5.31 m^3/hr	10.5%
LDO Winter (Evap Cooler OFF)	69.74 m^3/hr	5.31 m^3/hr	7.6%

Data regarding the water utilization of the existing HTPS HFO plant has not been available for the purpose of the is assessment. However, based on the above table it is expected that the proposed CCGT plant and its modern efficient processes will use less water than the existing HFO plant, but will also re-use an amount of water (as detailed above).

Boreholes – For Process Water

The project design includes three new boreholes to be drilled at locations adjacent to previous wells that had been used to abstract water for the HTPS. The 3 new boreholes will be drilled to 95m, 110m and 220m depth to the same aquifer that had been used by the HTPS. The new wells have licenses granted by the WAJ, with no limit on abstraction. The licenses are valid and are presented in Appendix P.

Table 3-4 Borehole Locations, Licenses and Status

#	Existing DW	Location		License Issue Date	Expected Date
		East	West		
W01-2	Deep Well No.2	256460.32	170161.82	7-Apr-2016	7-Aug-2016
W01-6	Deep Well No.6	256131.14	170227.22	7-Apr-2016	7-Aug-2016
W01-10	Deep Well No.10	256022.03	170187.4	7-Apr-2016	7-Aug-2016

Figure 3-6 Borehole locations

Expected water consumption of the proposed CCGT project will be 160,000m³ per annum. This expected value is based on seasonal fluctuations of water consumption, as well as use of LDO fuel for a maximum of 40 days per year.

The project will significantly reduce water consumption from that of the HTPS, which had operated from the same aquifer with a water consumption of approximately 430,600m³ per annum.

Water abstraction will therefore be reduced from previous rates, and is not expected to pose a concern for the projects on-going operation, availability of supply, or restriction of use in regard to other 3rd party uses.

Table 3-5 HTPS Well Water Consumption Data 2012

Month	Quantity [m3]
Jan	47400
Feb	34000
Mar	45500
Apr	34900
May	31000
Jun	54700
Jul	41400
Aug	34000
Sep	24900
Oct	25500
Nov	21600
Dec	35700

Potable Water Supply

The Water Authority of Jordan (WAJ) will supply potable water under a water supply agreement. Water will be delivered via a new water line to be constructed by WAJ. Water delivered by WAJ will be used for potable water in the first instance, but will be flexible to supply plant processes if required and if within the Water Supply Agreement. The water supply agreement includes supply provision of up to 2,450m^3/week.

Under normal potable use demand, it is estimated that approximately 1m^3/hr will be supplied, and will be stored and distributed to the consumers in the plant.

Raw Water System

Raw water supply to the Plant will be sourced from the three new boreholes in the first instance. If necessary for emergency supply, an small amount of flexibility of supply will remain available in combination with the Water Supply Agreement with WAJ, where potable water could be used for process purposes.

Water from the new boreholes will be pumped to on-site water storage tanks (see water balance document in Appendix C). The raw water treatment system will be designed to optimize the raw water consumption, which will be used by the following applications:

- Steam/water cycle make-up water
- Closed cooling loop make-up water
- Facilities cleaning water
- Service water

Major components of the raw water treatment plant system will include the following:

- Pre-treatment of raw water with activated Carbon filters.
- Reverse Osmosis System: filtration of raw water to feed the Demineralization plant.

Demineralization plant: the treated water will be subject to chemical conditioning, microfiltration, a second step of reverse osmosis.

Pre-treated or filtered water will be used as: Tempering water, Service water, and fire protection, supply for Plant hoses, and demineralisation plant feed.

Demineralized water will be used for the water-steam cycle make-up (water supply to the HRSG and CCCW).

The design, installation and operation of all aspects of the system will comply with the relevant local and national codes, directives and regulations and be in accordance with recognized international standards.

Water balance diagrams for the proposed project are presented in Appendix C for the summer and winter seasons with operation on both natural gas and back up LDO fuels.

It is important to note that the plant will not discharge process wastewater streams. All treated wastewater effluent will either be re-used, irrigated or evaporated. Sanitary and domestic wastewater will be directed off-site directly to the municipal sewerage network. Where water is re-used it will meet the quality criteria specified in:

- Jordanian Standard 202:2007 – Industrial Reclaimed Wastewater
- Jordanian Standard 893:2006 – Reclaimed Domestic Wastewater

Industrial Wastewater Treatment Plant

An Industrial Wastewater Treatment Plant (IWTP) will be built to service the project. The modular industrial wastewater and treated effluent disposal systems will be provided to ensure that all potentially contaminated wastewaters generated by the operation and maintenance of the station will be treated in accordance with the latest guidelines for thermal power plant issued by the IFC guidelines.

Industrial wastes streams that will be collected and treated include:

- Water treatment plant waste water;
- Mechanical Equipment drains;
- Collection points under all mechanical equipment;
- Air preheater cleaning wastewaters;
- Boiler cleaning wastewaters;
- Laboratory liquid wastes;

Wastewater from the demineralization and condensate plant will be controlled by addition of acid or caustic in a single neutralization basin located adjacent to the water treatment plant. Effluent from the drains of the laboratory and chemical dosing drains will also be treated in the neutralization basin (pH adjustment).

Wastewater from other streams will be directed to the Industrial Wastewater Treatment Plant's (IWTP) clarifier system. At this stage the water will undergo coagulation and flocculation in order to achieve 100% clarification. The clarified effluent will be filtered and directed to a treated effluent tank.

The combined treated effluents will be sent to the reaction tank, undergo further filtration and finally sent to the filter water basin when it can be pumped for re-use within the plant or sent to evaporation ponds. The estimated treatment capability of the IWTP is $30m^3/h$.

Sludge from the clarification process will be thickened and dehydrated into cakes for disposal off-site.

Sanitary and Domestic Wastewater

All sanitary and domestic wastewater will be directed off-site and connected to the main sewerage line in Zarqa that conveys raw wastewater to the Municipality operated Al Samra Wastewater Treatment Plant, approximately 10km to the north.

Oil Contaminated Water Treatment

Surface water/storm water run-off and drains with the potential of oil contamination will be directed to an oil/water separator to lifting stations prior to pumping to the neutralization basin. All treated oily wastewater will not exceed 10mg/L of waste oil concentration.

This includes all runoff water from inside bunded structures, not including road drainage.

All treated oily wastewater will be sent to the evaporation pond.

Storm Water

Storm water runoff from roads and roofs, will be discharged at two locations to the wadi to the immediate north of the proposed CCGT project site. The two discharge locations will be in regard to collected storm water runoff from the power block and ACC area (in general) and the storage tank/plant entrance area respectively.

As per the sub-section above regarding 'Oil Contaminated Water Treatment', collected stormwater from bunded structures and areas subject to oily processes will be contained in separate drainage systems for discharge to the specific oily water treatment.

Prior to discharge to the wadi, the project design will include sediment/grease traps for stormwater, to ensure that loading of these constituents to the wadi is minimised.

Evaporation Pond

One (1) lined evaporation pond is provided for the collection and containment of the treated effluents. There will be zero discharge of wastewaters from the evaporation pond and therefore the pond has been sufficiently sized (44,000m^3) to contain and evaporate the effluent from the specified sources on the plant. The minimum capacity of the evaporation pond is such that the wastewater supplied to it over the annual cycle, including direct catchment rainfall, is evaporated in an eleven (11) month period, based on published average evaporation rates in Jordan.

3.5.5 Auxiliary Facilities

Demineralised Water Treatment Plant

The demineralised water plant will produce 60m^3/hr of DM water for the following processes:

- Water/steam cycle make-up;
- Condensate polishing regeneration;
- Closed circuit cooling water make-up;
- Generator cooling water make-up;
- Steam transformer make-up;
- Hydrogen generation;
- Condensate polishing; laboratory use; and
- Boiler chemical cleaning and rinses.

The water quality characteristics of the treated water are presented in the following table.

Table 3-6 Demineralised Water Quality

Parameter	Concentration
Conductivity	≤0.1µS/cm
Sodium	≤0.5µg/L
Chloride	≤0.5µg/L
Sulphate	≤0.5µg/L
Total Silica as SiO2	≤5µg/L
TOC	≤100µg/L
DO	≤100µg/L

Chemical storage and handling

On site storage facilities for all operational chemicals will have a capacity of 30 days for the project (based on average consumption during normal conditions).

Solid chemicals will be delivered and stored in dry, covered conditions. Solid and liquid chemical storage tanks and silos will include vents or fume trap/absorber basin.

Chemical Dosing System

Chemical dosing of the fluids circulating through the cooling system, steam generation and turbine systems will be carried out, in order to maintain pH levels, oxygen content, remove excess salts, and ensure general good water quality characteristics within the manufacturer's technical parameters. It includes the following subsystems:

- Dosing of trisodium phosphate to the STG (sporadic, usually after shutdowns), in order to precipitate and remove the salts that may enter the cycle
- Dosing of oxygen scavenger to cycle, in order to maintain the oxygen content in feed water within the range of values established by the manufacturers of the HRSG and STG
- Dosing of alkaline agent (sulphuric acid), to cycle, in order to maintain pH in feed water and steam within the range of values established by the manufacturers of the HRSG and STG.

Additionally, a corrosion inhibitor will be added to the close cooling circuit, to reduce the corrosive characteristics of demineralized water and passive metal surfaces (carbon steel) of the circuit. The corrosion inhibitor will be supplied to the system manually through a specific dosing tank located between the discharge and the suction of the cooling water pumps.

Water and steam sampling system

Water & steam sampling and analysis system will be installed to supervise and maintain the quality of plant make up water, condensate, feed water and steam water, so as to ensure the plant operates safely and economically.

Continuous analysis will be carried out by either automated systems or manually on a regular basis. The main parameters that will be analysed are:

- pH
- Conductivity
- Dissolved oxygen
- Sodium
- Silica

The following sampling point will be supplied for the project:

Table 3-7 Sampling points and instruments

Item	Sample point	Analyser
Condensate	CEP Outlet	CC O2 Na M
Feed water	Deaerator Inlet	SC O2 M
	Deaerator outlet	O2 M
	Economizer Inlet	CC SC pH O2 SiO2 M
Steam	Superheated Steam (Left)	CC Na SiO2 M
	Superheated Steam (right)	
Drain	HP heater drain	CC M
	LP heater drain	M
	coil steam heater	CC M
Cooling water	Electric Generator Cooling Water	SC pH M
	Closed Cooling Water	SC pH M
Cleaning water at thermal state	Discharge of startup separator	CC M

Notes:

- M - Manual sampling
- CC – on-line Cation Conductivity Analyser
- SC –on-line Specific Conductivity Analyser
- DO –on-line Dissolved Oxygen Analyser
- pH –on-line pH Analyser
- SiO2 –on-line Silica Analyser
- Na–on-line Sodium Analyser

3.5.6 Support Services

The facilities that will be provided to support the power production operations will include:

- Central Control Room
- HVAC system
- Electrical Systems
- Site office and amenities
- Laboratory (existing at Hussein TPS)
- Workshops
- Warehouse and stores
- Firefighting system
- Mobile plant and vehicles
- Site access and security

3.5.7 Associated Facilities

Please note: In line with the associated facilities below, there is no requirement for these facilities to undergo EIA based on the categorisation of projects in Jordan as per Annex 2 & 3 of the EIA Regulation No. (37) of 2005.

In regard to IFC Performance Standard 1, the associated facilities are 'physical elements' of the project that would not have been constructed or expanded if the project did not exist. Furthermore, without these associated facilities, the project would not be viable. Although these facilities will not be specifically funded as part of the project, there is a requirement for such facilities to be included to the scope of the projects 'area of influence'.

Gas Pipeline

A new gas pipeline spur of approximately 600m will be constructed and operated by NEPCO from the main Jordanian gas pipeline that runs from Aqaba to the north of Jordan. The main gas pipeline in Jordan is located in close proximity to the site approximately 600m to the east. The new spur will be a direct connection to this line and will pass underground to the site through a 12-inch diameter line at a depth of between 1 to 2m below ground level. The sub-surface gas pipeline will be constructed through land that is both public and private in ownership. The private land is located adjacent to the existing main gas pipeline is open undeveloped land with no apparent land use. The pipeline will also be located within a wadi (public land), prior to entering the project site. The photographs below show the open and undeveloped nature of the land and wadi which the pipeline will be routed through.

Figure 3-7 NEPCO Gas Pipeline Route (Indicative: Yellow = Private Land, Green = Public Land)

Satellite Image Source: Google Earth

Plate 3-18 Land at NEPCO Gas Station (View of Open Private land)

Plate 3-19 Land at NEPCO Gas Pipeline Spur (View towards gas station from wadi)

Plate 3-20 Wadi for NEPCO gas pipeline route (View toward project site)

As the pipeline will be buried underground, it will be marked by spaced signs/markers to indicate is presence. As such, the pipeline will not sever any routes for local people and/or vehicles. Land acquisition is not required, however as a portion of the pipeline route (approximately 200m) will be buried under private land, NEPCO will require a right of way during construction and for any maintenance during operation. The application for any right of way will be the responsibility of NEPCO and will be undertaken in line with the necessary

Jordanian laws, expected to be based on the Jordan Acquisition Law, No. 12 of 1987. ACWA Power Zarqa will support and monitor the process being undertaken by NEPCO to ensure consistency to IFC PS5 and EBRD PR5 when pursuing the Right of Way, including any compensation entitlements relating to the temporary construction disturbances and future maintenance. PS5 and PR5 are generally consistent with the Jordan Acquisition Law, which includes mechanisms for consultation with affected landowners and grievances (amongst other similar principles). Further, ACWA Power Zarqa will ensure that affected landowners have access to the projects grievance mechanism and are included to on-going consultation as per the SEP.

NEPCO have been consulted at the ESIA stage (face to face meetings on site and email correspondence) and have provided drawings to indicate the proposed pipeline routing. The outlined pipeline spur routing to the Hussein TPS is shown in the figure below.

Based on the routing shown below the proposed gas pipeline will be conveyed beneath open ground alongside the boundary of a small grazing area (sectioned off by a fence) and along the graveyard, NEPCO training centre boundaries, before entering the CEGCO landholding in the eastern extent of the project.

Figure 3-8 NEPCO Pipeline Spur to the ACWA Power Zarqa CCGT Project (approximate routing in green)

Satellite Image Source: Google Earth

A panoramic photograph of the open land for the proposed pipeline is provided below. Not visible within the photo is the section of wadi that the gas pipeline will be constructed within. The gas pipeline will be routed adjacent to the existing sewerage line built within the channel of the wadi. This will also ensure that access is not easily gained, particularly by vehicles which may damage sub surface piping from surface movements.

In addition to meeting with NEPCO, they have responded to email consultation regarding the associated gas pipeline as follows:

1. What is the overall planning process that NEPCO has followed to identify a gas pipeline route that minimizes environmental and social impacts?

- The route was selected far away from the populations.
- The route selected beside a drainage channel in order not to affect the agricultural environment.
- The pipeline selected to be underground in order not affect both people and animals from one side to another.
- The agricultural soil to be returned back to the top as before excavation.

2. We have been shown a gas pipeline route from the gas station to The project provided by CEGCO.

a) Can you confirm if the pipeline routing has been finalized?

- The route was sent to NEPCO for land lease, no change expected on the route.

b) Have any alternative routes been considered?

- As the distance is small (Around 700 meters) no alternatives is considered.

c) Can you confirm if the pipeline will be underground and whether it will have any security protection {e.9. fence line}?

- Underground with sufficient depth according ASME code B31.8, only warning sign above the pipeline to be installed, no fence.

d) Will the route sever any existing pathways or access for local community and herders of sheep?

- The pipeline will be underground and will not affect the access of both people and animals.

e) Will the EPC Contractor be preparing on Environmental Impact Assessment (EIA) for the pipeline (i.e. for assessment of the following: Ecology, Soils/contamination. drainage, land-use, grazing rights, land ownership, access to farm animals, noise, air quality, construction methodology, habitat restoration post construction etc.)?

- There is no need to EIA study since its short length
  Author Note: NEPCO are not authorized to decide on the projects requirement for EIA in Jordan. As stated previously, the requirement for gas pipeline EIA is not included in Annex 2 & 3 of the EIA Regulation No. (37) of 2005.

f) If on EIA is to be prepared, will this be available for review and what is the timeline?

- See the reply of point e.

Water Pipeline

A new separate water supply agreement has been established with the Water Authority of Jordan (WAJ) to supply up to 2,450m^3/week, which will provide all potable water requirements, and will remain flexible if top up of process water supply is required (e.g. in emergencies). The water supply agreement will require a new pipeline to be constructed by the WAJ of approximately 800m in length prior to entering the proposed site at the location of the proposed evaporation pond, in the north west of the existing HTPS landholding. The routing of the water pipeline will beneath the existing road network. No land acquisition is expected, however, there may be some disruption to vehicle users during construction and any required maintenance.

WAJ therefore may require a right of way from the road authority for the construction phase and if required for maintenance. ACWA Power Zarqa will support and monitor the process being undertaken by WAJ to ensure consistency to IFC PS5 and EBRD PR5 when pursuing the Right of Way, including any compensation entitlements relating to the temporary construction disturbances and future maintenance. PS5 and PR5 are generally consistent with the Jordan Acquisition Law, which includes mechanisms for consultation with any affected landowners and grievances (amongst other similar principles). Further, ACWA Power Zarqa will ensure that any affected landowners have access to the projects grievance mechanism and are included to on-going consultation as per the SEP.

Plant Entrance and Access Connection

As the proposed project will be a self-contained site and facility, segregated from the existing HTPS by a fence line, a new access gate specific for the project will be constructed. The new access point will be in the north of the proposed back up fuel and water storage tank area, to connect to an existing road at the same location. A new section of road will therefore be constructed and will be approximately 40m in length, which will cross an existing small wadi channel immediately adjacent to the project boundary. It is understood that the Jordanian Ministry of Water has approved the specification of the culvert size to be used to ensure suitable conveyance of flow when the wadi is consumed by rainfall.

The access road will be dedicated for the new plant and will be constructed as part of the site preparation activities.

A photograph of the location of the proposed access is shown below. The road will access the site via a new gate along the existing HTPS concrete boundary wall. The photograph has been taken from the road side of the existing local road upon which it will connect to.

Plate 3-21 New Site Access Location

Switchgear Station and Over Head Transmissions Lines

NEPCO will be responsible for the projects switchgear station and overhead transmission lines which will evacuate generated electrical power to the grid. It is noted that these facilities are already in place, due to their previous operational use at the existing HTPS. As such, the project will re-use these existing facilities. Minor upgrades will however be required to the existing switchgear station. NEPCO have confirmed that the project will not require the movement or re-location of any existing overhead transmission line infrastructure, including pylons).

Back Up Fuel Pipeline

An existing distillate fuel pipeline from the adjacent petrochemical refinery is already in existence due to its previous use at the existing HTPS. As the refinery will supply the back-up fuel, the proposed project will make use of this pipeline which already enters the proposed project site in the evaporation pond area. The pipeline will require slight re-routing to the proposed back up fuel storage tank area. All works relating to this pipeline will occur within the proposed project site.

The pipeline is a total length of approximately 1,700m and is of a 6-inch diameter. The pipeline is above ground whilst within the petrochemical and proposed project boundaries. An approximate 50m section of the pipeline is sub-surface which is beneath the road to the west of the proposed project site.

3.6 Project Alternatives

In line with Jordanian and lender guidelines for EIA/ESIA, the evaluation of various project design and activity alternatives were considered, in order to ensure that the objectives of the proposed project have accounted for social, ecological, economic and technological options.

The following project alternatives are discussed in this chapter:

- No Project
- Alternative project location and layouts
- Alternative power production technologies
- Alternative fuel
- Alternative water supply
- Alternative cooling system
- Alternative emissions control
- Alternative wastewater treatment

No Project

The ‘no project’ option is not viable due to the social and economic requirement for additional power generating capacity in Jordan. As discussed in the “Key Project Objectives” section, the project is aligned with Jordan’s 1967 power strategy. Equally, as mentioned earlier, the existing HTPS was shut down in December 2015 and as such the requirement to replace the deficit in the energy output is important for economic development in Jordan.

Alternative project location and layout

The proposed CCGT project will be built entirely within the land holding of the existing HTPS, on brownfield available land. As such, there is no immediate requirement to dismantle any existing buildings. Equally, there is no need to acquire any additional property from the public or private sector lands immediately adjacent to the site.

A key advantage of the location of the proposed project in this area is the existence of the CEGCO offices, stores and departments already based at the Hussein TPS site. In addition, several associated facilities of the project are already in place at this location, such as the switchgear, overhead transmission lines and back up fuel pipeline. The gas pipeline is also located only 600m away which requires minimal construction works to install the gas pipeline spur to the plant. As such, few additional works are required on such facilities. In regards to social aspects, the location of the project at this site enable many of the existing HTPS operational workforce to remain in their jobs at this location; rather than being transferred elsewhere within CEGCO.

With regards to the surrounding land use, these are primarily of an industrial type, with a large scale petrochemical refinery, steelworks and wastewater treatment plant within 5km of the proposed project site. It is recognised that a small residential area is situated in a similar location, which is understood to have established and grown since the commencement of operations at local industries in the mid to late 1900's.

With regard to potential alternative locations, it is understood that no other specific sites have been considered, and that the location within the existing Hussein TPS landholding is considered to be suitable technically.

Alternative power production technologies

The advantages for using renewable resources in power production range from prevention and minimisation of long term and cumulative impacts to the environment at the regional and global scale; as well as eliminating any dependence on foreign supplies and volatility in economic and political situations. However, the feasibility of such projects is largely dependent on the availability of the renewable energy source, the reliability of the power output, the ability of the station to meet peak demands, and the ability to store energy. Besides this, the size of the proposed site is not sufficient for the required power generation capacity by renewable energy (e.g. large space required for solar).

The size of the project site is suitable for a reciprocating engine power plant, however, the selection of the combined cycle gas turbine technology has been preferred for a number of reasons including its higher efficiency, flexibility, reliability and cost effectiveness. It is considered that combined cycle gas turbine technology is generally less pollution than reciprocating engines in terms of emissions.

Equally, the principal role of the power station, and the country's needs for power influence the selection process. Currently, NEPCO is seeking to guarantee that base-load requirements are met, as well as to ensure that periods of peak demand can be covered. Jordan is currently implementing a widespread renewables programme that includes several photovoltaic plants and feasibility of wind. The use of the proposed technology and fuel at the Hussein TPS project will therefore compliment these technologies, but will particularly increase energy security within the country.

The proposed project will operate in combined cycle mode and primarily use natural gas as a source of energy. These technologies have been proven technically and commercially over long periods and have become more efficient and have incorporated abatement technologies to further reduce impacts to the environment.

Alternative Fuel

The choice of gas turbines as the primary power block generators provides flexibility in the choice of fuel that can be used. Gas turbines typically operate on a range of fuels from natural gas to crude oils fractions (in some facilities in the Middle East).

The choice to use natural gas as the primary fuel is considered to be the most environmentally and socially appropriate of the potential alternatives, due to the lower emissions factors (generally), including greenhouse gases, and the reduced risks associated to the storage and transportation of liquid fuels to and on-site.

Light Distillate Oil (LDO) is the back-up fuel of choice and is required as a liquid to enable back up storage on the site. The choice of LDO over other liquid fuel fractions is also preferred due to the light nature of its consistency, compared to regular distillate and crude fuels. As such, LDO is cleaner in emissions compared to other such liquid fuels.

Alternative water supply

Viable water resources locally include the following:

- Piped supply (from Water Authority of Jordan (WAJ));
- Local Groundwater – Existing HTPS Wells;
- Treated Sewage Effluent (from Al Samra WWTP).

The proposed design has opted for local groundwater as it primary process water source and piped potable supply from WAJ as its potable source. The use of piped supply will be connected to a main water line locally, with pipeline spur to the project site. The use of local groundwater ensures that other local potable water users in Jordan are not affected by a large potable supply being dedicated to the project.
Potable water will be supplied under a water supply agreement, for which 2,450m^3 has been guaranteed for the project on a monthly basis. The source of the piped water is not specifically known but is expected to be drawn from various groundwater wells in the Zarqa region. The quality will be for potable supply.

As outlined in the water and wastewater resources chapter, there are several aquifer layers locally. The HTPS HFO plant made use of several boreholes on the project site, which were drilled to the relatively shallow first aquifer layer (approximately 50-120m depth). Groundwater abstraction for the HTPS as its primary raw water source, had led to depletion of the groundwater in the local area, prior to closure of the HTPS. These previous boreholes have since been capped and closed.

The project design includes three new boreholes to be drilled in locations adjacent to and at the same depth as 3 of the previous HTPS wells on the site (95m, 110m and 220m depth). The expected water consumption of the proposed CCGT project will be 160,000m^3 per annum, which is therefore expected to significantly reduce water consumption from that of the HTPS, which had operated from the same aquifer with a water consumption of approximately 430,600m^3 per annum.

Treated wastewater is a potential viable water source and the Al Samra plant, the largest wastewater treatment facility in Jordan located approximately 10km to the north of the proposed project site. Such a water supply may not be guaranteed at a required flow rate and therefore is not considered appropriate for the proposed project as a back-up supply. It is understood that this option is not considered practical due to the extensive pipeline network connecting to the proposed project, and additional treatment facilities that would be required if such treated water was used.

Alternative cooling system

In order to minimise water resource use, the project includes the use of Air Cooled Condensers (ACC) for cooling of the steam water cycle through the HRSG and steam turbine. ACC's do not lose water and therefore require minimal water, to be made up only the water is being bled.

Alternative and viable cooling water options include the use of mechanical draft cooling towers, however, the use of such technology would require greater consumption of water resources, due to water loses due to evaporation and drift. In order to ensure water consumption is minimised, the only feasible option for the project is to use ACC. Similarly, a once through cooling system is not viable due to the lack of available water resources locally.

Alternative emissions control

Due to the operation of the plant on natural gas and LDO (as back up fuel), emissions are designed to be minimised to the lowest possible concentrations, and will be complaint with Jordanian, European Commission Industrial Emissions Directive (IED) and IFC EHS guidelines for Thermal Power Plants. The project's design includes low NOx burners within the gas turbine combustion chamber. No additional emissions abatement technology control has been incorporated.

The economic investment of incorporating additional emissions abatement technology is not considered financially viable, due to the already low and predicted compliant emissions concentrations of the plant. Additional mitigation for air emissions on gas turbine units is uncommon, certainly in the Middle East region, and would unlikely provide a significant benefit to the local air shed, at large expense.

Alternative wastewater treatment and management

The proposed project will not result in the discharge of process wastewater (treated or untreated) off the site. The proposed project will treat all process wastewater streams on the site and either re-use the treated effluent, or evaporate it. Sanitary and domestic wastewater will be directed off-site for treatment at the municipality operated Al Samra WWTP. Storm-water will be treated (via sedimentation and grease trap) prior to discharge to the adjacent wadi.

The chosen option of treatment of process streams on-site enables an amount of water re-use rather than use of additional water resources.

An alternative would be to treat sanitary and domestic streams on-site, in order to provide water for landscaping irrigation. However, this would require a dedicated treatment plant on the site for what would likely be a relatively low flow of sanitary and domestic wastewater, with potential associated environmental impacts relating to odour.

Other options for wastewater management may include the storage and removal of wastewater by external contractors at licensed facilities off-site. However, this would require a regular stream of vehicles and removals that pose other environmental and social externalities, such as increased traffic, noise, emissions amongst safety risks.

The management of all process wastewater on-site is therefore considered to be a Best Available Technique.

3.7 Construction Logistics

The following series of works will be undertaken in association with the Project:

Preparatory Works

- Site surveys and site preparation & development;
- Infrastructure works; and
- Construction facilities.

Civil Works

- General civil work that may include supply & driving of piles for foundation purposes; soil improvement, back-filling, levelling and grading;
- General buildings;
- Civil part for power generation including excavation, foundation, sub-structure, construction and finishing of the complete building complexes including all gas turbine, HRSG and steam turbine foundations and superstructures, and ventilation / air conditioning facilities of buildings;
- Civil part for fuel systems;
- Civil part for electrical and I&C plant including Central Control Room (CCR), Local Control Room (LCR), metering building;

Mechanical Parts:

- Power island;
- Fuel systems;

Ancillary systems:

- Service & potable water tanks,
- Sewage & storm water collection systems,
- Process wastewater system,
- Balance of mechanical equipment,
- Fire alarm & detection, fire protection, fire fighting systems,
- Compressed air system,
- Sampling/monitoring system,
- Storage tanks; and
- Electrical & I&C Systems.

The preliminary geotechnical investigations indicate that general soil improvement will be unlikely. Compaction is expected to be limited to local areas where “soft spots” may be encountered, for road construction and backfilling to foundations.

Excavation methods will be dependent on the ground conditions and the depth of foundations. Therefore, either shallow strip foundation design or shallow / basement raft foundations may be used depending on the technical requirements of the structures.

The need for piling will be determined on completion of the final site investigation. Piling techniques will be dependent on ground conditions, and could include bored, cast in situ and/or driven piles.

In accordance with normal construction practice in Jordan, the superstructure construction system may be concrete frame with concrete block work infill or steel frame with insulated panels. Steel framed structures will generally be used for the longer span "industrial" buildings and buildings that house the process equipment.

Cut/Fill Balance

The site will be prepared so that separate areas of the project are at different elevations to others. This will require an amount of cut and fill, within the project area to enable this. A document presenting the cut/fill balance and diagrams of areas for cut/fill has been presented in Appendix Q.

Table 3-8 Cut/Fill Balance Table

EARTHWORKS BOQ				
PLATFORM LEVEL (m)		TOP SOIL EXCAVATION (1 m) (m^3)	EXCAVATION (m^3)	FILL (m^3)
EVAPORATION POND AREA	(+82.00)	45855	187025	-
LDO AREA POWER BLOCK AREA WTP & ADMINISTRATION AREA	(+94.00) (+96.00) (+105.00)	84100	93650	179285

As per the above table there will be an excess of excavated soil/bedrock. Such material will be disposed of appropriately as per the Site Waste Management Plan in line with any required mitigation outlined in the Waste Management section of this ESIA.

Construction Materials

Construction materials will be sourced locally where possible. Materials available locally include:

- Ready mix concrete;
- Concrete Products, road kerbing and paving etc.;
- Steel reinforcement;
- Building block work;
- Pipework;
- Tiling and finishing products, roof tiles etc.;
- Asphalt products.

Materials that are not sourced locally will be either regionally obtained or as a last resort will be imported from overseas. Local agents will be used wherever possible for sourcing mechanical and electrical plant and machinery. High quality finishing products may be imported if they are not available locally.

3.8 Construction Management

Programme

The full construction programme is presented in Appendix D.

Construction is expected to commence in mid-2016, following the financial close of the project and attainment of all necessary local permits/approvals in Jordan.

The construction timeline will run from mid 2016 through to the initial Commercial Operation Date (COD) on 1st December 2017, upon which the project will operate commercially in simple cycle. Construction and commissioning works by the EPC contactor will continue through to the full COD on 1st June 2018, upon which the plant will operate commercially in combined cycle.

EPC Contract and LNTP

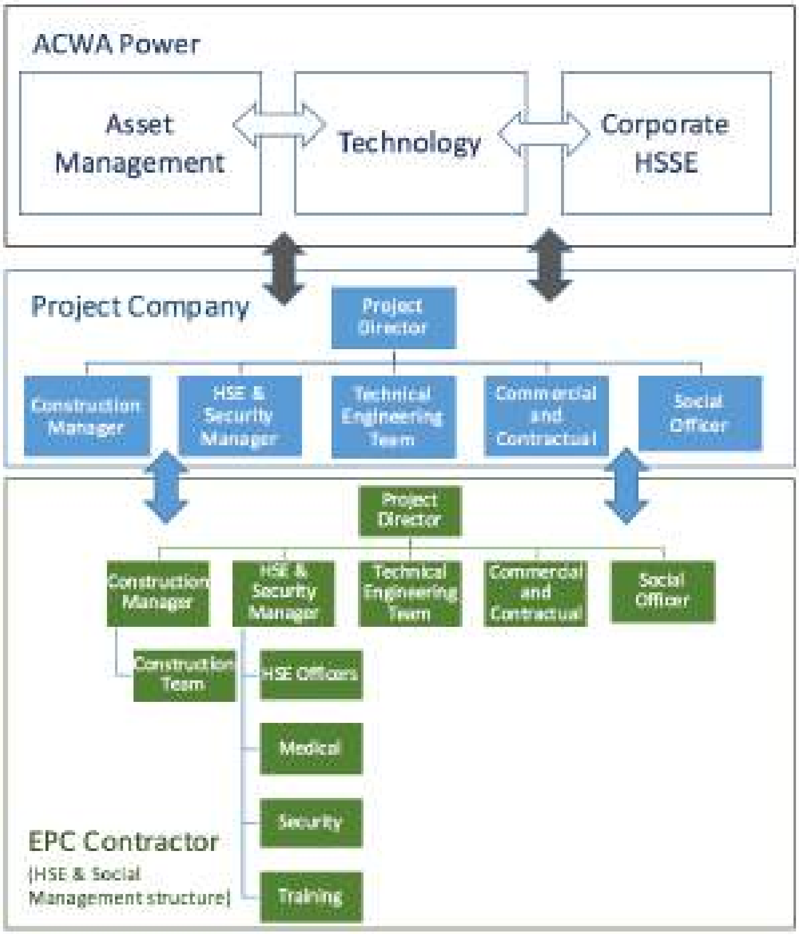
SEPCO III signed the projects EPC Contract in January 2016, and have since been issued with two Limited Notices to Proceed (LNTP), including the 2nd LNTP in February which instructed the procurement of the Gas Turbines, Heat Recovery Steam Generators and Steam Turbines, as well as a limited amount of site preparation works. The construction permit has also been granted to SEPCO III as a result of the LNTP.

At the time of writing this ESIA ISSUE 2 it is understood that a 3rd LNTP is being developed.

Construction Structure and HSE Management

The construction stage project and HSE structure is presented below and will operate on a top down structure from ACWA Power in order to use the wider ACWA power policies as the basis for all project related HSE and HR policies for ACWA Power Zarqa and SEPCO III.

Figure 3-9 Construction Structure and HSE Management



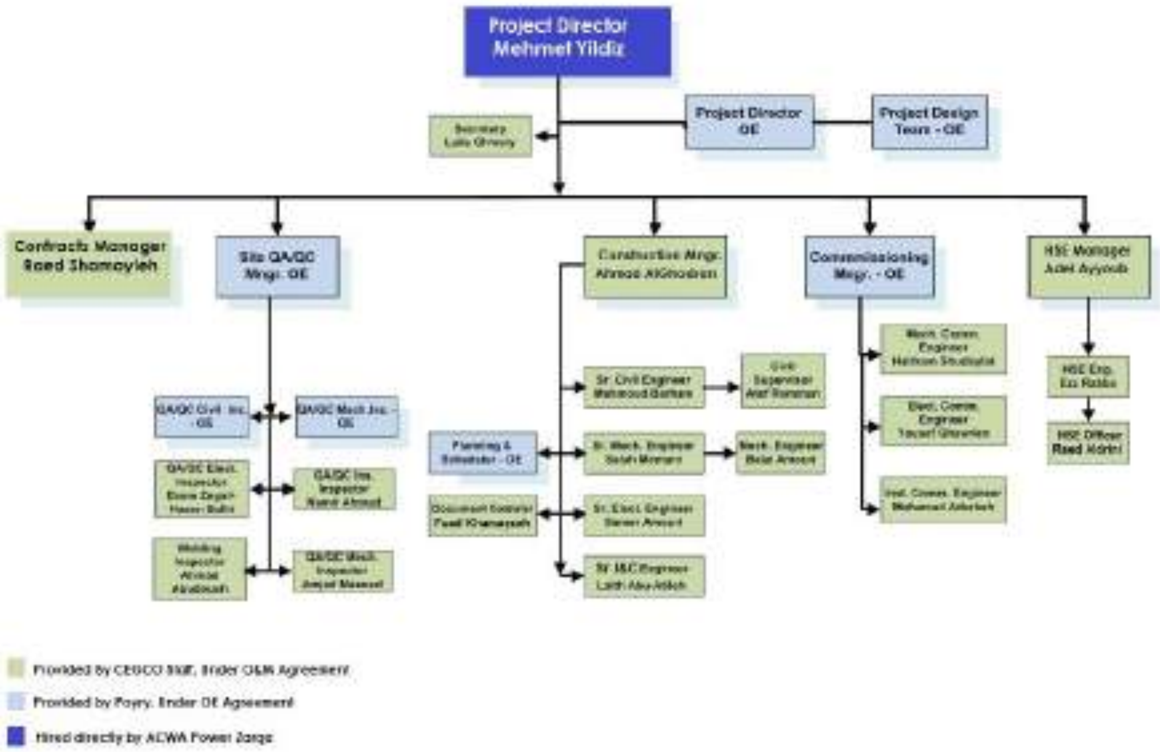
ACWA Power Zarqa will directly employ 6 staff during construction. These will include:

- 1 CEO;
- 1 Project Director;
- 1 CFO;
- 2 Accountants;
- 1 Public Relations Manager;

Additional staff not listed above include those from the Owners Engineer (Poyry) and those from CEGCO who will work with ACWA Power Zarqa under the O&M Agreement. The staff from Poyry and CEGCO (under the O&M Agreement) can effectively be considered part of the project company.

The proposed structure of ACWA Power Zarqa during construction (for staff stemming from the Project Director) is shown below, with staff included from the owner's engineers and CEGCO.

Figure 3-10 ACWA Power Zarqa Staff Organogram



As per the above staff organogram, ACWA Power Zarqa's staffing structure includes a HSE Manager and HSE team. The HSE Manager and Team are provided by CEGCO under the O&M Agreement and will oversee HSE on behalf of the project company, ACWA Power Zarqa. This HSE team will oversee SEPCO III's dedicated HSE Team on-site. Both HSE teams will be subject to co-ordination and inspection by ACWA Power Corporate HSE personnel.

Construction Laydown Areas

The construction laydown area will comprise several areas within the existing HTPS landholding, thanks to the availability of land in these areas. These areas have initially been indicated on the proposed site plan in Appendix E. This includes the indication of site offices and administration blocks during construction (located to the south of the project site, within the CEGCO landholding).

A photograph of the area to be used for the construction laydown within the existing HTPS landholding is shown below. The area has an amount of existing training equipment for NEPCO (e.g. un-connected cables, high voltage power lines, pylons etc.). This training equipment will be removed prior to the establishment of the laydown areas.

Plate 3-22 Area for Construction Laydown

Workers and Facilities

At the peak of construction, it is anticipated that up to 1,500 workers will be employed on site. The EPC contractor and engaged sub-contractors will therefore be responsible for the on-site provision of workers services, such as canteens, domestic facilities and transportation.

The canteens will generate putrescible and domestic waste, which will be collected from designated areas for storage and removal to an appropriate municipal waste disposal facility. Additionally, litterbins will be provided around the construction site.

The domestic services will consist of sanitary facilities, including restrooms, water tanks and drinking water. All liquid sanitary facilities will drain to a centralized septic tank collection system, which will be emptied on a regular basis and transported off-site for disposal.

Finally, the contractors will be required to transport the work staff between a central location and the project site. Consequently, traffic will be generated from daily workforce commutes. It is anticipated that buses, vans, pick-up trucks and cars will be used for staff commute and equipment transport.

Worker Accommodation

An area for the EPC Contractors worker accommodation will be located off-site in an area of land close to the Al Samra power plant, approximately 3km north of the project. SEPCO III had leased this land previously during the construction of the Al Samra power plant Phase II project. The land had continued to be leased by SEPCO III in order to provide accommodation for other SEPCO III projects more generally in Jordan. The existing accommodation area is being expanded onto adjacent land to provide additional accommodation and recreational space for the approximate 200 SEPCO III staff for the ACWA Power Zarqa Project. The accommodation area will include a range of facilities, utilities and amenities, and will be prepared and managed for alignment with the IFC & EBRD guidelines for worker accommodation (August 2009).

The approximate location is shown on the image below, with the proposed accommodation area in orange. The size of the plot is 16,175m^2, and the lease is currently valid until 6th May 2017, upon which time it is expected to be renewed with the land owner.

The EPC camp is being leased as per the land lease agreement presented in Appendix R. SEPCO III have committed to providing accommodation and amenities that is up to the standard required by IFC and EBRD.

The location of any required sub-contractor camp/accommodation areas is not known at this point in time as specific sub-contractors have not been engaged. It is expected that the sub-contractors will employ a large proportion of local workers who will therefore live locally.

Figure 3-11 Proposed Worker Accommodation Area

Satellite Image Source: Google Earth

Sub-Contractor companies have not been confirmed at present, but are expected to be locally based. SEPCO III's experience of other local power projects suggests that the majority of sub-contractor staff will likely reside locally. Where sub-contractors enable require specific worker accommodation areas, they will provide facilities to a standard consistent with the IFC & EBRD Guidelines on Worker Accommodation. This will be a requirement of their sub-contractor agreements.

Figure 3-12 Current Overview of SEPCO III Camp Area

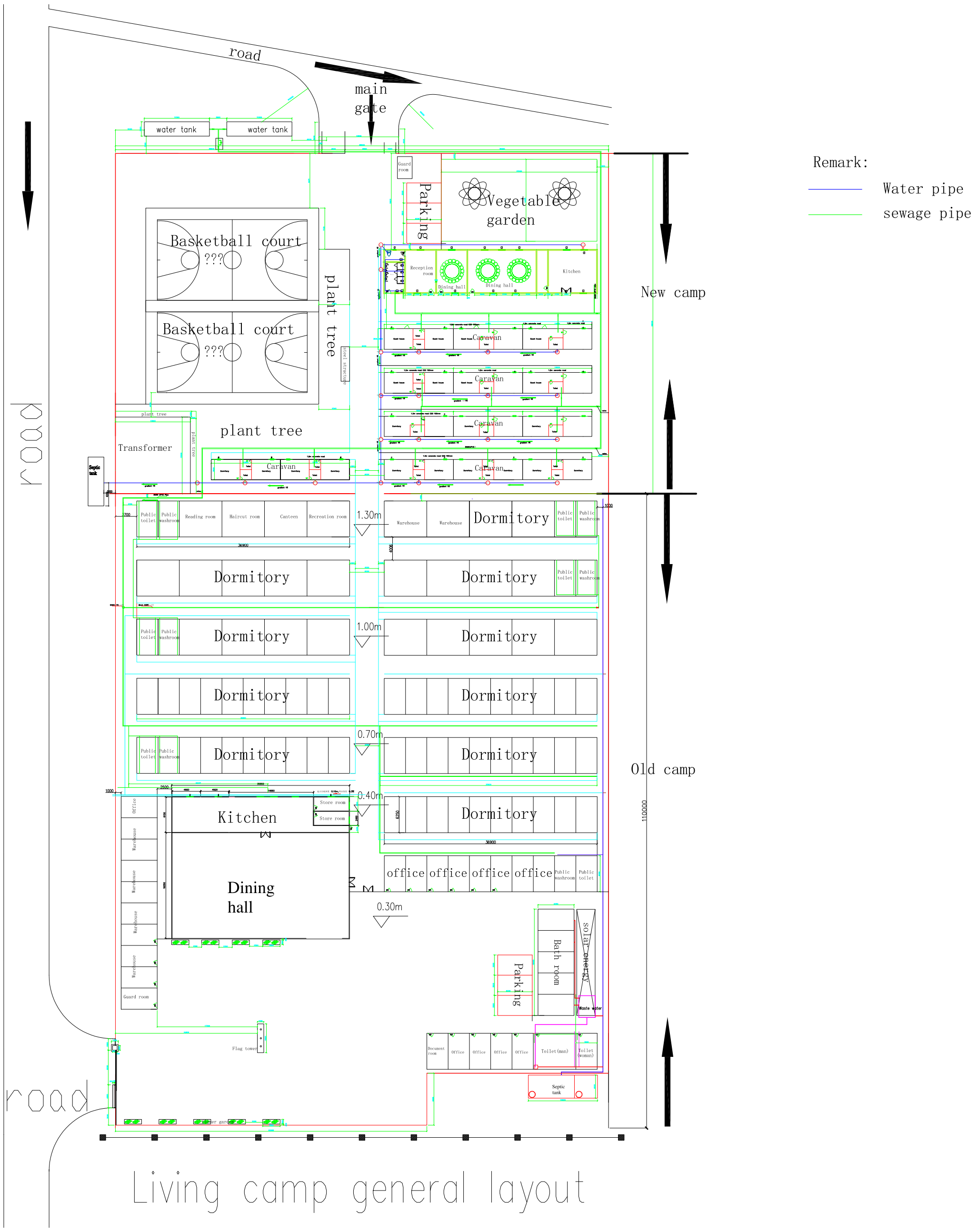
The EPC Contractors' accommodation area will include living accommodation, general amenities, recreational facilities and security to ensure healthy and safe living. Utilities at the accommodation area will be provided by temporary facilities. This will include water delivery by tanker, collection of domestic and sanitary wastewater in septic tanks and electrical generation by temporary diesel generators. All wastes and wastewater will be temporarily stored appropriately and removed from the accommodation area for treatment and/or disposal by a licensed handler to a licensed treatment facility.

A list of camp facilities and a plan showing the camp arrangement are shown overleaf.

Table 3-9 SEPCO III Accommodation Area Facilities

NO	Name of facility	Amount	Remark
1	Dormitory	68	
2	Guest room	21	Caravan
3	Office	13	
4	Warehouse	10	
5	Kitchen	2	
6	Dining hall	3	
7	Reception room	1	
8	Basketball court	2	
9	Public bathroom	3	
10	Public washroom	6	
11	Public toilet	6	
12	Reading room	1	
13	Haircut room	1	
14	Canteen	1	
15	Recreation room	1	
16	Guard room	2	
17	Document room	1	

Figure 3-13 SEPCO III Worker Camp Arrangement



Heavy Machinery

There will be a range of heavy plant and machinery required for use on site during the construction period and this will be managed by the individual contractor/sub-contractors working in their specific areas of the site. Heavy plant and machinery is likely to include the use of cranes, excavators, lorries, dump trucks, bulldozers, concrete pumps, generators, piling equipment, pavers and graders amongst other equipment.

Power Supply

Power supplies are likely to be provided by the use of generators (semi-permanent and mobile), which will be positioned around the site. It is anticipated that sub stations to the main grid will be connected to the site at some point during construction in order to provide electricity.

Fuel Requirements

Fuel requirements for vehicles and generators are currently unknown and are dependent on the requirement of electrical energy and construction plant during this period. Diesel is anticipated to be the main fuel for this use and will be used for the operation of the generators and construction plant. Where required, fuel will be the responsibility of the relevant contractor/sub-contractor as required.

Chemical and Hazardous Material Storage

Chemical and hazardous material storage during the construction phase will be undertaken by the relevant contractor/sub-contractor responsible for such chemicals or hazardous materials. Requirements for the storage of such substances will be set out in the site-specific Construction Environmental & Social Management Plan (CESMP) to be prepared by the EPC together with sub-plans by each sub-contractor, prior to the commencement of construction works at the site.

Solid Waste management

Solid waste management will be undertaken as part of an overall site waste management operation that will incorporate the requirements of waste producers, waste storage, transportation, removal and treatment/disposal.

Requirements for solid waste management will be set out in the site specific, standalone CESMP to be prepared prior to the commencement of construction works.

3.9 Operational Phase

The operation of the project will be initially based on a 25-year lifespan that coincides with the Power Purchase Agreement (PPA) and loan that will be obtained. It is possible that the operation of the plant may continue after this period subject to a further PPA and subject to compliance with the required Jordanian laws and regulations at this time.

The operation of the plant will effectively include the generation of power from the installed units and ongoing maintenance activities associated with this generation. The key power generating activity will be conducted in combined cycle mode via operation of the gas turbines, and the transfer of hot exhaust gases to the HRSG for steam generation.

The initial operation of the plant after commissioning will be undertaken in simple cycle mode, whereby the only electrical generation will be from the gas turbine generators. The plant can operate in simple cycle mode at a reduced output and operational efficiency compared to combined cycle. The intimal operation in simple cycle is required due to the ongoing installation of the HRSG, Steam Turbines and closed cooling system (via Air Cooled Condensers) that will continue after initial gas turbine installation.

Simple cycle operation may also be required during periods of maintenance, and allows an amount of flexibility for the plant and the required output demands, for the duration of the operational phase.

Operational Management and Staffing

The Project will be owned by ACWA Power Zarqa, a special purpose vehicle set up to own the project and power plant. A number of existing CEGCO staff have been transferred on a voluntary basis to ACWA Power Zarqa company. For these staff, their contracts with CEGCO have been completed to Jordanian legal requirements and they have been provided with new positions at the project company "ACWA Power Zarqa'..

ACWA Power Zarqa will employ 6 staff during operation. This will include:

- 1 CTO;
- 1 Project Director;
- 1 CFO;
- 2 Accountants;
- 1 Public Relations Manager;

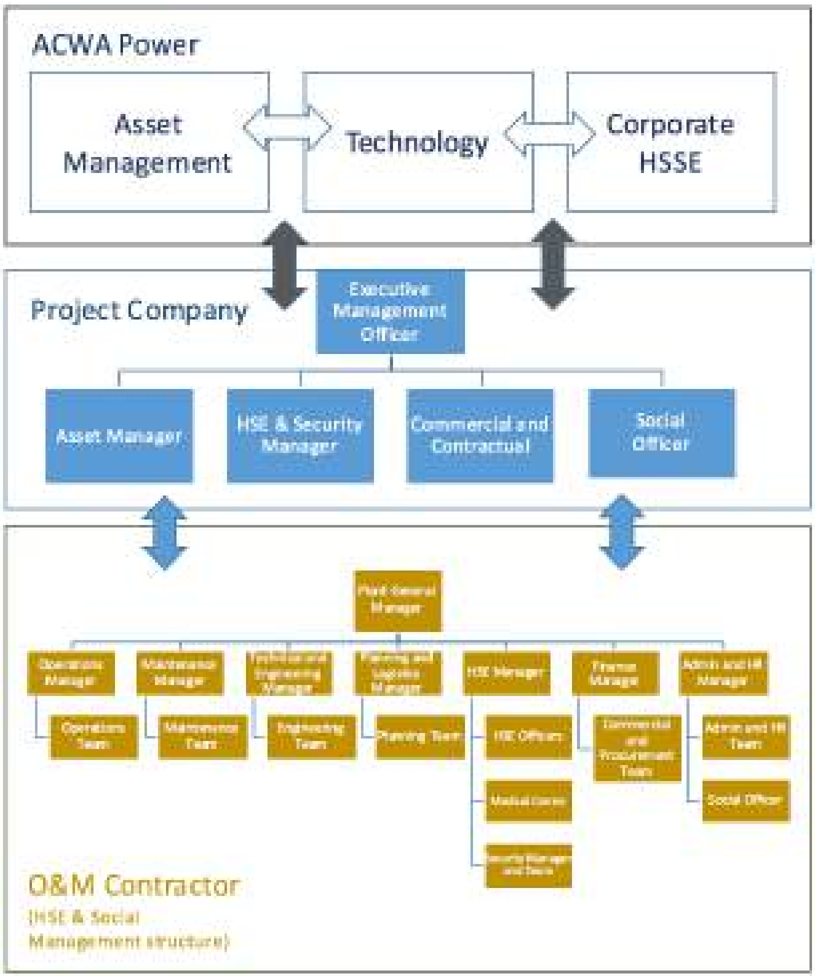
Additional staff not listed above include those from CEGCO who will work with ACWA Power Zarqa under the O&M Agreement. The staff from CEGCO under the O&M Agreement can be considered part of ACWA Power Zarqa. This will include a HSE Team, who will oversee the O&M's HSE Team.

The day to day operations of the project will be run by CEGCO (the O&M Company for the project), overseen by ACWA Power Zarqa. CEGCO will have a dedicated HSE Team on-site, running day to day management of the HSE aspects of operation. The CEGCO HSE Team will include an Environmental Manager and Social Officer.

Operational Structure and HSE Management

The projects operational structure and operational HSE management organisational chart is provided below.

Figure 3-14 Operational Structure and HSE Management



3.10 Decommissioning of ACWA Power Zarqa CCGT

The proposed CCGT project will operate under a PPA for a 25-year period, if at that time, NEPCO chooses to decommission the facility, then NEPCO will ensure the decommissioning of the thermal power station with respect to the measures describe in the Environmental & Social Management and Monitoring Plan (ESMMP). However, given the time lapse between the preparation of this ESIA and associated EMMP, the NEPCO would be required to carry out an Environmental Impact Assessment of the decommissioning that will be in accordance with the national and international environmental regulations, and any lending institution's environmental policies in force at the time of decommissioning.

The overhead transmission lines and supply pipelines, will be the property of NEPCO and hence NEPCO will be responsible of their decommissioning as well (if necessary).

3.11 HTPS HFO Plant Decommissioning/Disassembly

The decommissioning/disassembly of the existing HTPS will be undertaken by CEGCO as a separate project unrelated to the proposed ACWA Power Zarqa project.

Plate 3-23 Existing HTPS HFO Plant (For Decommissioning) – Photo: August 2012

Decommissioning Plan

An indicative decommissioning plan for the existing HTPS, has been provided by CEGCO, as shown below.

Table 3-10 Indicative Existing HTPS Decommissioning/Disassembly Plan

Task Name	Days	Start
Decommissioned Fuel handling, including sale of remaining quantities in tanks of decommissioned units	186 days	Dec 2016
Sell Boilers	196 days	November 2016
Dismantling the units	44 days	April 2017
Deliver to awarded companies	43 days	July 2017
Sell Turbines	134 days	August 2017
Dismantling the units	44 days	November 2017
Deliver to awarded companies	24 days	January 2018
Sell Transformers	109 days	March 2018
Dismantling the units	33 days	June 2018
Deliver to awarded companies	34 days	July 2018
Sell Fuel Tanks	153days	September 2018
Dismantling the units	33 days	November 2018
Deliver to awarded companies	22 days	January 2019
Final Demolition Phase	44 days	January 2019
All remaining equipment, buildings ...etc. , to be removed or to be sold to scrap dealers.	21 days	February 2019
Final Cleaning of land	24 days	March 2019

In line with the initial decommissioning plan provided by CEGCO, the existing structure, including all mechanical units and fuel containers, related services and infrastructure will be decommissioned gradually between December 2016 until March 2019. This period of decommissioning will coincide with both the construction and operational phases of the proposed project.

HSE and Emergency Planning & Preparedness During HTPS HFO Decommissioning

A number of HSE and emergency risks will be present during the decommissioning of the existing HTPS HFO plant. Without specifically detailing Health and Safety risks for a separate project from the proposed CCGT plant, such risks may occur due to the falling of items, residues of fuels tanks amongst many other aspects.

Due to the proximity and location of the existing HTPS HFO plant above the proposed CCGT project, such risks have the potential to impact upon construction/operation of the proposed plant with potential impacts to built structures and the safety of site personnel.

In this instance, it is important that at the time of full decommissioning, effective HSE and emergency planning is undertaken and is consistent with the plans developed by the proposed CCGT project. During the preparation of plans by CEGCO (or their engaged demolition company), the project company and EPC Contractor (SEPCO III) will engage in a review and collaboration for the specific HSE and emergency plans relating to this project. Further, the proposed ACWA Power Zarqa project plans for HSE and Emergency Planning (during construction and operation) will include reference to the proposed demolition of the existing HTPS HFO plant, inclusive of plans to follow in the event of an emergency situation at the decommissioning site.

Land Use Post HTPS HFO Decommissioning

At present, the use of the land following decommissioning is unclear and there are no specific plans for any sort of development on this land at this stage for CEGCO. In particular, there are no governmental plans available for development in the remaining area of the HTPS plant area after demolition, and there has been no indication from NEPCO in regard to proposed future plant expansions, or additional power facilities on this land. Specifically, NEPCO have remarked in meetings that there are no plans for this land, and that future power developments have been proposed in other areas of Jordan, not the Zarqa area, due to the capacity that will be provided by the proposed CCGT plant in combination with the Al Samra plant (1,031MW). It is understood that the earliest plan NEPCO have for a new fossil fuel power plant in Jordan is for a CCGT plant in 2027 in the city of Irbid in the north of Jordan (approximately 75km from the proposed project site).

It is therefore not possible to speculate in regard to a cumulative assessment of this future land use following decommissioning in this ESIA.

3.12 Permitting

A list of required permits required for the project is outlined in Appendix S.

3.13 Project Performance to IFC Performance Standards and EBRD Performance Requirements

The following table summarises the proposed projects performance against the respective IFC Performance Standards and EBRD Performance Requirements. Where PS/PR's are not applicable this has been stated or sub-sections not included.

Table 3-11 Project Performance to IFC Performance Standards and EBRD Performance Requirements

IFC Performance Standard EBRD Performance Requirements	Project Performance
PS 1: Assessment and Management of Environmental and Social Risks and Impacts **PR 1: Assessment and Management of Environmental and Social Impacts and issues**	**ESMS / Environmental and Social Management System** In general, the project will adopt an ESMS and policy consistent with ACWA Power corporate requirements and Policy. The projects ESIA includes an Outline ESMMP (ESIA, Volume 3) that can be used as a guide to prepare the site specific CESMP and OESMP. The site-specific CESMP & OESMP will form the basis of environmental and social management on the project site during construction and operation. The CESMP and OESMP will be living documents and will therefore be updated throughout the projects lifetime, where changes in operations, site management or regulation occur. **Policy / Environmental and Social Policy** The Project Company ESMS will be based on the existing environmental & social policy of ACWA Power. **Identification of Risks & Impacts / Environmental and Social Assessment** This ESIA has assessed the potential environmental and social impacts, and outlined the applicable regulations & standards in regard to the project (as per those relevant in Jordan and in line with the IFC General EHS guidelines and sector specific EHS guidelines for Thermal Power plants. Further and in line with EBRD requirements, the assessment has included assessment against European Union standards as appropriate. **Management Programs / Environmental and Social Management Plan** This ESIA has provided an outline Environmental & Social Management & Monitoring Plan (ESMMP) (ESIA, Volume 3) that is consistent with measures to reduce or to ameliorate project impacts, as detailed in this ESIA (Volume 2). The framework ESMMP documents will be used by the EPC Contractor (SEPCO III) and the O&M Company (CEGCO) to prepare the site specific CESMP and OESMP.

	Organisational Capacity and Competency / **Organisational Capacity and Commitment** The Outline ESMMP (ESIA, Volume 3) includes a guide for how the organisational structure should be arranged to manage environmental and social risks at the construction and operational phases. This is also consistent with roles included to the Stakeholder Engagement Plan (SEP). **Supply Chain Management** As appropriate, key supply chains will be monitored periodically during operations to ensure that materials, goods and service providers do not employ forced or child labour, whilst ensuring the suppliers have a suitable occupational health and safety record. The requirements for monitoring of the supply chain is outlined in the ESIA Volume 3, which is intended to be built into the projects supply chain management plan (to be prepared by the EPC and O&M respectively for construction and operations). **Emergency Preparedness and Response** A section of the outline ESMMP (ESIA, Volume 3) outlines the requirement for the identification of risks in order to develop an Emergency, Preparedness and Response Plan. The need for consistency and perhaps integration of this plan with those of other local industries/ emergency services and dialogue to local communities and concerned stakeholders is outlined in ESIA Volume 3. **Monitoring & Review** / **Project Monitoring and Reporting** The Outline ESMMP (ESIA. Volume 3) includes an outline of the required compliance monitoring developed from the projects mitigation measures. The requirements for monitoring will be developed into the environmental monitoring plans as part of the site-specific CESMP and OESMP documents. This will include the requirement for periodic independent monitoring and reporting in line with the IFC/EBRD requirements. **Stakeholder Engagement** An amount of community engagement in regard to this project has already been undertaken as is outlined in various sections of this ESIA Volume 2. This included a stakeholder meeting at the ESIA scoping stage. A Stakeholder Engagement Plan (SEP) has been prepared separate to the ESIA to demonstrate the intended plans for stakeholder engagement throughout the projects lifecycle. It is noted that the SEP will be a living document and will change over time in line with changes to community /stakeholder dynamics, new regulations and changes to the power plants lifecycle. **External Communications and Grievance Mechanisms** The SEP prepared for the project details the external communication channels, stakeholders and grievance mechanism, as well as the process for its implementation.

	On-going Reporting to Affected Communities As per the 'External Communications above, the SEP prepared for the project details the external communication channels and appropriate stakeholders for reporting.
PS 2: Labour and Working Conditions **PR2: Labour and Working Conditions**	**Working Conditions and Management of Worker Relationships / Human Resources Policies / Working Relationship / Non-Discrimination and Equal Opportunity / Grievance Mechanism** The EPC Contractor (SEPCO III), O&M Company (CEGCO) and the project company (ACWA Power Zarqa) has provided assurance that the ACWA Power HR policy will be adopted as the overarching Policy for its own operations and will be implemented to any sub-contractor companies via their sub-contractor agreements. Where suitable skilled and unskilled labour is available locally, SEPCO III, CEGCO and the project company will engage these labour pools as first preference (where vacancies apply). The ESIA recommends that the HR policy for construction and operations include a system of equal opportunities and non-discrimination, that has clear worker terms of contract and a grievance mechanism (as outlined in PS1). The SEP includes a detailed grievance mechanism for the project that can be used by internal staff (construction and operation phases) as well as by external parties. The overarching ACWA Power HR Policy will provide the basis upon which the projects HR Policy will be developed. The projects HR Policy will ensure alignment with Jordanian labour law and will ensure consistency with international ILO and UN conventions. The ESIA outlines specific mitigation measures for worker accommodation, if accommodation is necessary. **Protecting the Work Force / General /Child Labour / Workers Organisaitons /Wages, Benefits and Conditions of Work / Worker Accommodation** The overarching ACWA Power HR Policy will provide the basis upon which the projects HR Policy will be developed (inclusive for ACWA Power Zarqa Company, and to be adopted by SEPCO III's in their construction HR policy, as well as CEGCO for their operational HR policy). The projects HR Policy will ensure alignment with Jordanian labour law and will ensure consistency with international ILO and UN conventions: • ILO Convention 87 on Freedom of Association and Protection of the Right to Organize • ILO Convention 98 on the Right to Organize and Collective Bargaining • ILO Convention 29 on Forced Labor • ILO Convention 105 on the Abolition of Forced Labor • ILO Convention 138 on Minimum Age (of Employment) ILO Convention 182 on the Worst Forms of Child Labor • ILO Convention 100 on Equal Remuneration • ILO Convention 111 on Discrimination (Employment and Occupation)

	• UN Convention on the Rights of the Child, Article 32.1 • UN Convention on the Protection of the Rights of all Migrant Workers and Members of their Families Note: In line with the above, the ACWA Power HR Policy the minimum age of working is 18 years. Freedom of Association (FoA)and collective bargaining is included to the ACWA Power annual sustainability reports and our "Our Commitments" policy under "making certain of human rights, the safety and welfare of workers, fair employment and equal opportunity practices across our operations" where Human Rights is intended to cover FoA and Collective Bargaining. The ESIA outlines specific mitigation measures for worker accommodation, in line with the lender requirements. **Occupational Health & Safety / Occupational Health & Safety** SEPCO III and CEGCO staff will include a dedicated Health and Safety team as part of its structure during site activities. On-site health and safety will ensure that all staff are appropriately trained in order to safely undertake their working activities. All staff will be provided with the necessary Personal Protective Equipment, specific to their working duties. Representatives from the respective Health and Safety Teams will be available on site at all times and will co-ordinate with the health and safety representatives of any employed sub-contractor companies. **Retrenchment** The project company has and will continue to employ personnel that were originally engaged in employment with CEGCO at the existing Hussein TPS. The project does not intend to implement any collective dismissals. Where considered necessary the process for such dismissals will undertake an analysis of alternatives in regard to retrenchment. Where retrenchment is the only alternative available, this would result in the development of a retrenchment plan in order to reduce adverse impacts upon workers. A retrenchment plan would ensure compliance with all relevant local laws, and would also align with the requirements of IFC PS2. **Workers Engaged by Third parties / Non-Employee Workers** In line with the overarching project HR policy and as per the comments above regarding the roll out of the ACWA Power HR Policy to the EPC and sub-contractors, the EPC has confirmed that sub-contractor agreements will include mechanisms to ensure that the rights for third party workers are the same as those employed directly by the project, as per the IFC PS requirements outlined above (including access to a grievance mechanism). This will be implemented during construction and also by CEGCO during operations.

	Supply Chain / Supply Chain As appropriate, key supply chains will be monitored periodically during operations to ensure that materials, goods and service providers do not employ forced or child labour, whilst ensuring the suppliers have a suitable occupational health and safety record. The requirements for monitoring of the supply chain is outlined in the ESIA Volume 3. **Security Personnel Requirements** The project constitutes a project of national importance and will employ security personnel through the construction and operational phases. SEPCO III have confirmed that a security company has already been employed for the construction phase. The security company will be armed and will also be trained in relation to weapons handling and human rights. Specifically, SEPCO III have confirmed that security arrangements be guided by UN Code of conducts for law enforcement officials and UN basic principles on the use of Force and Firearms by law enforcement officials. SEPCO III have prepared a security risk assessment, which is presented in Appendix T. SEPCO III will a prepare a Security Plan based on the security risk assessment, which will be reviewed by ACWA Power and the lenders, to ensure applicability to the Voluntary Principles on Security and Human Rights and IFC PS4 During operation CEGCO will employ internal security personnel to protect and patrol the exterior of the plant and gatehouses from any threats. All security personnel arrangements for CEGCO will be structured in line with the same arrangements as for SEPCO III (as above); this includes preparation of the security risk assessment and security plan. Besides the above, security personnel will receive internal training in regard to grievances, reporting such grievances and dialogue with any members of the local community.
PS 3: Resource Efficiency and Pollution Prevention **PR 3: Resource Efficiency and Pollution Prevention and Control**	**Resource Efficiency / Resource Efficiency / Greenhouse Gases** Given that the purpose of the project is to produce power, all aspects of the project will look to increase the efficiency of the plant in terms of the energy it uses versus the power output, but also in reducing the amount of energy the plant consumes. This also ensures the most efficient use of materials and fuels in order to maximise power output. Project efficiency will be 49.6% (Net, based on Natural gas firing, LHV), and will be one of the most efficient power plants in Jordan, as shown below with lowest HHV and LHV values for both fuel types.

Table 3-12 Efficiency Comparison of ACWA Power Zarqa vs. Recent IPP Projects in Jordan

Exiting Jordan Power Plant Guaranteed Heat Rates Comparison						
Power Plant	**Phase**	**Fuel**	**Percent of Dependable Capacity**	**Capacity (MW)**	**HHV (kJ/kWh)**	**LHV (kJ/kWh)**
Amman East	Combined Cycle	Natural Gas	100%	369.67	8,390	7,538
Al Qutrana	Combined Cycle	Natural Gas	100%	373.073	8,406	7,552
ACWA Power Zarqa	Combined Cycle	Natural Gas	100%	485	8,187	7,356
Amman East	Combined Cycle	Distillate Fuel	100%	330	8,399	7,890
Al Qutrana	Combined Cycle	Distillate Fuel	100%	330.297	8,399	7890
ACWA Power Zarqa	Combined Cycle	Distillate Fuel	100%	468	8,293	7,790

Source of data from the respective IPP PPA's

The projects predicted greenhouse gas emissions are as follows:

CO2 emission:

Sl. No.	**Fuel**	**CO2 emission (tonnes per hour)**	**Operating hour per year**	**CO2 emission (tonnes per year)**
1	Natural gas	194.13	7860	1,296,979
2	Liquid fuel	270.38	900	206,840
			8760	**1,503,819**

The above calculation is with 85% plant load factor

Electricity production:

Sl. No.	**Fuel**	**Net output (MW)**	**Operating hour per year**	**Total per annum (MW hr)**
1	Natural gas	485	7860	**3,240,285**
2	Liquid fuel	468	900	**358,020**
			8760	3,598,305

Natural Gas – Carbon Intensity				
1	Flue gas flow rate	1283.93	t/h	For gas firing considering the degradation factor
2	% weight of CO2 in flue gas	5.04		
3	CO2 emission	64.71	t/hr	For 1 GTG
	CO2 emission	194.13	t/hr	For 3 GTG
4	Plant net output	488.8	MW	As per EPC Guarantee value
5	Plant gross output	505.6	MW	
6	CO2 emission	**397**	g/kWh	Net
		384	g/kWh	Gross

Note: Derived via stoichiometric calculation for natural gas firing.

Greenhouse Gas Emission Intensity Comparison

Scenario	Carbon Intensity (gCO_2/kWh)
Average Carbon Intensity for Electricity Generation Using Natural Gas, Jordan Source: IFC CEET Tool (09/01/2013) – via - CO2 Emissions from Fuel Combustion Highlights (2012 Edition), © OECD/IEA, Paris, 2012, page 111-122.	573
World Bank Group Thermal Power (2008) Recommendations Target for New CCGT Ref: Table 4, Typical CO2 Emissions Performance of New thermal Power Plants: Efficiency (% Gross, LHV), pp. 8, (World Bank Group, 2008)	396

In comparison to the table above, the project is expected to be well below the current carbon intensity of energy projects in Jordan (on Natural Gas). The comparison of predicted CO_2/kWh vs. World Bank Group recommended carbon intensity rates, indicates very similar values for new CCGT plants.

Water efficiency of the project will also be high due to re-use of treated process water streams. Based on natural gas firing the for typical operations the % of water to be re-used will be up to 70.8% in the summer with evaporative cooling off (40.4% with evaporative cooling on). Efficiency is reduced for LDO firing due to a higher water demand, but will still re-use an amount of treated wastewater.

Pollution Prevention / Pollution prevention and Control

	The ESIA has described and assessed the significance of the foreseeable environmental and social issues related to the construction an operation of the project. A particular emphasis of the ESIA has been in relation to the pollution prevention and minimisation through use of suitable mitigation and management measures on the site and applied to the projects externalities (air emissions, wastewater, solid & hazardous waste, noise, use of hazardous materials). Such mitigation measures include BAT and good industry practices during construction and operations, to ensure compliance with the requirements of the local Jordanian regulation, IFC EHS Guidelines and EC standards as appropriate. Volume 3 of this ESIA is dedicated as an Outline ESMMP, which outlines how the mitigation and monitoring measures outlined in the ESIA are to be implemented during the construction and operational phases of the project. The framework in Volume 3 is to be used to prepare detailed and site-specific CESMP and OESMP's documents by the EPC Contactor and O&M Company respectively to guide environmental and social management & monitoring at the relevant project stages; in relation to the mitigation set out in this ESIA. **Water** The project use of water is explained and assessed within this ESIA, but has been reduced as far as practically possible through the implementation of BAT (i.e. air cooled condensers) and water reduction techniques such as re-use. Water use is below 100m^3/hr under all operating conditions and seasons. **Waste** Waste Management and wastewater management have been assessed in separate sections of this ESIA. The project will reduce the generation of waste and wastewater as far as practically possible, particularly in regard to process wastewater, where the facility will not discharge untreated or treated process streams. **Safe use and management of hazardous substances and materials** As has been outlined in this ESIA the use of hazardous materials will be subject to several controls, this includes the management of any hazardous wastes generated by the project during construction and operation. **Pesticide use and management** The project will not use pesticides.
PS 4: Community Health, Safety and Security **PR4: Health and Safety**	**Community Health Safety and Security / General requirements for health and safety management / Occupational Health and Safety / Community Health and Safety / Emergency Preparedness and Response** The project site is located on brownfield land in close proximity to a number of residential properties (<200m to the nearest properties), as well as commercial and industrial activities.

	Although the project will not include specific public buildings or dedicated public facilities there is the potential for impacts to the wider community in the unlikely event of emergency conditions (e.g. fire, explosion, pollution of surface waters (wadi) etc.). The Outline ESMMP (ESIA, Volume 3) details the requirement to develop an Emergency Preparedness and Response Plan to deal with any potential disasters that may not be controllable within the site or with local emergency resources. Such impacts could affect local communities who live in proximity to the project site. The ESIA outlines the requirement for this plan to be prepared to ensure consistency between any local plans (e.g. at local industrial facilities) and co-ordination with the local communities. The ESIA also outlines the requirement to include suitable equipment for emergency situations and the required training of personnel in regard to the plan and in order to operate such equipment. This includes dialogue of this plan to the local community. As above, the SEP includes a grievance mechanism that will be implemented during the construction and operation phases and will be accessible to local communities. The project will include dedicated health and safety teams during both construction and operation. In the past CEGCO have had interactions with the local communities around the Hussein TPS, which has included the provision of health screening and GP services to such communities. **Infrastructure, Building and Equipment Design and Safety / Hazardous Materials Safety** All structures and site buildings will be constructed to suitable construction requirements based on the project design to ensure safety to those using the buildings and those living in l the project area. This includes the suitable containment of hazardous materials (e.g. bunded structures) and design of separate drainage systems and traps for oils/sediment prior to stormwater discharge. **Product Safety / Services Safety** These are not applicable as the plant is not producing products for distribution or providing primary services. **Traffic and Road Safety** Traffic and road Safety will fall under the Traffic Management Plan outlined as a requirement as part of this ESIA. The Traffic Management Plan to be prepared for construction and operation. The EPC and O&M will include measures to ensure the safety of local populations, other road users, pedestrians and communities. **Natural Hazards** The local area of the project is not known or recorded to be at risk from natural hazards. Although flooding is not foreseen, the plant will be slightly

elevated from the immediate local topography and wadi to ensure avoidance of flooding impacts.

Exposure to Disease

In general, the project operations will employ staff who have worked locally at the Hussein TPS and are within the local community.

For construction, workers will likely be mixed between local populations (predominantly for subcontractor staff) and expatriates (EPC staff). Workers will be in close proximity to nearby communities both at the site and at their camp location (e.g. <200m from residences at both locations). The Health and Safety teams on site will provide advice during training/inductions on exposure to disease.

During construction SEPCO III plan to protect against the spread of internal and external diseases by taking the following measures:

- Site personnel will only be cleared for work after with a medical fitness certificate from an authorized medical centre.
- SEPCO III project staff will include a Doctor, Nurse and First aiders. The medical staff shall ensure a monitoring and health surveillance program.
- Any reportable disease shall be diagnosed by the authorized occupation health centre doctor. Diagnosis includes identifying any new symptoms, or any significant worsening of existing symptoms.
- Any external and internal spreading diseases shall be diagnosed and taken the precautions as per the instructions from the national/ local medical authority.

Security Personnel

The project constitutes a project of national importance and will employ security personnel through the construction and operational phases.

Specifically, SEPCO III have confirmed that security arrangements be guided by UN Code of conducts for law enforcement officials and UN basic principles on the use of Force and Firearms by law enforcement officials. SEPCO III have prepared a security risk assessment, which is presented in Appendix T. SEPCO III will a prepare a Security Plan based on the security risk assessment, which will be reviewed by ACWA Power and the lenders, to ensure applicability to the Voluntary Principles on Security and Human Rights and IFC PS4

During operation CEGCO will employ internal security personnel to protect and patrol the exterior of the plant and gatehouses from any threats. All security personnel arrangements for CEGCO will be structured in line with the same arrangements as for SEPCO III (as above); this includes preparation of the security risk assessment and security plan.

Besides the above, security personnel will receive internal training in regard to grievances, reporting such grievances and dialogue with any members of the local community.

PS 5: Land Acquisition and Involuntary Resettlement **PR 5: Land Acquisition, Involuntary Resettlement and Economic Displacement**	**General / Avoid or Minimise Displacement** The project will involve the construction and operation of a CCGT plant on brownfield land within the existing CEGCO landholding of the Hussein TPS. Land for the project is being leased from CEGCO by the Project Company. The projects key facilities will not directly result in the physical and economic displacement of local residents, property & landowners. The project includes associated facilities including a gas pipeline spur (600m length through public (wadi) and private land (approximately 200m of open and undeveloped land with no identifiable specific or informal land use) and a new water pipeline spur (buried under existing road network). Land acquisition for both facilities is not expected, but would require right of way access to be obtained as necessary by NEPCO and WAJ respectively. ACWA Power Zarqa will co-ordinate, support and monitor the process being undertaken by NEPCO & WAJ to ensure consistency to IFC PS5 and EBRD PR5 (including any gaps form the Jordanian requirements) when pursuing the Right of Way, including any compensation entitlements relating to the temporary construction disturbances and future maintenance. PS5 and PR5 are generally consistent with the Jordan Acquisition Law, which includes mechanisms for consultation with affected landowners and grievances (amongst other similar principles). Further, ACWA Power Zarqa will ensure that affected landowners have access to the projects grievance mechanism and are included to on-going consultation as per the SEP. In regard to the project design, the lease of the project land within the existing CEGCO landholding has avoided any direct land acquisition. The project therefore has no physical or economic displacement of key facilities requiring compensation, or livelihood restoration. **Displacement / Displacement** As above the project will not result in displacement due to key project facilities. The associated facilities will be located underground within existing open land and a wadi. This will therefore not result in the physical displacement of people and will not cause economic displacement. **Private Sector Responsibilities Under Government Managed Resettlement** This is not applicable for the project, as there is no resettlement.
PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources **PR 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources**	PS6 and PR6 are not triggered by this project, or its associated facilities.

PS 7: Indigenous Peoples **PR 7: Indigenous Peoples**	PS 7 / PR7 is not triggered by the project, as the local community does not consist of any identified indigenous populations.
PS 8: Cultural Heritage **PR 8: Cultural Heritage**	**Protection of Cultural Heritage in Project Design and Execution / Screening for Impacts on Cultural Heritage / Avoiding Impacts / Chance Finds Procedure** The ESIA has not identified any known cultural or archaeological features/artefacts within the site footprint. Further research of such features has no identified any in the expected routing of the associated facilities. The ESIA has outlined the need for a chance finds procedure to be developed during the construction phase, in line with the working brief provided. **Projects Use of Cultural Heritage / Projects Use of Cultural Heritage** This aspect of PS 8 is not applicable to the project as the project will not make use of existing cultural heritage.
PR 9: Financial Intermediaries	Not applicable to the ACWA Power Zarqa CCGT Project.
PR10: Information Disclosure and Stakeholder Engagement	**Stakeholder Identification / Stakeholder Engagement Plan** An amount of community engagement in regard to this project has already been undertaken as is outlined in various sections of this ESIA Volume 2. This included a stakeholder meeting at the ESIA scoping stage, where stakeholders were identified in tandem with the MoE in Jordan. The full report for stakeholder engagement is presented in Appendix F, with a summary of the process included to Section 4.4 of this volume. Key discussion topics included Air Quality, Water Resources, Noise, Occupational Health & Safety and Employment Opportunities. A Stakeholder Engagement Plan (SEP) has been prepared separate to the ESIA to demonstrate the intended plans for stakeholder engagement throughout the projects lifecycle. It is noted that the SEP will be a living document and will change over time in line with changes to community /stakeholder dynamics, new regulations and changes to the power plants lifecycle. The SEP identifies representative project stakeholders. **Information Disclosure / Meaningful Consultation / Disclosure and Consultation on Category A Projects / Engagement During Project Implementation and External Reporting /Grievance Mechanism** Information has been disclosed to stakeholders at the scoping consultation meeting where stakeholders were also invited to input their opinion and discuss the project generally, whilst asking questions. The minutes from the scoping consultation meeting have been included to this ESIA and te ESIA scope was adjusted to take account of requests in regard to the comments received. Further, an consultation meeting on the main outcomes of the supplemental ESIA will take place in line with requests by EBRD and IFC; as

	outlined in the SEP. On-going consultation and reporting during the project stages is outlined in the SEP, along with a grievance mechanism. The project's ESIA package has been disclosed in a preliminary nature on the IFC website and will be further disclosed on the EBRD website prior to financial close.

4 ESIA METHODOLOGY

4.1 Introduction

The ESIA methodology is specific to each of the technical subjects but includes, as a minimum, a desk study review of available information and standards, on-line information sources, and existing site data and laboratory analyses where available. Detailed site surveys, monitoring and predictive modelling have been undertaken to study the baseline situation and to predict impacts.

4.2 Delineation of Study Boundaries and Scope of Assessment

The ESIA will assess the potential impacts related to the proposed projects construction, commissioning and operation, as described in Chapter 3 of this ESIA. The proposed project is located within the existing landholding of the Hussein TPS, owned by CEGCO. No land acquisition will be required for the project or its associated facilities.

In addition, the associated facilities set out in Chapter 3 of this ESIA will also be assessed. It should be recognised that significant efforts have been made to obtain design data regarding the associated facilities (e.g. routings capacities, requirements for land acquisitions, EIA requirements etc.), upon which the assessments have been made. Specific information regarding the gas pipeline spur has been kindly provided by NEPCO, whilst an amount of information regarding the water pipeline has also been provided by WAJ, not including the intended routing. As such, this ESIA has included an appropriate level of assessment in regard to the information available and provided. Such assessment is included to the appropriate construction or operational related sections of each chapter. It is noted that no land acquisition for the pipelines will be required and both will be located sub-surface without any severance (e.g. fence lines). Only right of way access requirements will be necessary.

The decommissioning and disassembly of the HTPS has been included to the cumulative impacts section of the ESIA, as this relates to a different and future project (off-site from the proposed project) to be undertaken by CEGCO. However, the decommissioning is initially scheduled to coincide with the construction and operation of the proposed project. As such, relevant chapters such as air quality, noise, waste and cultural heritage & Archaeology include a qualitative assessment of the potential cumulative impacts of this decommissioning exercise.

4.3 Baseline Surveys

Forming an integral part of the ESIA, the baseline surveys provide a benchmark of the existing conditions by which the potential impacts of the proposed CCGT project can be assessed for the construction and operational phases.

The baseline surveys are commensurate to those outlined in the projects Terms of Reference (scoping study) approved by the Ministry of Environment, following the scoping consultation exercise with key stakeholders. The scope of the ESIA, including that of the baseline surveys is also based upon dialogue with IFC and EBRD (via conference call).

The environmental baseline surveys carried out as part of the ESIA have consisted of the following:

- Site walkover survey – 2010, September - November 2012, February - April 2016;
- Air Quality Monitoring – February – April 2016

- Noise baseline survey – February 2016, March 2016 and April 2016
- Terrestrial ecology baseline survey – February 2016;
- Soil sampling survey – March 2016
- Groundwater Quality survey – February & March 2016
- Scoping consultation exercise– 23rd February 2016
- Other consultation – Ongoing between February – April 2016

These surveys are described in the relevant chapters, with analysis results provided, and included to the applicable appendices. The surveys have intended to provide representative data in regard to the area that may potentially be impacted by the project. Justification of the scope of such studies has been provided in the approved Environmental Scoping Study.

4.4 Consultation Process

The scale and nature of the proposed project and the emphasis that the Jordanian and lenders requirements place upon stakeholder engagement ensures that consultation is an important aspect of the environmental impact assessment process.

Of particular note is the scoping consultation exercise that was undertaken on 23rd February 2016, where the Ministry of Environment invited identified local stakeholders to a meeting to discuss the scope of the project and that of the ESIA. The full overview of the scoping consultation exercise is presented in Appendix F.

Plate 4-1 Scoping Consultation Photographs

The points raised during the consultation process have been addressed in this ESIA, or the ESIA scope was adjusted to suit the consultation outcomes. For example, such key outcomes included the need to undertake a more extensive noise monitoring survey for the baseline.

Table 4-1 Comments Addressed from the Scoping Consultation Exercise

Comments from Scoping Consultation Exercise	How comments have been addressed in the ESIA
A stakeholder stated that additional air quality monitoring points should be considered at areas located at a distance from the project site in order to improve the accuracy of the modelling results and pollutant concentrations in such areas (given that all air quality monitoring points are currently located within the Project site and adjacent nearby areas only). In	Data collected from the the project site area is considered representative of the local air shed within which the dispersion of project emissions will occur. As the locations of these monitoring stations are downwind of the petrochemical refinery, the results of the monitoring activities are taken to indicate the worst case conditions in the air shed locally. The worst case baseline conditions have therefore been taken as the background for the cumulative impacts assessment of the emissions dispersion model. As such the emissions modelling undertaken in the

Comments from Scoping Consultation Exercise	How comments have been addressed in the ESIA
addition, several stakeholders suggested that such data could be available from the Ministry of Environment's continuous air quality monitoring program in the area.	ESIA portrays the worst-case in terms of ambient air quality as a result of the project. *See the Air Quality Section*
A stakeholder stated that there must be a continuous air quality monitoring program during the operation phase of the project to measures stack emissions and which should be coordinated with the Environmental Monitoring Department at the Ministry of Environment.	The project will include Continuous Emission Monitoring Systems (CEMS) on each stack. *See the Project Description and Air Quality Sections*
A comment was raised on the noise baseline monitoring duration stating that 1 hour of monitoring during daytime and 1 hour of monitoring during night-time is not considered sufficient.	The noise baseline study was revised initially based on the feedback of the scoping consultation and was again undertaken following comments form MoE in regard to the scoping report approval. Three separate noise surveys were conducted. The last survey was undertaken over 3 days and 3 nights, with hour long noise monitoring undertaken at 6 locations for both daytime and night time periods. *See Noise Baseline Section*
Some stakeholders inquired about the water requirements of the Project and how will it be supplied and also required that the potential impacts on water resources in the area be studied as part of the EIA.	Water sources are explained in the Project Description. In regard to groundwater, a hydrogeology study had previously been undertaken in regard to this resource. The impacts upon the potential abstraction of back-up water (from groundwater) have been assessed in the ESIA. *See Project Description and Water & Wastewater Sections*
Several comments were raised requiring that the EIA identify all the waste streams that will be generated from the project (including hazardous waste) and identify the appropriate handling and disposal measures to be implemented.	The ESIA includes expected waste streams as a result of construction and operation. The ESIA outlines the requirement for the EPC Contractor and O&M Company to prepare Waste Management Plans specific to the construction and operational phases. Specific mitigation in regard to waste and how it should be managed & handled is outlined in provided in the ESIA. *See Waste Management Section*
A stakeholder required that the EIA must identify appropriate measures to prevent urbanization in areas close to the thermal power plant. This could include for example the acquisition of land areas adjacent to the power plant.	As the project is a new facility within an existing land holding of CEGCO, it is generally not considered that the project will lead to wider land use changes than have and are currently occurring. Land use planning outside of the project scope is not considered a responsibility of the ESIA. Potential impacts upon community health, safety and security have been assessed as part of the ESIA. The request is considered to be outside of the scope of the ESIA. *See Socio-Economic and Community Safety & Security Sections*
A stakeholder inquired on how employees of the old HTPS will be dealt with and that this should be addressed as part of the EIA study.	Employment in regard to existing HTPS employees and future employees at the new project site has been detailed in various sections of the ESIA. *See Socio-Economic Section and Project Description*

Comments from Scoping Consultation Exercise	How comments have been addressed in the ESIA
A stakeholder required that the EIA must cover the associated facilities of the Project such as the gas pipeline	The ESIA includes assessment of the associated facilities where suitable design information for such facilities has been provided. Specific environmental parameters in regard to the associated facilities (e.g. biodiversity, cultural heritage and archaeology etc.) include assessment of such facilities. A sub-section of the Project Description fully outlines all information regarding the associated facilities. *See Project Description and relevant parameter sections*
The EIA must include an Environmental Emergency Response Plan which details procedures for dealing and handling of any environmental emergency which might occur at the Project site	The requirement for the EPC Contractor and O&M Company to develop project specific Emergency Preparedness and Response Plan has been included to the ESIA. These will be prepared prior to construction and operation. *See ESIA Volume 3 Outline ESSMP*

During the ESIA process there has been further engagement with the providers of the associated facilities (e.g. NEPCO, and WAJ) to understand the nature of such facilities and the processes that will be followed for environmental and social assessment, as well as any required land acquisition and resettlement. Such consultation has been via face to face dialogue and email correspondence.

In line with discussions with EBRD and IFC it is intended to hold a final consultation meeting to present the findings of this updated ESIA to the consultees who attended the scoping consultation exercise, as well as several representatives from three local community groups. Volume 1 of the ESIA (Arabic translation) will be provided to the consutees, and there will be the opportunity for comment. It is noted that this is not a specific requirement of the MoE in Jordan.

4.5 Impact Assessment Significance Criteria

In order to obtain a credible assessment of environmental impacts, the assignment of 'impact significance' for each identified impact needs to be a robust, consistent and transparent process. The methodology to assess 'impact significance' is outlined below and follows International Best Practice based on the assumption that the significance of an impact on resources or receptors is considered to result from an interaction between three factors:

The nature and magnitude of the impact or change;

The number of resources or receptors affected; and

The environmental value (sensitivity) of those resources or receptors to the change.

A three-step approach has been used to determine the significance of environmental effects, as follows:

- Step 1 – evaluation of value / sensitivity of resource;
- Step 2 – assessing the magnitude of the impact on the resource; and
- Step 3 – determining the significance of effects.

The magnitude of the impact is defined where possible in quantitative terms. The magnitude of an impact has a number of different components, for example: the extent of physical change, the level of change in an environmental condition, its spatial footprint, its duration, its frequency and its likelihood of occurrence where the impact is not certain to occur.

The criterion that has been used for assessing the magnitude of impacts includes the geographical scale of the impact, the permanence of the impact and the reversibility of the impacted condition. A brief description of the magnitude of the impacts is provided in Table 4-1 below.

Table 4-2 Criteria for Magnitude of Impact

Magnitude of Impact	Description of Magnitude
Major	Adverse: Loss of resource and/or quality and integrity; severe damage to key characteristics, features or elements. A major impact is usually large scale, permanent and irreversible. Beneficial: Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality.
Moderate	Adverse: Significant impact on the resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements. Moderate impacts usually extend above the site boundary, and are usually permanent, irreversible or cumulative. Beneficial: Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality.
Minor	Adverse: Some measurable change in attributes quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements. Minor impacts usually are only noticeable within the site and are temporary and reversible. Beneficial: Minor benefit to, or addition of, one (maybe more) key characteristic(s), features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring.
Negligible	Adverse: Very minor loss or detrimental alteration to one or more characteristics, features or elements. Beneficial: Very minor benefit to or positive addition of one or more characteristics, features or elements.
No change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.

In addition to the factors outlined in the table above, the possibility of any standards being breached will be taken into consideration in the determination of the magnitude of the impact.

The environmental value (or sensitivity) of the resource or receptor has been defined by using the criteria below.

Table 4-3 Environmental Value of Receptor or Resource

Value (sensitivity)	Description of Value
Very High	High importance and rarity on an international scale and limited or no potential for substitution. The receptor has already reached its carrying capacity, so any further impact is likely to lead to an excessive damage to the system that it supports. Locations or communities that are highly vulnerable to the environmental impact under consideration or critical for society (e.g. indigenous peoples, hospitals, schools).
High	High importance and rarity on a national scale, and limited potential for substitution. The receptor is closed to reaching its carrying capacity, so a further impact may lead to a significant damage to the system that it supports. Locations or communities that are particularly vulnerable to the environmental impact under consideration (e.g. residential areas, vulnerable/marginalized groups).
Medium	High or medium importance and rarity on a regional scale, limited potential for substitution. The receptor is already significantly impacted, but it is not close to reaching its carrying capacity. Further impacts will get increase the stress of the underlying system, but evidence does not suggest that it is about to reach a critical point. Locations or groups that are relatively vulnerable to the environmental impact under consideration (e.g. commercial areas).
Low (or Lower)	Low or medium importance and rarity on a local scale. The receptor is not significantly impacted and shows a large spare carrying capacity. Impacts are not likely to generate any noticeable stress in the underlying system. Locations or groups that show a low vulnerability to the environmental impact under consideration (e.g. industrial areas).
Very Low	Very low importance and rarity on a local scale. The receptor is not impacted and shows a very large spare carrying capacity. Impacts are very unlikely to generate any noticeable stress in the underlying system. Locations or groups that show a very low vulnerability to the environmental impact under consideration (e.g. industrial areas).

The existence of receptors that are legally protected (e.g. designated areas, protected habitats or species) will be taken into consideration for the assessment of the sensitivity of the receptors.

The significance of effects is a combination of the environmental value (or sensitivity) of a receptor or resource and the magnitude of the project impact value (change). Table 4-3 below shows the criterion used for determining the significance of effects. Definitions of each significance category are provided for in Table 4-4.

Table 4-4 Criteria for Determining Significance of Effects

		Magnitude of impact (degree of change)				
		No change	**Negligible**	**Minor**	**Moderate**	**Major**
Environmental value (sensitivity)	**Very High**	Neutral	Minor	Moderate to Major	Major	Major
	High	Neutral	Minor	Minor to moderate	Moderate to Major	Major
	Medium	Neutral	Negligible to minor	Minor	Moderate	Moderate to Major
	Low	Neutral	Negligible to minor	Negligible to minor	Minor	Minor to moderate
	Very Low	Neutral	Negligible	Negligible to minor	Minor	Minor

Table 4-5 Definition of Significance of Effects

Significance Category	Criteria
Very Large	Only adverse effects are assigned this level of importance as they represent key factors in the decision-making process. Effects are associated with sites and features of national or regional importance. Effects exceed statutory limits. Mitigation & Management Measures are unlikely to remove such effects.
Large	Important considerations at a local scale but, if adverse, are potential concerns to the project and may become key factors in the decision making process. Mitigation & Management Measures and detailed design work are unlikely to remove all of the effects upon the affected communities or interests.
Moderate	These effects, if adverse, while important at a local scale, are not likely to be key decision-making issues. Nevertheless, the cumulative effect of such issues may lead to an increase in the overall effects on a particular area or on a particular resource. They represent issues where effects will be experienced but Mitigation & management measures and detailed design work may ameliorate or enhance some of the consequences upon affected communities or interests. Some residual effects will still arise.
Minor	Local issue unlikely to be of importance in the decision-making process. Effects do not exceed statutory limits. Nevertheless they are of relevance in enhancing the subsequent design of the project and consideration of mitigation or compensation measures.
Neutral or Negligible	No effect or effect which is beneath the level of perception, within normal bounds of variation or within the margin of forecasting error. No mitigation is required.

4.6 Mitigation Measures

It should be recognised that the project already includes a variety of mitigation measures as outlined in the project description. Such mitigation measures ensure that the required regulations are complied with, for instance, the use of Low NOx burners within the gas turbines.

The projects impact assessment process as outlined above therefore takes into consideration those mitigation measures included to the projects design. In addition to the mitigation implemented at design, the ESIA outlines numerous other measures for construction and the operational phase upon which the project can further minimise or avoid negative impacts, and ameliorate positive impacts.

4.7 Residual Impacts

The residual impacts section considers the overall significance of impacts following the implementation of the additional Mitigation & management measures not included by design (Outline in 4.5 above). The significance of such impacts is based upon the same criteria used to determine the impact significance in Section 4.4.

5 AIR QUALITY

5.1 Introduction

Air quality and in particular instances of poor ambient air quality are influenced less by geographical considerations and more by proximity to pollution sources (e.g. cities, highways and industrial facilities). Typically, the construction and operation of new industrial facilities will result in air quality impacts to the local air shed, as a factor of the fuel type, combustion rates and types of installed emissions abatement.

In regard to this ESIA, the air quality section refers to the air emissions from the proposed projects construction and operational phases, the ambient air quality of the local air-shed, and the interrelationship between these two aspects.

This section includes the following:

- Air emission and ambient air quality standards & guidelines;
- Baseline survey of ambient air quality;
- Identified receptors;
- Potential impacts relating to the projects construction;
- Potential impacts relating to the projects operation;
- Air emissions dispersion predictive modelling (operational activities);
- Potential Impact Assessment;
- Air quality Mitigation & management measures (Construction and Operation); and
- Assessment of residual impacts following the application of Mitigation & management measures.

5.2 Methodology

The air quality chapter primarily assess the impacts that the project will have upon ambient air quality at both the construction and operational phases. In order to undertake this, baseline data from monitoring exercises has been collected to provide a baseline upon which an assessment against the quality of the existing air shed and local sensitive receptors can be made.

Construction related impacts have been assessed on a qualitative basis, drawing upon knowledge of such construction sites in the Jordan and the Middle East region. The constriction impacts have assessed such impacts against sensitive receptors identified locally.

Details regarding predicted air emissions for operation have been provided by the equipment manufacturer and verified by ACWA Power for both the main fuel (natural gas) and the back up fuel (LDO). The emissions have been modelled using the latest AERMOD BREEZE software, with dispersion plots and modelled concentrations indicating how emission will disperse and also what concentrations are expected at modelled receptors. The predicted modelling output has been assessed against the applicable standards and guidelines identified.

Where necessary, cumulative impacts of the existing air shed have been included to the assessment (i.e. existing air quality + predicted impacts), as well as potential future cumulative impacts of the decommissioning of the existing HTPS, to be undertaken during the operational phase of the proposed project.

5.3 Applicable Regulation and Standards

The applicable environmental Legislation in relation to air quality relates to:

Jordanian Requirements

Air Protection Regulation No. 28 for 2005

JS 1140-2006 Ambient Air Quality

JS 1189-2006 – Maximum Allowable limits of pollutants from Stationary Sources

Lender Requirements

European Commission – Industrial Emissions Directive

IFC EHS Guidelines: Thermal Power Plants – Emissions Guidelines

IFC EHS General EHS Guidelines – Ambient Air Quality Guidelines

5.3.1 Air Emissions

Jordanian

The following tables outline the air quality emissions and ambient concentrations required for compliance in regard to Jordanian and IFC standards/guidelines.

Table 5-1 Jordanian Maximum Permissible Emission Rates

Pollutant	Unit	Jordanian Standard 1189:2006 (1-hour average)
NO_x (as NO_2)	mg/Nm³	1500
SO_x (as SO_2)		6500 *
VOC's		20
HCl		10
Dioxins		1×10^{-6}
Lead		0.5
Lead Compounds		20
Cadmium		0.05
Cadmium Compounds		10
Chlorine		30
Hydrogen Fluoride		15
Copper		1
Nickel		2
Fluorine		5
Ammonia		50
Particulates		20-50**

* Until another petroleum source with a lower sulphur content is available, or after 5 years (whichever comes first).

** Depending on the emission process.

EBRD - European

In line with the EBRD Performance Requirements, EBRD funded projects should strive to achieve compliance with European environmental standards. The applicable standards for gas turbines form the EU Industrial Emissions Directive (IED) have been outlined in the table below.

Note: The EU IED standards referenced below are for combustion plants applicable under Article 30 (3) (i.e. post 2016 plants), in line with the limits of Annex V – Part 2 of 2010/75/EU.

Table 5-2 European Union – 2010/75/EU Industrial Emissions Directive Standards

Pollutant	Unit	EU IED*	
		Natural Gas	Distillate (Light & Middle)
NO_x	mg/Nm^3	50	50
CO		100	100

* Only applicable for gas turbines operating >70% loading. Where the gas turbine is only used for <500 hours per annum the emission limits do not apply. This may be the case with back up fuel requirements.

IFC EHS Guidelines

In line with lenders who are EPFI's there is a requirement for compliance to the IFC's EHS Guidelines in line with the Equator Principles. The respective IFC guidelines for emissions are detailed below.

Table 5-3 IFC EHS Guidelines for Thermal Power Plants - Air Emissions (mg/m^3 unless stated)

Pollutant	Combustion Turbines >50MW		
	Gas	All other Fuel Types	
		Non Degraded Air shed	Degraded Air shed
Nitrogen Oxides (NOx)	51	152	
Sulphur Dioxide (SO_2)	n/a	Use <1% S Content in Fuel	Use ≤0.5% S Content in Fuel
Particulate Matter (PM)	n/a	50	30

5.3.2 Ambient Air Quality

Jordanian

The respective Jordanian ambient air quality standards are presented in the table below.

Table 5-4 Jordanian Ambient Air Quality Standards

Pollutant	Averaging Period	Standard (ppm unless stated)	Number of Allowable Exceedances
Nitrogen dioxide (NO_2)	1-hour	0.210 (400µg/m³)	3 times in any consecutive 12 months
	24-hour	0.080	-
	Annual	0.050	3 times in any consecutive 12 months
Carbon Monoxide (CO)	1-hour	26	3 times in any consecutive 12 months
	8-hour	9	3 times in any consecutive 12 months
Sulphur Dioxide (SO_2)	1-hour	0.300 (786µg/m³)	3 times in any consecutive 12 months
	24-hour	0.140 (400µg/m³)	1 times in any consecutive 12 months
	Annual	0.040 (114µg/m³)	-
TSP	24-hour	260µg/m³	3 times in any consecutive 12 months
	Annual	75 µg/m³	-
PM_{10}	24-hour	120 µg/m³	3 times in any consecutive 12 months
	Annual	70 µg/m³	-
$PM_{2.5}$	24-hour	65 µg/m³	3 times in any consecutive 12 months
	Annual	15 µg/m³	3 times in any consecutive 12 months
H_2S	1-hour	0.030	3 times in any consecutive 12 months
	24-hour	0.010	-
O_3	1-hour	0.120	-
	8-hour	0.080	-
Source: Jordanian Standard 1140:2006			

EBRD – European

As is required by the EBRD Performance Requirements, the following ambient air quality standards relate to those prescribed by the European Commission (EC). These standards are linked to the the current air quality Directive 2008/50/EC and previous Directives on air quality including 96/62/EC, 1-3 daughter Directives 1999/30/EC, 2000/69/EC, 2002/3/EC, and Decision on Exchange of Information 97/101/EC.

The standards detailed below have been prepared for compliance by EU Member States, of which Jordan is not. The principle behind the EC standards is for Member States to assess air sheds within their geographical boundaries and to prepare air quality management strategies for non-compliant air sheds. This is undertaken at the government level and is a driver for policy on air pollution regulation & standards.

Not being a member State, the Jordanian government does not manage local air quality in the same respect, and as such the applicability of the EC standards in this ESIA assessment can only be implemented for reference purposes only.

Table 5-5 EC Ambient Air Quality Standards (µg/m³ unless stated)

Pollutant	Concentration	Averaging Period	Permitted Exceedances per Year
PM2.5	25	Annual	n/a
PM10	50	24-hour	35
	40	Annual	n/a
Sulphur Dioxide	350	1-hour	24
	125	24-hour	3
Nitrogen Dioxide	200	1-hour	18
	40	Annual	n/a
Lead	0.5	Annual	n/a
Carbon Monoxide	10 mg/m³	Maximum Daily 8-hour mean	n/a
Benzene	5	Annual	n/a
Ozone	120	Maximum Daily 8-hour mean	25 days averaged over 3 years
Arsenic	6 ng/m³	Annual	n/a
Cadmium	5 ng/m³	Annual	n/a
Nickel	20 ng/m³	Annual	n/a
PAH	1 ng/m³ (expressed as concentration of Benzo(a)pyrene)	Annual	n/a

IFC EHS Guidelines

The IFC Guideline is to apply national legislated standards, or in their absence, the current WHO Guidelines, or other internationally recognised sources.

The IFC Guidelines include 25% of relevant ambient air quality standards as a guide to determine significant impacts upon existing impacts of airshed.

Table 5-6 WHO Ambient Air Quality Guidelines (μg/m³ unless stated)

Parameter	IFC EHS Guidelines	
	24 hour	Annual
PM10	150 (Interim target 1)	70 (Interim target 1)
	100 (Interim target 2)	50 (Interim target 2)
	75 (Interim target 3)	30 (Interim target 3)
	50 (guideline)	20 (guideline)
PM2.5	75 (Interim target 1)	35 (Interim target 1)
	50 (Interim target 2)	25 (Interim target 2)
	37.5 (Interim target 3)	15 (Interim target 3)
	25 (guideline)	10 (guideline)
Nitrogen Dioxide	200 (1 hour)	40
Sulphur Dioxide	125 (Interim target 1)	500 (10 minute guideline)
	50 (Interim target 2)	
	20 (guideline)	
Ozone	100 (8 hour daily maximum guideline)	-

5.4 Baseline Environmental Conditions

5.4.1 Local Influences upon Air Quality

The proposed project location is in a predominantly industrial and commercial area of Zarqa, Jordan, which has several evident point, diffuse and mobile source emissions locally.

Notable local points sources of air emissions include the petrochemical refinery in Zarqa owned by the Jordanian Petrochemical Refinery Company Ltd, as well as two facilities for steel fabrication.

At a further distance is the Al Samra Power plant (approximately 3km to the north of the proposed ACWA Power Zarqa project). The Samra Power Plant, owned by the Samra Electric power Company (SEPCO) includes 4 phases with all units fully operational (Phase 4 operational since 2013), for a total of 1031MW. Phases 1, 2 and 3 are combined cycle plants and the 4th phase is simple cycle. A proposed project announced in January 2016 is for the conversion of the 4th phase to combined cycle. This is currently under project design.

Table 5-7 Samra Power Plant Units

Phase	Unit	Nominal Capacity	Commercial Operation Date
Phase I	First Gas Turbine	100 MW	01/11/2005
	Second Gas Turbine	100 MW	11/02/2006
	First Steam Turbine	100 MW	08/10/2006
Phase II	Third Gas Turbine	100 MW	13/12/2007
	Fourth Gas Turbine	100 MW	05/07/2008
	Second Steam Turbine	100 MW	02/08/2010
Phase III	Fifth Gas Turbine	142.5 MW	25/01/2011
	Sixth Gas Turbine	142.5 MW	04/05/2011
Phase IV	Seventh Gas Turbine	146 MW	26/06/2013
	Total	1031 MW	

Source: www. sepco.com.jo

The existing Hussein TPS is now closed and is no longer an emissions source to the local air shed.

The photographs below show existing air pollution inputs to the local air shed.

Plate 5-1 Multiple Emissions Sources from the adjacent Petrochemical Refinery

Plate 5-2 Stack emissions source from the adjacent Petrochemical Refinery (at start up)

The petrochemical complex is the only refinery facility of its type in Jordan and appears to include multiple stack structures for either steam release or direct air emissions. It is understood that the local steel works are not for steel generating but rather for steel fabrication. With one of the facilities including a small stack structure. Where these stacks are emitting emissions relating to fossil fuel combustion there is potential for elevated concentrations of NO_2, SO_2, CO and particulates in the local area; depending on the fuel type being used.

Several diffuse sources may be present from the petrochemical refinery, but are considered to likely consist of Volatile Organic Compounds (VOC's) due to hydrocarbon processing. Mobile sources of emissions will likely be present in close proximity to roads and vehicle emissions.

The prevailing wind direction in Zarqa is north-westerly, which will result in typical emission dispersion towards the east of the industrial premises. Dispersion of any emissions in the local area will be dependent on the wind direction, wind strength, and also other meteorological factors such as the humidity.

Please note: It was mentioned by an attendee at the ESIA scoping consultation meeting that a local ambient air quality monitoring station may be present in the wider Zarqa area, which could potentially be used for baseline air quality inputs. It is noted in this ESIA that the presence of such a monitoring station remains unknown and it is not clear if it exists, who owns it and whether such information could be shared. As a result, this ESIA baseline does not include the results of any other monitoring station/campaign other than those described below.

5.4.2 Existing Ambient Air Quality Data 2012

Note: Ambient air quality data from 2012 was undertaken during the operational phase of the existing HTPS HFO plant (closed for operations in December 2015). The outcomes of this *monitoring are therefore not consistent with the state of the current air shed. The summary below in regard to the 2012 monitoring data has been provided for indicative purposes only.*

Ambient air quality monitoring via a continuous analyser at the Hussein TPS site was undertaken in November 2012 over a 2-week period. SO_2 and PM_{10} were monitored between 6-19th November 2012 with NO_x & NO_2 being monitored between 12-19th November 2012. Daily averages were provided on 2 days during this period for $PM_{2.5}$ & TSP. The results indicated that noticeable but not exceeding concentrations of all pollutants were identified in the air shed the results were compliant to the Jordanian ambient air quality standards. Concentrations of particulate matter varied, which is likely to be a factor of the prevailing meteorological conditions on certain days.

5.4.3 Ambient Air Quality Survey 2016

Diffusion Tube Survey

Passive diffusion tubes were arranged at six (6) locations in the local project area to monitor concentrations of NO_2, SO_2, O_3. Diffusion tubes to monitoring Top 5 Volatile Organic Compounds (VOC's) and BTEX tubes were placed at 4 of the 6 locations (specifically A-1, A-2, A-3 & A-4). Each monitoring parameter was afforded duplicate tubes at each location for quality purposes (A and B tubes).

Ambient air quality monitoring by diffusion tubes is considered appropriate to assess longer-term average concentrations of pollutants in an air shed. The diffusion tubes were installed on 27th January 2016 and were exposed until 23rd February 2016. Upon collection, the tubes were capped and returned to the supplier in the United Kingdom (GRADKO) who undertook the analysis in their UKAS accredited laboratory.

The diffusion tube monitoring stations were located to effectively assess pollutant concentrations more generally in the local air shed and at key sensitive receptors (e.g. the settlement to the north of the proposed plant and the CEGCO accommodation area to the south). The locations of the diffusion tube monitoring stations are shown in the figure below (Locations A-1 to A-6).

Importantly, the diffusion tubes were located in secure locations where possible to avoid instances of theft or damage. It is considered that only one location was accessible to the general public (location A-6).

Figure 5-1 Diffusion Tube Monitoring Locations

Satellite Image Source: Google Earth

Table 5-8 Diffusion Tube Monitoring Locations

Site ID	Co-Ordinates	Location	Photograph
A-1	32° 7'11.66"N 36° 7'38.21"E	Located on the northern project boundary in the proposed GT/HRSG area.	
A-2	32° 7'5.56"N 36° 7'46.97"E	Located on the eastern boundary of the project, in the proposed gas receiving station area.	

A-3	32° 7'26.66"N 36° 7'14.53"E	Located at the extreme north western project boundary in close proximity to the main road and adjacent petrochemical refinery, approximately 900m from the proposed power block.	
A-4	32° 6'50.11"N 36° 7'25.04"E	Located at the southern side of the in the CEGCO accommodation area approximately 720m from the proposed power block.	
A-5	32° 7'23.28"N 36° 7'56.85"E	Located on the first floor roof of a residential property in the adjacent settlement, approximately 600m from the proposed power block.	
A-6	32° 7'2.30"N 36° 8'3.83"E	Located close to the entrance of the steelworks plant approximately 620m from the proposed power block.	

Figure 5-2 Diffusion Tube Results NO_2, SO_2 & O_3

Location	Tube	Concentration (µg/m³)		
		NO_2	SO_2	O_3
A-1	A	16.70	21.96	48.89
	B	16.06	20.49	67.47
A-2	A	15.70	14.57	55.48
	B	15.16	17.85	54.11
A-3	A	24.53	41.65	54.05
	B	24.22	38.13	44.95
A-4	A	16.42	9.63	79.29
	B	18.15	12.91	68.23
A-5	A	18.34	17.60	61.57
	B	16.53	10.60	62.47
A-6	A	15.60	18.69	59.17
	B	16.19	19.93	52.56
Air shed Average		**17.8**	**20.3**	**59.0**
Jordanian AQ Standards		0.05ppm (103µg/m³) Annual	0.04ppm (114µg/m³) Annual	0.08ppm (171µg/m³) 8-hour
IFC EHS Guideline		40 µg/m³ Annual	20 µg/m³ 24-hour (Guideline)	100 8-hour
EC Ambient Standards		40 µg/m³ Annual	125 µg/m³ 24-hour	120 8-hour

Note: Diffusion tube monitoring results for the month long exposure period have been compared to annual average standards/guidelines (where standards exist). The annual average standards/guidelines are the most representative for a month long period of exposure. The annual average standards/guidelines are also the lowest concentration values and therefore provide a more stringent assessment of current air quality when comparison to the standards is made.

Note: Conversion from ppm to µg/m3 has been made at a reference temperature of 0°C.

Please note, the laboratory analysis certificates for the diffusion tube results below are presented in Appendix G.

Figure 5-3 Diffusion Tube Results BTEX & TOP 5 VOC's

Location	Tube	Concentration			
		BTEX	µg/m³	Top 5 VOC's	µg/m³
A-1	A	Benzene	1.13	Butane, 2-methyl-	2.27
		Toluene	4.27	Pentane	1.90
		Ethylbenzene	1.29	Pentane, 2 Methyl-	2.13
		m/p-xylene	4.16	Hexane	1.62
		o-xylene	1.62	Heptane	1.26
	B	Benzene	1.28	Butane, 2-methyl-	2.20
		Toluene	4.89	Pentane, 2 Methyl-	2.38
		Ethylbenzene	1.40	Pentane	1.89
		m/p-xylene	4.46	Hexane	1.83
		o-xylene	1.72	Heptane	1.38
A-2	A	Benzene	1.58	Butane, 2-methyl-	3.00
		Toluene	4.82	Pentane	2.61
		Ethylbenzene	1.48	Pentane, 2 Methyl-	2.70
		m/p-xylene	4.49	Hexane	1.26
		o-xylene	1.72	Pentane, 3 Methyl-	1.03
	B	Benzene	1.50	Butane, 2-methyl-	2.46
		Toluene	4.52	Pentane	2.29
		Ethylbenzene	1.38	Pentane, 2 Methyl-	2.36
		m/p-xylene	4.12	Hexane	1.68
		o-xylene	1.57	Pentane, 3 Methyl-	1.12
A-3	A	Benzene	2.62	Pentane	7.56
		Toluene	10.13	Butane, 2-methyl-	7.33
		Ethylbenzene	2.62	Pentane, 2 Methyl-	7.24
		m/p-xylene	7.43	Hexane	6.44
		o-xylene	2.95	Heptane	5.09
	B	Benzene	2.61	Pentane	7.48
		Toluene	9.11	Butane, 2-methyl-	7.34
		Ethylbenzene	2.71	Pentane, 2 Methyl-	7.57
		m/p-xylene	7.85	Hexane	6.30
		o-xylene	3.09	Heptane	4.78
A-4	A	Benzene	1.62	Butane, 2-methyl-	3.38
		Toluene	5.70	Pentane	2.87
		Ethylbenzene	1.19	Pentane, 2 Methyl-	2.86
		m/p-xylene	3.45	Hexane	2.05
		o-xylene	1.30	Pentane, 3 Methyl-	1.13
	B	Benzene	1.36	Butane, 2-methyl-	2.79
		Toluene	4.99	Pentane	2.41
		Ethylbenzene	1.07	Pentane, 2 Methyl-	2.68
		m/p-xylene	3.06	Hexane	1.59
		o-xylene	1.18	Pentane, 3 Methyl-	0.99

Note: Specific standards for VOC's do not exist in Jordan. Values for VOC's are provided for indicative purposes to show indications of other pollutants in the air shed.

The results of the diffusion tube analysis indicate that noticeable concentrations of all monitored pollutants are present in the air shed at level above typical background expectations. Given the obvious local sources, such results are not surprising. It is important to note that besides the analysis results for SO_2 from monitoring location A-3, all monitored results are within the ambient air quality standards and guidelines of Jordan, EU IED and IFC EHS Guidelines.

The only exceedance noted is against the 24-hour guideline for SO2 outlined by the IFC at location A-3. Annual averaging standards/guidelines for SO2 do not exist, however, in relation to the 24-hour guideline of 20µg/m³, there is an exceedance of almost double the guideline. Such concentrations are however within both WHO Interim Targets, and due to the influence of the extremely close road and petrochemical refinery, such an exceedance is not a surprise at this location.

In general monitoring station A-3 was identified to have the highest quantities of all monitored gases, which is hypothesised to be due to the proximity to the local emission sources of the main road and refinery. The consistency in VOC's and the recorded concentrations perhaps suggest a key influence of the petrochemical refinery, whereby similar VOC's are being recorded at all locations in the local airshed.

Despite the noticeable concentrations of pollutants within the airshed, the wider airshed is considered not to be degraded in regard to the annual average standards/guidelines.

Continuous Ambient Air Quality Monitoring 2016

To compliment the diffusion tube monitoring survey with shorter term data that can be compared to the hourly and 24-hourly averaging standards/guidelines, a continuous air quality analyser was set up on the project site between 22nd to 29th March 2016. A key purpose of the continuous monitoring is to indicate peak pollutant concentrations and trends in air quality, that may relate to diurnal fluctuations, or other potential variables.

A one-week monitoring period is considered suitable to provide representative an indication of short term ambient trends in air quality.

The full results of the continuous ambient air quality monitoring are presented in Appendix H.

Table 5-9 Continuous Ambient Air Quality Monitoring Methodology

Parameter(s)	Method
NO, NO2, NOx	Direct-reading - Chemiluminescence method
CO	Direct-reading- electrochemical cell
PM10 and PM2.5	Continuous direct mass method using a tapered element oscillating microbalance analyser.
SO2	Direct-reading -electrochemical cell.
Wind Speed, Wind Direction, Ambient Temperature, and Relative Humidity	Meteorological Monitoring Guidance + our thermal Environment Monitor (EQUEST Brand) and wind sensor (Vaisala Brand)

The monitoring station was installed on the proposed project site in the GT/HRSG area. The choice of the location provided a representative consideration of the air shed without direct background influences from specific emission sources. In addition, the placement of the monitoring station in this location provided a value for ambient air concentrations at the approximate point of emission from the proposed plant.

Table 5-10 Continuous Air Quality Monitoring Location

Site ID	Co-Ordinates	Location
A-Cont	32° 7'9.23"N 36° 7'42.92"E	Located on the proposed GT/HRSG area.

Figure 5-4 Continuous Air Quality Monitoring Location

Satellite Image Source: Google Earth

Table 5-11 Continuous Air Quality Monitoring Results

Param'	Unit	Concentrations										Standards/ Guidelines		
		Daily Average							Air shed					
		22/3	23/3	24/3	25/3	26/3	27/3	28/3	Min	Av'	Max	J'	WHO	EC
PM_{10}	μg/m³/ 24 Hrs.	39.2	42.6	43.0	53.9	37.7	34.3	31.5	20.2	40.3	72.3	120	50	50
$PM_{2.5}$	μg/m³/ 24 Hrs.	23.0	24.8	29.1	36.1	27.5	22.4	18.3	16.0	25.9	47.2	65	25	-
SO_2	μg/m³/ 24 Hrs.	1.42	1.54	1.53	1.86	1.54	1.36	1.01	0.2	1.5	4.20	400	20	125
NO	μg/m³/ 24 Hrs.	15.0	15.7	15.4	16.1	11.8	8.10	6.7	0.0	12.7	28.5	-	-	-
NO_2	μg/m³/ 24 Hrs.	7.0	7.7	8.1	9.10	8.00	7.40	5.8	3.6	7.6	14.0	164	-	-
NO_x	μg/m³/ 24 Hrs.	17.5	17.5	19.5	21.7	17.7	15.5	13.4	10.6	17.5	30.2	-	-	-
CO*	μg/m³/ 8 Hrs.	251.7	256.9	268.2	276.8	248.4	222.6	208.6	178.9	247.6	366.9	-	-	-

**CO standards relate to 8-hour limits that are 10mg/m³ for the most stringent (EC). All results are easily compliant with the CO standards.*

Note: Conversion from ppm to μg/m3 has been made at a reference temperature of 0°C.

The results of the continuous monitoring have provided similar results to the diffusion tubes, which also indicate that the air shed is not degraded for the monitored pollutants.

Data regarding particulates has shown that ambient concentrations are elevated and on occasions do exceed the EU and IFC standards/guidelines. For PM10 the average concentrations are generally below the required values for the 24-hour averaging period except for 1 day during the monitoring period; which coincided with the highest wind conditions (26km/hr). For PM2.5, the average concentration over the 7-day monitoring period does slightly exceed the guidelines and standards of IFC and EU, however both PM2.5 & PM10 are within the Jordanian standards.

In regard to particulates, it is recognised that ambient concentrations are typically elevated in the middle east region due to the dry and dusty surface conditions. Such local conditions are generally affected by meteorological conditions, particularly wind and humidity which increase dust dispersion and suspend dust respectively. The elevated particulate conditions cannot therefore be attributed specifically to anthropogenic sources, although it is likely that local vehicular and industrial activity does represent a proportion of the contribution.

Summary of Ambient Air Quality

It is summarised that although the project is located in an area with several local industrial facilities, the results above from short term and longer term monitoring activities indicate that the air shed is not degraded in regard to the national Jordanian ambient air quality standards for the potential key project pollutants (i.e. from hydrocarbon combustion) that have been monitored (i.e. NO_2, SO_2, CO and Particulates).

5.5 Sensitive Receptors

Table 5-12 Air Quality - Receptors sensitivity

Receptor	Sensitivity	Justification
Residences	High	Residences are very sensitive to the quality of ambient air due to the permanent occupation by humans.
Commercial Premises	Medium	Commercial premises have a medium sensitivity as they are occupied for a portion of the day.
Industrial Facilities	Low	Industrial facilities have a lower tolerance to the quality of air as the operational nature of such facilities can result in poorer air due to their own emissions. Humans working at such facilities are sensitive to impacts but are typically only in the place of work on a shift basis for a period of the day.

5.6 Significance of Impacts

5.6.1 Construction

During construction the ambient air quality at local receptors may potentially be affected by increased dust, particularly during the site preparation stage (site clearance and earthworks) and by the exhaust fumes of construction vehicles and power generators. The typical air emissions resulting from these activities include: nitrogen oxides, sulphur dioxides, VOCs, and BTEX.

The principle sources of particulate and gaseous emissions during construction will be:

- Excavations and earthworks, such as ground breaking, cutting, filling and levelling;
- Truck movements on unpaved, or compacted surfaces;
- Particulate dispersion from uncovered truckloads;
- Unregulated stockpiles;
- Vehicle and Construction Plant emissions (e.g. NO_x, SO_x and CO) and particulates from vehicles, generators and other mechanical equipment; and
- Stored VOCs and other volatile hazardous materials.

Secondary impacts from increased vehicle movements are likely to have an impact to receptors along site access routes, particularly at junctions, where vehicle acceleration occurs. Effects of vehicular dust may also occur where vehicles move upon unpaved surfaces or where dirty vehicles move off the site without wheel washing or other cleaning. Any transportation of materials may result in the emissions where not effectively contained in the vehicle.

Dust due to site preparation

Dust resulting from construction activities typically comprises large diameter particles, which settle rapidly and close to the generation source. Far field dust impacts from construction works are therefore not considered significant.

Depending on factors such as the meteorology, particle mass and moisture content of the soil, this will influence the dispersion of dust from activities such as excavating, handling of soil and the transfer of soil to trucks. Additional impacts will relate to the movement of soil where trucks are not effectively covered, or where vehicles are moving on unpaved surfaces.

The significance of dust impacts from construction works will largely be based on the direction of the wind and the proximity of sensitive receptors. The prevailing wind direction in the project area is westerly and as such dust emissions are likely to disperse to the east, which is an area of less occupied land.

Dust due to movement of trucks and material transportation

Except for vehicle movements on unpaved surfaces, dust due to the movement of trucks and material transportation should only occur where Mitigation & management measures are not effectively implemented at the site, or by contractors bringing materials to the site (i.e. the sheeting/containment of truck and wheel washing).

Unpaved vehicle movements will likely occur for a period on-site during the construction phase on the site landmass itself. Impacts due to such movements are not expected off-site due to the paved nature of local roads. It is recognised that several hard standing roads are present at the project site, and as such these impacts will be minimised.

Uncontained and/or un-sheeted trucks may be subject to losses of material where the containment is not effective (i.e. spills), or where wind or other air turbulence may disturb the contents and result in dispersion of material. Such impacts have the potential to degrade local air quality in the immediate area of such movements, if particles become suspended. Given the expected large particle size of soil and the likely high moisture content of soil, such impacts are not expected to be widespread and will likely be minimised to the areas immediately surrounding transportation corridors only.

Vehicular and Equipment Gaseous and Particulate Emissions

Vehicles and equipment that operate on liquid fuel (i.e. oil) will result in the emission of gases and particulates to air due to the combustion of fossil fuels. Such vehicle and equipment are likely to include, but not be limited to the following:

- Excavators;
- Graders;
- Pavers;
- Trucks;
- Generators;
- Pumps; and
- Hand held equipment operating on liquid fuel.

Air quality impacts relating to the use of the above are generally small, but where old or unmaintained equipment is operated, it is possible for noticeable impacts to occur.

In addition, where there are multiple vehicles or equipment operational, there is the potential for cumulative impacts resulting from the combination of emissions. Given the expected high activity level throughout construction, it is possible that emissions from equipment and vehicles may affect those receptors within immediate proximity to the site boundaries, or those that are adjacent to transportation routes.

Volatile Organic Compound (VOC) emissions

A small volume of fuels, paints, solvents and other volatile substances will be stored on the site during the construction phase, within various sub-contractor laydown areas, depending on the specific activities of each subcontractor. If not properly contained, such substances have the potential to result in the dispersion of volatile emissions to the local air shed. Given that the likely storage of such volatile substances will be in small volumes, any potential impacts will be limited to the immediate site area. Impacts may occur to areas immediately outside of the site, where inappropriate storage or use of substances is in close proximity to the construction site boundaries.

Odours

A number of temporary toilet blocks will be provided on the construction site and at the EPC accommodation area. It is understood that sanitary wastewater will be collected in septic tanks and removed from the site by a MoE licensed transporter for treatment at the Al Samra wastewater treatment plant. Without suitable containment and management of raw wastewater on site, or during the transfer process, there is the potential for odours to impacts to occur. Such impacts are likely to be temporary and limited to the immediate surrounding area.

Table 5-13 Air Quality – Magnitude of Construction impacts

Impact	Magnitude	Justification
Dust from Earthworks	**Minor Negative**	Temporary effects and a potential cumulative loss of air quality in the site and immediate surroundings due to some dust dispersion outside project boundary.
Dust from Vehicle Movements	**Minor Negative**	Temporary impacts are anticipated, although these impacts will be small in nature due to the slow moving vehicles on unpaved site roads.
Gaseous and Particulate emissions from Vehicles	**Minor Negative**	Noticeable temporary impacts may occur within the site itself. Where vehicle emissions are combined with existing emissions from local industrial sources the cumulative effect is likely to be minimal upon external receptors.
VOCs and other hazardous volatiles	**Negligible Negative**	Temporary impacts may only be noticeable at the immediate area of storage or use and will generally be limited to the site.
Odours	**Negligible Negative**	Temporary impacts may only be noticeable at the immediate area of dispersion and will generally be limited to the site, laydown and accommodation area.

Table 5-14 Air Quality - Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Dust from Earthworks	Minor Negative	Local Industrial Facilities	Low	**Negligible to Minor**
		Local Commercial Premises	Medium	**Minor**
		Residential Receptors	High	**Minor to Moderate**
Dust from Vehicle Movements	Minor Negative	Local Industrial Facilities	Low	**Negligible to Minor**
		Local Commercial Premises	Medium	**Minor**
		Residential Receptors	High	**Minor to Moderate**
Gaseous and emissions from Vehicles	Minor Negative	Local Industrial Facilities	Low	**Negligible to Minor**
		Local Commercial Premises	Medium	**Minor**
		Residential Receptors	High	**Minor to Moderate**
VOCs and other hazardous volatiles	Negligible Negative	Local Industrial Facilities	Low	**Negligible to Minor**
		Local Commercial Premises	Medium	**Negligible to Minor**
		Residential Receptors	High	**Minor**
Odour	Negligible Negative	Local Industrial Facilities	Low	**Negligible to Minor**
		Local Commercial Premises	Medium	**Negligible to Minor**
		Residential Receptors	High	**Minor**

5.6.2 Operation

Greenhouse Gases

The projects predicted greenhouse gas emissions are as follows:

Table 5-15 Projects Predicted Greenhouse Gas Emissions

CO2 emission:

Sl. No.	Fuel	CO2 emission (tonnes per hour)	Operating hour per year	CO2 emission (tonnes per year)
1	Natural gas	194.13	7860	1,296,979
2	Liquid fuel	270.38	900	206,840
			8760	**1,503,819**

The above calculation is with 85% plant load factor

Electricity production:

Sl. No.	Fuel	Net output (MW)	Operating hour per year	Total per annum (MW hr)
1	Natural gas	485	7860	**3,240,285**
2	Liquid fuel	468	900	**358,020**
			8760	3,598,305

Natural Gas				
1	Flue gas flow rate	1283.93	t/h	For gas firing considering the degradation factor
2	% weight of CO2 in flue gas	5.04	%	
	CO2 emission	64.71	t/hr	For 1 GTG
3	CO2 emission	194.13	t/hr	For 3 GTG
4	Plant net output	488.8	MW	As per EPC Guarantee value
5	Plant gross output	505.6	MW	
		397	g/kWh	Net
6	CO2 emission	**384**	g/kWh	Gross
		1,445,488	tonnes/year	With 85% plant load factor

Note: Derived via stoichiometric calculation for natural gas firing.

Table 5-16 Greenhouse Gas Emission Intensity Comparison

Scenario	Carbon Intensity (gCO_2/kWh)
Average Carbon Intensity for Electricity Generation Using Natural Gas, Jordan Source: IFC CEET Tool (09/01/2013) – via - CO2 Emissions from Fuel Combustion Highlights (2012 Edition), © OECD/IEA, Paris, 2012, page 111-122.	573
World Bank Group Thermal Power (2008) Recommendations Target for New CCGT Ref: Table 4, Typical CO2 Emissions Performance of New thermal Power Plants: Efficiency (% Gross, LHV), pp. 8, (World Bank Group, 2008)	396

In comparison to the table above, the project is expected to be well below the current carbon intensity of energy projects in Jordan (on Natural Gas). The comparison of predicted CO_2/kWh vs. World Bank Group recommended carbon intensity rates, indicates very similar values for new CCGT plants.

As is well documented in various publications, there is overwhelming evidence to indicate that the combustion of fossil fuels (e.g. coal, oil, gas) is linked as a key factor influencing current global warming trends, by contributing to higher atmospheric concentrations of carbon dioxide and other greenhouses gases. The combustion of natural gas fuel (and back up LDO) at the proposed project will therefore be a key local source of greenhouse gas emissions, with a potential influence upon wider global warming.

<u>ACWA Zarqa CCGT vs. HTPS – Greenhouse Gas Emissions</u>

It is recognised that to an extent, the project effectively replaces the existing Hussein TPS, which was operational on heavy fuel oil at a significantly lower efficiency. The project is therefore considered to provide a much improved reduced carbon intensity in the generation of electricity compared to the previous plant, whether it is operated on natural gas or LDO.

Using the IFC CEET GHG Emission Calculation Tool, an estimate has been made to the GHG generation of the original HTPS HFO plant. Based on the previous HFO allocation of 675,749 tonnes per annum, the existing HTPS plant would have emitted an estimated 2,119,838 tonnes of CO_2-eq/annum *(calculation based on Residual Fuel Oil as HFO not included to IFC CEET Tool)*. By emitting an estimated 1,445,488 tonnes of CO_2 per annum, the proposed project would therefore make a significant saving in GHG emissions compared to the original HTPS HFO plant. In addition, the higher net electrical output, is also significantly reducing the carbon intensity of the proposed CCGT project in comparison to the HTPS plant. In 2014, the HTPS plant generated 1,065,512 MWh, which relates to a carbon intensity of 1,990g/KWh (as per annual GHG calculation as above).

Air Emissions

The proposed projects design guarantees (from EPC Contract) compliance with the air emission standards specified by Jordan (as per: JS 1189-2006) and the IFC EHS guidelines for Thermal Power Plants (Combustion Turbines: Non-Degraded Airsheds). In regard to the European Commission's Industrial Emission Directive, the project is compliant for gas fired operation, but NOx may exceeds the IED standard under back up LDO operation.

Table 5-17 Project Emission Guarentees vs Emission Standards/Guidelines

Fuel		Natural Gas (Main Fuel)	LDO (back up)	Jordanian Emission Standard	EC Emission Standard		IFC EHS Emission Guideline	
Loading		100%	100%		NG	LDO	NG	LDO
Main (HRSG) Stack	Unit	mg/Nm^3	mg/Nm^3	mg/Nm^3	mg/Nm^3		mg/Nm^3	
	NO_x as NO_2	25	74	1,500	50	50	51	152
	PM_{10}	50	50	-	-	-	-	50
	CO	15	20	-	100	100	-	-
	SO_2	-	Not included	6,500	-	-	-	*
Bypass Stack	NO_x as NO_2	25	74	1,500	50	50	51	152
	PM_{10}	50	50	-	-	-	-	50
	CO	15	20	-	100	100	-	-
	SO_2	-	Not included	6,500	-	-	-	*

** Based on S content in fuel (<1% S for NDA)*

The potential impact of the proposed facility on local air quality has been assessed using Breeze AERMOD7 (version 7.10 and US EPA version 15181), a new generation dispersion model that incorporates the latest understanding of the atmospheric boundary layer.

The primary emission sources at the site are as follows:

- Three main stacks associated with the HRSG; and
- Three bypass stacks.

It is noted that any particular turbine can only emit emissions from either the main stack or the bypass stack; not from both. The emissions and stack design data has been provided by the manufacturer and EPC Contractor and specifically relates to the final project design, in terms of stack characteristics and expected emissions rates per fuel type.

For normal project operations, the key pollutants arising from natural gas combustion and emitted via the HRSG/ bypass stacks will be nitrogen dioxide (NOx as NO2) and CO.

In the event of a natural gas supply failure, or required maintenance activity, the plant will operate on low-sulphur light distillate fuel oil (LDO) as its back-up, which will result in emissions of sulphur dioxide (SO_2) and particulate matter (PM_{10}) in addition to NO_x and CO.

Model Inputs

All modelling inputs have been verified by the ACWA Power technical team prior to inclusion to the model. The model inputs are based on design data as per the owner's technical specification, and as per specifications from the manufacturers, in line with the type of fuel. It has been confirmed that the modelled emission rates for sulphur dioxide for LDO fuel are based upon 1% sulphur content. Stack height has been based on typical dispersion characteristics for the equipment and as per the manufacturers recommendations. Optimisation of stack height in regard to project design has not been included to the scope of this ESIA, or related emissions dispersion model.

Table 5-18 Emissions Modelling Input Data – HRSG Stacks

Parameter / Fuel	Natural Gas	LDO
Stack Height (m)	60.0	
Stack Diameter (m)	4.8	
Temperature (K)	392	427
Actual Flow Rate (Am^3/s)	446	492
Exit Velocity (m/s)	24.7	27.2
Emission Rate (g/s)		
NOx	8.6	45.2
PM_{10}	-	1.8
CO	8.3	6.7
SO_2	-	193

Table 5-19 Emissions Modelling Input Data – Bypass Stacks

Parameter / Fuel	Natural Gas	LDO
Stack Height (m)	45.0	
Stack Diameter (m)	5.4	
Temperature (K)	832	831
Actual Flow Rate (Am^3/s)	947	957
Exit Velocity (m/s)	41.4	41.8
Emission Rate (g/s)		
NOx	8.6	45.2
PM_{10}	-	1.8
CO	8.3	6.7
SO_2	-	193

Dispersion modelling has been carried out for the three years of meteorological data from Amman and for the following scenarios.

Table 5-20 Emissions Modelling Scenarios

Scenario	Fuel	Pollutants	Operational Mode	Emissions Via
Scenario 1	Natural gas	NO_x, CO	Combined	Main stacks
Scenario 2	Natural gas	NO_x, CO	Simple	Bypass stacks
Scenario 3	LDO	NO_x, CO, SO_2, PM_{10}	Combined	Main stacks
Scenario 4	LDO	NO_x, CO, SO_2, PM_{10}	Simple	Bypass stacks

Note: Each modelling scenario has modelled the process contribution of the proposed plant. The background concentrations of the ambient air are based on the monitoring data collected at the baseline phase. This has been considered in terms of a cumulative assessment, by adding the projects process contributions to the baseline.

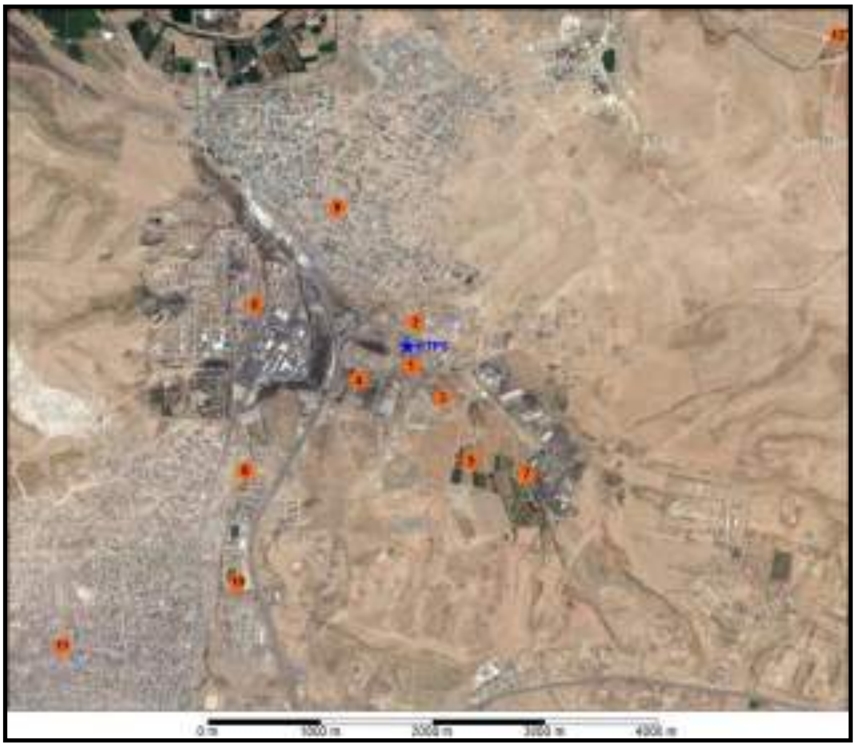
The modelling has been carried out using three years (2013-2015) of hourly sequential meteorological data in order to take account of inter-annual variability and reduce the effect of any atypical conditions. The model has also considered the effects of buildings and terrain.

Specific receptors have been identified where people are likely to be regularly exposed for prolonged periods of time (e.g. residential areas). The location of the discrete sensitive receptors is presented in Table 3.2 and Figure 3.4.

Table 5-21 Location of Sensitive Receptors

ID	Receptor	Type	Location Relative to Proposed Power Block Area
1	NEPCO Training Centre	Commercial	0.2km south
2	Nearest Residential Receptor to the Proposed Site (Hashmiyeh)	Residential	0.25km north
3	Zarqa Cemetery	Cultural	0.5km south-southeast
4	CEGCO Engineers Accommodation	Residential	0.65km southwest
5	Agricultural Land	Agriculture	1km southeast
6	Petrochemical Refinery	Industrial	1.5km west
7	Steelworks	Industrial	1.7m southeast
8	Education Centre	Educational	1.75km southwest
9	Residential Cluster (Hashmiyeh)	Residential	1.7km northwest
10	Sports Stadium	Recreational	2.5km southwest
11	North Zarqa (Residential)	Residential	4.1km southwest
12	Wastewater Treatment Facility	Industrial	5km northeast

Figure 5-5 Sensitive Receptor Locations



Pollutant concentrations have been predicted at both discrete receptor locations and over an 8 by 6 km Cartesian grid with 100 m resolution.

The full emissions dispersion modelling report with predicted emission concentrations at sensitive receptors and emissions dispersion plots are presented in Appendix I.

Results Summary - Normal Operation (Scenario 1)

Table 5-22 Maximum Predicted NO2 Concentrations – Natural Gas, Combined Cycle (µg/m3)

Receptor	Annual Mean	24-Hour Mean	1-Hour Mean
NEPCO Training Centre	0.26	0.83	4.3
Nearest Residential Receptor to the Proposed Site (Hashmiyeh)	0.27	0.71	3.8
Zarqa Cemetery	0.65	1.6	6.0
CEGCO Engineers Accommodation	0.32	1.0	5.6
Agricultural Land	0.41	1.0	3.5
Petrochemical Refinery	0.17	0.70	3.0
Steelworks	0.37	0.87	4.6
Education Centre	0.10	0.35	2.1
Residential Cluster (Hashmiyeh)	0.14	0.77	3.2
Sports Stadium	0.051	0.19	2.2
North Zarqa (Residential)	0.041	0.15	1.8
Wastewater Treatment Facility	0.13	0.39	1.9
Maximum PC	0.65	1.6	6.0
Air Quality Standard	40	145	200
PC as a %age of AQS*	1.6%	1.1%	3.0%

*AQS relates to the most stringent AQS out of Jordan, WHO and EC.

Figure 5-6 Predicted Annual Mean NO2 Concentrations (µg/m3) – Scenario 1

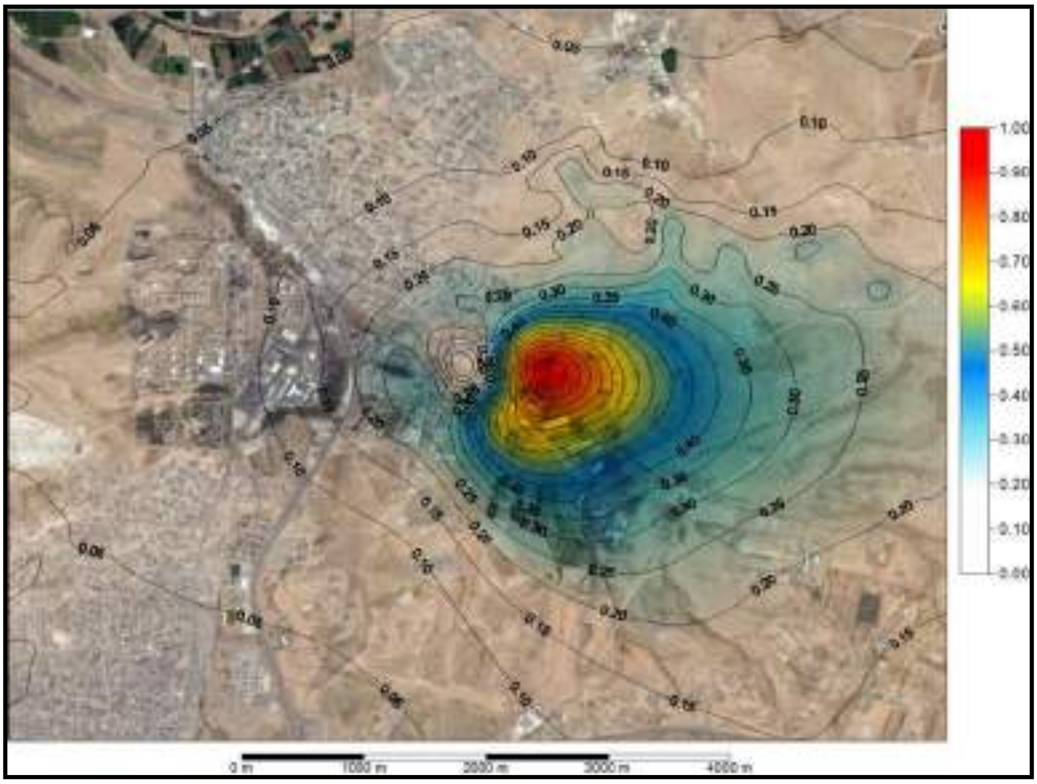


Figure 5-7 Predicted Maximum 24-Hour Mean NO2 Concentrations (µg/m3) – Scenario 1

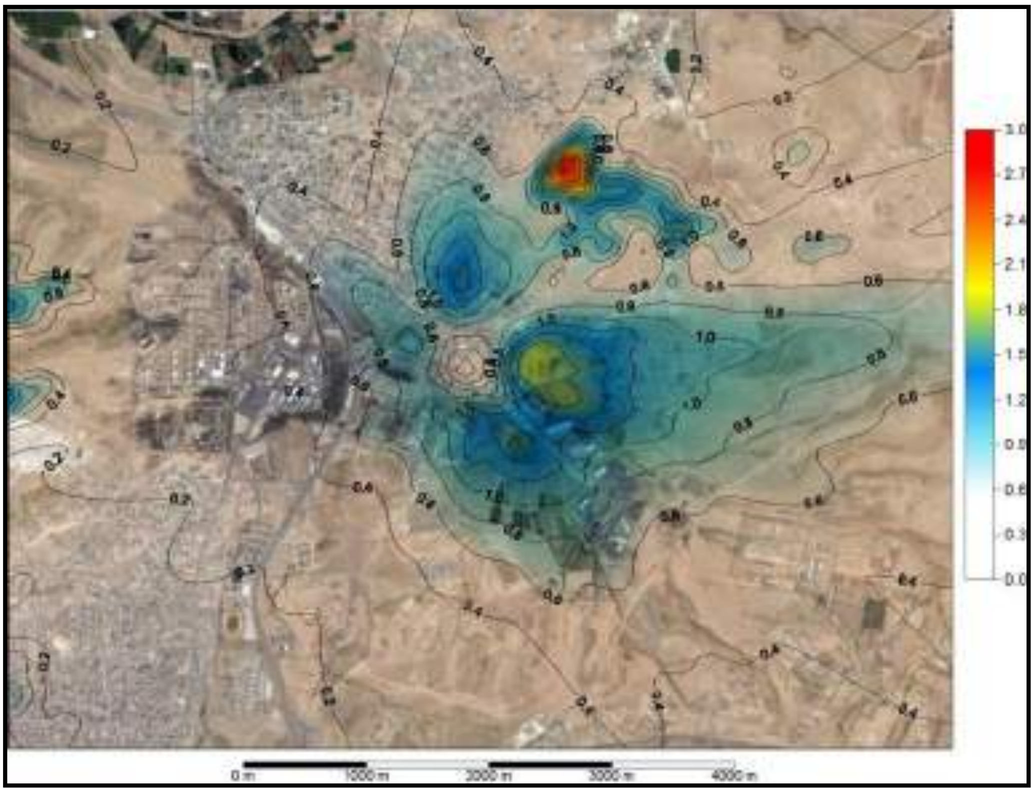
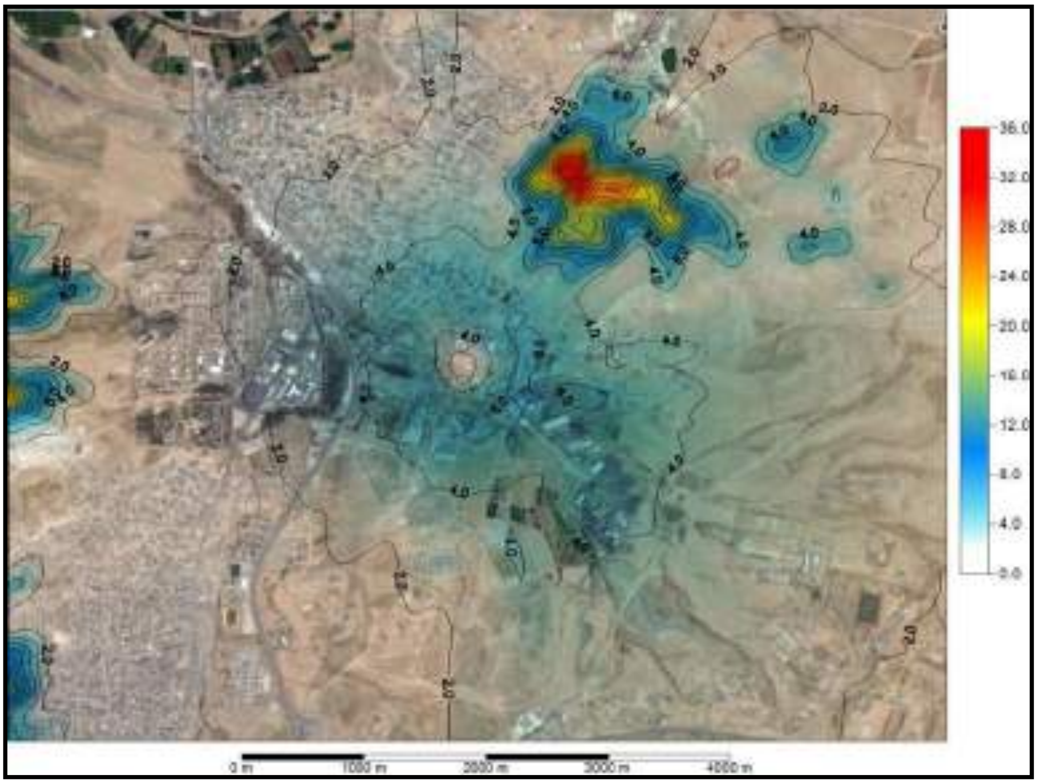


Figure 5-8 Predicted Maximum 1-Hour Mean NO2 Concentrations (µg/m3) – Scenario 1



For normal operation utilising natural gas in combined cycle mode (Scenario 1), the modelling study predicts that ground-level pollutant concentrations of NO2 at modelled sensitive receptors and maximum ground level concentrations, will be within all applicable ambient air quality standards of Jordan, the IFC and EC, and the risk of an exceedance is considered to be negligible, given that monitored background concentrations of NO2 are low (as per the baseline section). At the worst affected modelled receptor, the process contribution of the project will be less than 3% of the most stringent ambient standards as a worst case for NO2.

Table 5-23 Maximum Predicted CO Concentrations – Natural Gas, Combined Cycle (μg/m3)

Receptor	8-Hour Mean	1-Hour Mean
NEPCO Training Centre	5.8	11.7
Nearest Residential Receptor to the Proposed Site (Hashmiyeh)	4.0	10.4
Zarqa Cemetery	7.2	16.3
CEGCO Engineers Accommodation	6.9	15.2
Agricultural Land	5.6	9.5
Petrochemical Refinery	3.6	8.1
Steelworks	5.1	12.7
Education Centre	2.4	5.7
Residential Cluster (Hashmiyeh)	5.2	8.7
Sports Stadium	1.3	5.9
North Zarqa (Residential)	1.1	4.9
Wastewater Treatment Facility	1.7	5.1
Maximum PC	**7.2**	**16.3**
Air Quality Standard	**9,920**	**28,708**
PC as a %age of AQS*	**0.073%**	**0.057%**

*AQS relates to the most stringent AQS out of Jordan, IFC and EC.

The dispersion impacts are reduced for CO with the predicted plants process contribution at the worst affected modelled receptor being less than 0.1% for CO; considered negligible. Baseline concentrations of CO are also very low and therefore the cumulative impacts will be easily compliant to all required standards.

<u>Results Summary – Natural Gas Fired Operation – Simple Cycle (Scenario 2)</u>

For natural-gas fired, single cycle operation, the predicted impacts are reduced further due to enhanced dispersion; primarily due to the exit temperature of the plume.

Note: For full results of other scenarios (predictive contributions at modelled receptors and emissions dispersion plots) see Appendix I for the full air emission modelling study.

<u>Results Summary – LDO Operation – Combined Cycle & Simple Cycle (Scenario's 3 & 4)</u>

Operation of the project using light diesel oil (LDO) would only occur during emergency situations, where there is an interruption of the natural gas supply. In line with the PPA, operation under LDO firing would only occur for a maximum of 40 days per year (960 hours), and for 7 consecutive days.

For both combined cycle and simple cycle operation using light diesel oil, the predicted NO_2, CO and PM_{10} concentrations at receptor locations are well within the relevant air quality standards and the risk of an exceedance is considered to be negligible. Predicted concentrations of SO_2 under LDO firing are described below.

See Tables below for predicted concentrations at receptor locations under LDO combined cycle operation. Please note that under simple cycle operation the impacts for LDO fuel is greatly reduced for all pollutants.

Table 5-24 Maximum Predicted NO_2 Concentrations – LDO, Combined Cycle (µg/m3)

Receptor	Annual Mean	24-Hour Mean	1-Hour Mean
NEPCO Training Centre	1.1	3.4	17.9
Nearest Residential Receptor to the Proposed Site (Hashmiyeh)	1.1	2.8	15.6
Zarqa Cemetery	2.8	6.9	26.3
CEGCO Engineers Accommodation	1.3	4.2	24.6
Agricultural Land	1.84	4.7	16.2
Petrochemical Refinery	0.73	3.2	14.1
Steelworks	1.6	3.8	20.9
Education Centre	0.43	1.6	8.9
Residential Cluster (Hashmiyeh)	0.61	3.5	15.1
Sports Stadium	0.24	0.87	7.1
North Zarqa (Residential)	0.19	0.66	8.1
Wastewater Treatment Facility	0.60	1.9	8.8
Maximum PC	**2.8**	**6.9**	**26.3**
Air Quality Standard	**40**	**145**	**200**
PC as a %age of AQS *	**6.9%**	**4.8%**	**13.2%**

*AQS relates to the most stringent AQS out of Jordan, WHO and EC.

Table 5-25 Maximum Predicted CO Concentrations – LDO, Combined Cycle (µg/m3)

Receptor	8-Hour Mean	1-Hour Mean
NEPCO Training Centre	3.7	7.5
Nearest Residential Receptor to the Proposed Site (Hashmiyeh)	2.6	6.6
Zarqa Cemetery	4.9	11.1
CEGCO Engineers Accommodation	4.5	10.4
Agricultural Land	4.0	6.8
Petrochemical Refinery	2.6	5.9
Steelworks	3.7	8.8
Education Centre	1.7	3.7
Residential Cluster (Hashmiyeh)	3.7	6.3
Sports Stadium	0.90	3.0
North Zarqa (Residential)	0.73	3.4
Wastewater Treatment Facility	1.2	3.7
Maximum PC	**4.9**	**11.1**
Air Quality Standard	**9,920**	**28,708**
PC as a %age of AQS*	**0.049%**	**0.039%**

*AQS relates to the most stringent AQS out of Jordan, WHO and EC.

Table 5-26 Maximum Predicted PM_{10} Concentrations – LDO, Combined Cycle (µg/m³)

Receptor	Annual Mean	24-Hour Mean
NEPCO Training Centre	0.061	0.38
Nearest Residential Receptor to the Proposed Site (Hashmiyeh)	0.063	0.31
Zarqa Cemetery	0.16	0.78
CEGCO Engineers Accommodation	0.076	0.47
Agricultural Land	0.10	0.53
Petrochemical Refinery	0.041	0.36
Steelworks	0.092	0.43
Education Centre	0.024	0.18
Residential Cluster (Hashmiyeh)	0.034	0.39
Sports Stadium	0.013	0.10
North Zarqa (Residential)	0.011	0.074
Wastewater Treatment Facility	0.034	0.21
Maximum PC	**0.16**	**0.78**
Air Quality Standard	**40**	**50**
PC as a %age of AQS*	**0.39%**	**1.6%**

*AQS relates to the most stringent AQS out of Jordan, WHO and EC.

If it were assumed that all of the particulate matter is $PM_{2.5}$ the maximum annual mean process concentration at a receptor with long-term exposure (i.e. residential) is 0.51% of the annual Jordanian standard of 15 µg/m³ and 0.30% of the EU limit value of 25 µg/m³. The maximum 24-hour mean process concentration is 1.2% of the Jordanian AQ standard of 65 µg/m³. On this basis the impact of the $PM_{2.5}$ emissions would be of negligible significance.

Table 5-27 Maximum Predicted SO_2 Concentrations – LDO, Combined Cycle (µg/m³)

Receptor	Annual Mean	24-Hour Mean	1-Hour Mean	10-Minute Mean (a)
NEPCO Training Centre	6.6	41.8	219	293
Nearest Residential Receptor to the Proposed Site (Hashmiyeh)	6.8	34.0	191	256
Zarqa Cemetery	16.9	84.9	322	431
CEGCO Engineers Accommodation	8.2	51.4	301	404
Agricultural Land	11.2	57.9	198	266
Petrochemical Refinery	4.5	38.8	173	231
Steelworks	10.0	46.9	256	342
Education Centre	2.6	19.8	109	146
Residential Cluster (Hashmiyeh)	3.7	43.0	184	247
Sports Stadium	1.4	10.7	86.3	116
North Zarqa (Residential)	1.2	8.1	98.6	132
Wastewater Treatment Facility	3.7	23.3	108	145
Maximum PC	**16.9**	**84.9**	**322**	**431**
Air Quality Standard	**114**	**125**	**350**	**500**
PC as a %age of AQS	**14.8%**	**67.9%**	**92.0%**	**86.3%**
10-minute mean estimated by multiplying the 1-hour mean by 1.34 as recommended by UK Environment Agency Guidance.				

Figure 5-9 Predicted Annual Mean SO2 Concentrations (µg/m3) – Scenario 3

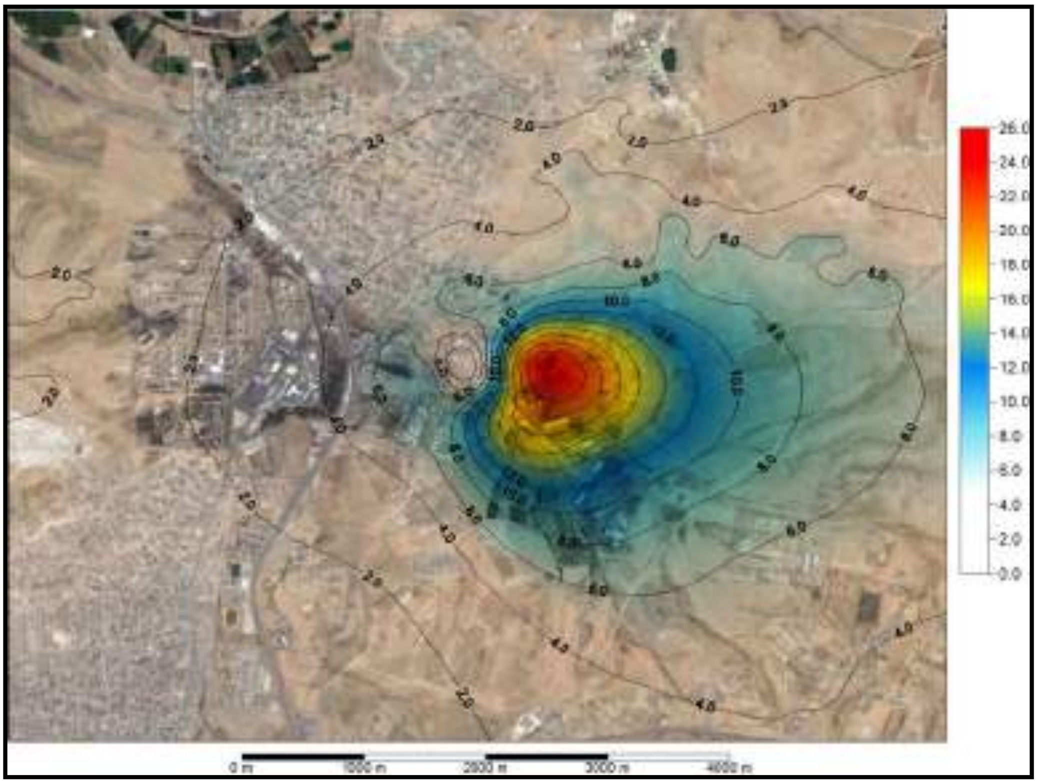


Figure 5-10 Predicted 24-hour SO2 Concentrations (μg/m3) – Scenario 3

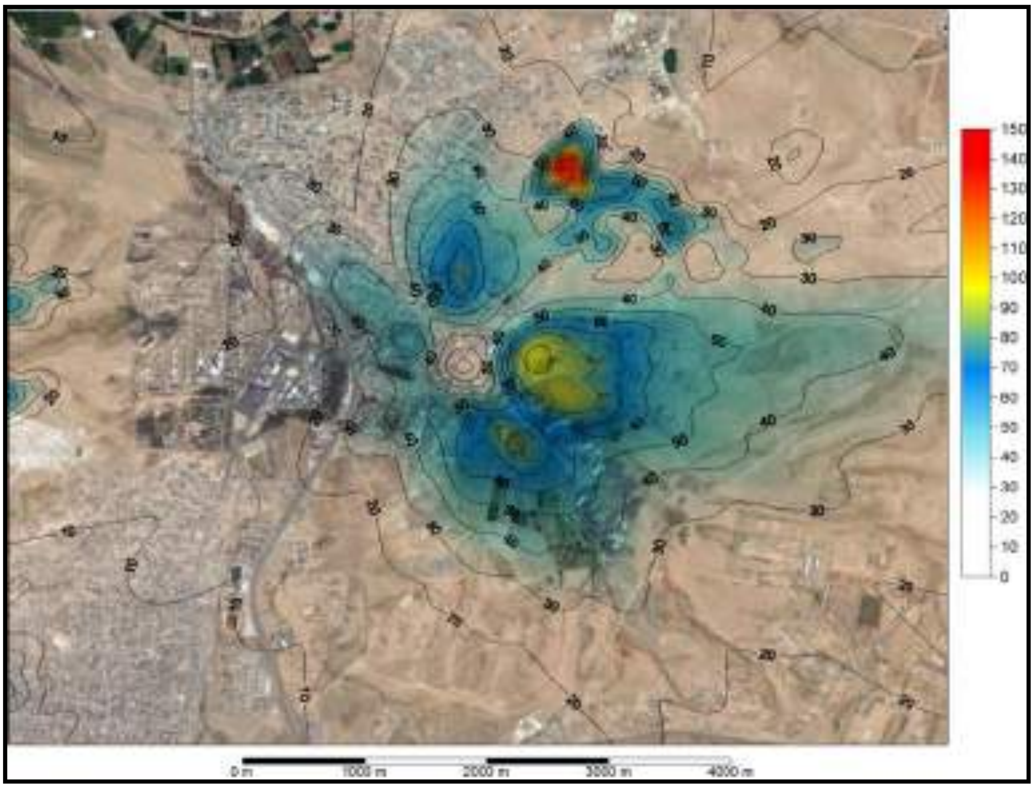
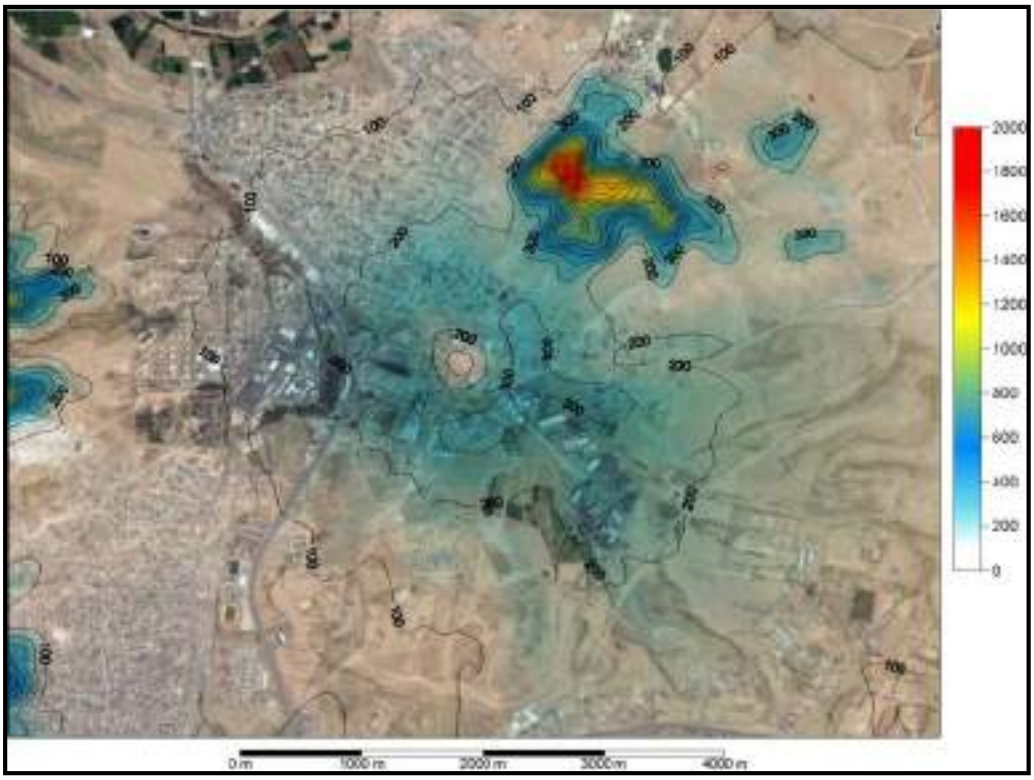


Figure 5-11 Predicted 1-hour SO2 Concentrations (μg/m3) – Scenario 3



Maximum predicted concentrations of SO_2 are potentially significant, particularly in terms of short-term impacts (for 1-hour and 10-minute averaging periods), with the contribution of SO_2 up to 92% of the EC Standard standard for the 1-hour period at the worst affected modelled receptor (Zarqa Cemetery). With respect to the nearest residential receptors, the impact is significant, but reduced from this percentage contribution and, highly unlikely to breach the air quality standards/guidelines.

Under the worst case modelled scenarios there are potential exceedances of the 1-hour average EC Standard (at the worst case receptor under the worst case meteorological conditions based on 3-years of meteorological data). However, the EC standards allow a breach of this standard up to 24 times per year. Based on the improbable use of LDO fuel for more than 500 hours per year, it is highly unlikely that the EC standard will be breached. Further it should be noted that the Jordanian standards are met under all circumstances.

Depending on the S content of the fuel being delivered there are some conditions where the modelled receptor locations would receive more than a 25% process contribution of the most stringent air quality standards from the proposed plant, primarily due to the proximity of receptors to the project. In general, there are few situations where the process contribution of SO2 would be >25% as per the Jordanian ambient standards. Such situations may occur during combined cycle operation where the S content of LDO is ≥0.4%.

Such process contributions of SO2 are primarily due to the proximity of receptors to the project. However, in reality, the impact of the proposed CCGT project will provide a significant reduction in SO2 impacts when compared to the previous HTPS HFO plant (closed in December 2015), that operated un-abated with a fuel sulphur content of approximately 4%. Hence, there is expected to be a major improvement in the air shed compared to pre-existing SO2 conditions.

It is stressed that the all modelled results are based upon worst case conditions for locations on 3 years of meteorological data. The model therefore shows the expected worst case in 1095 days, based on the meteorological input data. Again, it is highlighted that LDO operation is strictly for back up purposes and will only be used for a maximum of 40 days per year as a worst case.

As the baseline monitoring data indicates that existing SO_2 concentrations are relatively low, an exceedance of the relevant air quality standards at sensitive receptor locations is considered unlikely. However, the short term 1-hour standard may be breached (104.7% of the standard) at one adjacent modelled receptors (Zarqa Cemetery) by cumulative effects within the air shed.

Based on the relationship of SO2 emissions and the Sulphur content of the fuel, further analysis has been undertaken to determine at what sulphur level full compliance with the most stringent air quality standards will be achieved at. The analysis presented below provides the worst case modelled receptor concentration of SO2 in regard to LDO fuel ranging from 0.9% to 0.1% sulphur.

Table 5-28 Worst Case Modelled Receptor Based on Variable S Content of Fuel

Annual Mean	**0.9% S**		**0.8% S**		**0.7% S**		**0.6% S**		**0.5% S**		**0.4% S**		**0.3% S**		**0.2% S**		**0.1% S**	
Operation Type	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC
AQS	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114
Maximum PC	6.8	15.2	6.2	13.5	5.5	11.8	4.8	10.1	4.1	8.5	3.4	6.8	2.7	5.1	2.1	3.4	1.4	1.7
Maximum PC (% AQS)	5.96%	13.33%	5.44%	11.84%	4.82%	10.35%	4.21%	8.86%	3.60%	7.46%	2.98%	5.96%	2.37%	4.47%	1.84%	2.98%	1.23%	1.49%
Background	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.3
Maximum PEC	27.1	35.5	26.5	33.8	25.8	32.1	25.1	30.4	24.4	28.8	23.7	27.1	23	25.4	22.4	23.7	21.7	22
Maximum PEC (% AQS)	23.80%	31.20%	23.20%	29.70%	22.60%	28.20%	22.00%	26.70%	21.40%	25.20%	20.80%	23.70%	20.20%	22.30%	19.60%	20.80%	19.00%	19.30%
24-Hour Mean	**0.9% S**		**0.8% S**		**0.7% S**		**0.6% S**		**0.5% S**		**0.4% S**		**0.3% S**		**0.2% S**		**0.1% S**	
Operation Type	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC
AQS	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
Maximum PC	35	76.4	31.5	67.9	28	59.4	24.5	50.9	21	42.4	17.5	33.9	14	25.5	10.5	17	7	8.5
Maximum PC (% AQSS)	28.00%	61.12%	25.20%	54.32%	22.40%	47.52%	19.60%	40.72%	16.80%	33.92%	14.00%	27.12%	11.20%	20.40%	8.40%	13.60%	5.60%	6.80%
Background	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56
Maximum PEC	36.6	77.9	33.1	69.4	29.6	61	26.1	52.5	22.6	44	19.1	35.5	15.6	27	12.1	18.5	8.6	10
Maximum PEC (% AQS)	29.30%	62.30%	26.40%	55.60%	23.60%	48.80%	20.80%	42.00%	18.00%	35.20%	15.20%	28.40%	12.40%	21.60%	9.60%	14.80%	6.80%	8.00%
1-Hour Mean	**0.9% S**		**0.8% S**		**0.7% S**		**0.6% S**		**0.5% S**		**0.4% S**		**0.3% S**		**0.2% S**		**0.1% S**	
Operation Type	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC
AQS	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350
Maximum PC	145.2	289.7	130.7	257.5	116.2	225.3	101.7	193.1	87.1	160.9	72.6	128.7	58.1	96.6	43.6	64.4	29	32.2
Maximum PC (% AQS)	41.49%	82.77%	37.34%	73.57%	33.20%	64.37%	29.06%	55.17%	24.89%	45.97%	20.74%	36.77%	16.60%	27.60%	12.46%	18.40%	8.29%	9.20%
Background	40.6	40.6	40.6	40.6	40.6	40.6	40.6	40.6	40.6	40.6	40.6	40.6	40.6	40.6	40.6	40.6	40.6	40.6
Maximum PEC	185.8	330.3	171.3	298.1	156.8	265.9	142.3	233.7	127.7	201.5	113.2	169.3	98.7	137.2	84.2	105	69.6	72.8
Maximum PEC (% AQS)	53.10%	94.40%	48.90%	85.20%	44.80%	76.00%	40.60%	66.80%	36.50%	57.60%	32.30%	48.40%	28.20%	39.20%	24.00%	30.00%	19.90%	20.80%
10 Minute Mean	**0.9% S**		**0.8% S**		**0.7% S**		**0.6% S**		**0.5% S**		**0.4% S**		**0.3% S**		**0.2% S**		**0.1% S**	
Operation Type	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC	SC	CC
AQS	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
Maximum PC	194.6	388.1	175.1	345	155.7	301.9	136.2	258.8	116.8	215.6	97.3	172.5	77.8	129.4	58.4	86.3	38.9	43.1
Maximum PC (% AQS)	38.92%	77.62%	35.02%	69.00%	31.14%	60.38%	27.24%	51.76%	23.36%	43.12%	19.46%	34.50%	15.56%	25.88%	11.68%	17.26%	7.78%	8.62%
Background	54.404	54.404	54.404	54.404	54.404	54.404	54.404	54.404	54.404	54.404	54.404	54.404	54.404	54.404	54.404	54.404	54.404	54.404
Maximum PEC	249	442.5	229.5	399.4	210.1	356.3	190.6	313.2	171.2	270	151.7	226.9	132.2	183.8	112.8	140.7	93.3	97.5
Maximum PEC (% AQS)	49.80%	88.50%	45.90%	79.90%	42.00%	71.30%	38.10%	62.60%	34.20%	54.00%	30.30%	45.40%	26.40%	36.80%	22.60%	28.10%	18.70%	19.50%

CC: Combined Cycle

SC: Simple Cycle

Note: Orange cells represent process contributions above 25% of the most stringent ambient standards.

The analysis indicates that with an LDO fuel content of 0.9% Sulphur compliance would be achieved at the modelled receptors under all operational conditions and modelling periods, inclusive of the background air shed concentrations.

There are however situations where the process contribution of the LDO fuel could result in >25% contribution to the SO2 content in the air shed at the modelled receptors (based on the most stringent ambient standards). This would potentially occur with ≥0.3% S fuel under all combined cycle phases for the 24-hr, 1-hr and 10-min averaging periods. For simple cycle operation this would occur for fuel ≥0.6% S fuel for the 1-hr and 10-min averaging periods, or for ≥0.8% S content in fuel for the 24-hr averaging period. Under the annual average, there are no situations where a process contribution of >25% would occur.

VOC Emissions

Emissions from Volatile Organic Compounds (VOC's) may occur where there is inadequate transfer or storage of liquid fuels, solvents, paints and other volatile substances; or where there is any venting of their fumes.

The proposed plant will include storage tanks for LDO and it is likely that general maintenance activities will require the storage of very small quantities of other volatile substances. Although the stored LDO will only be utilised by the plants operation in emergency situations, there is the potential for impacts for VOC odour, particularly if fuel unloading by road tanker is required, or where vapour recovery systems of installed tanks are not effective. However, the impact of such an event compared to the existing background odour of the adjacent petrochemical facility may not be distinguishable at local receptors.

Table 5-29 Air Quality – Magnitude of Operational impacts

Impact	Magnitude	Justification
Stack Emissions from Natural Gas Combustion	**Minor Negative**	Without abatement technologies impacts will include small measurable impacts across the local air shed.
Stack Emissions from LDO Combustion	**Moderate Negative**	Impacts from LDO fuel combustion will result in measurable pollutant concentrations being added to the local air shed, particularly of SO2.
VOC Emissions	**Negligible Negative**	Impacts to air quality as a result of VOC emissions are unlikely to impact areas outside of the plant.

Table 5-30 Air Quality - Significance of Operational Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Stack Emissions from Natural Gas Combustion	Minor Negative	Local Industrial Facilities	Low	**Negligible to Minor**
		Local Commercial Premises	Medium	**Minor**
		Residential Receptors	High	**Minor to Moderate**
Stack Emissions from LDO Combustion	Moderate Negative	Local Industrial Facilities	Low	**Minor**
		Local Commercial Premises	Medium	**Moderate**
		Residential Receptors	High	**Moderate to Major**
VOC Emissions	Negligible Negative	Local Industrial Facilities	Low	**Negligible to Minor**
		Local Commercial Premises	Medium	**Negligible to Minor**
		Residential Receptors	High	**Minor**

5.7 Mitigation

5.7.1 Construction

Table 5-31 Air quality – Mitigation & Management Measures during the Construction Phase

Issue	Mitigation & Management Measures
Dust Generation	A visual assessment of dust emissions will be undertaken on a daily basis and actions taken to reduce emissions, where they are identified as excessive.
	Vehicle speeds will be restricted to 20Km/h on haul roads and un-surfaced areas of the site.
	No burning of wastes will be allowed on site throughout the construction phase.
	Regular wetting down of haul roads by water trucks.
	Minimise vehicles and plant movements over unsealed roads. Establish paved/tarred access roads in order to minimise dust.
	Where sand and other dusty materials are transported to the site, trucks will not be overloaded and will be appropriately covered / sheeted to avoid loses en-route.
	Any aggregate or dusty material stockpiles will be stored in enclosed structures. Alternatively temporary piles can be covered with impervious sheeting.
	Avoid or minimize excavation activities on windy days. Earthworks will be stopped when high winds are present (15 km/h).
	Re-vegetate areas, as soon as they are permanently cleared of the temporary lay down.
	Contractor vehicles are to access site on dedicated constructed tarmac road to Hussein TPS site to avoid impact on local traffic to neighbouring residential areas

Issue	Mitigation & Management Measures
	Dust generating activities such as stone cutting and grinding are to be undertaken away from the site boundaries and/or should be effectively screened.
	Powdery materials (e.g. cements) will be stored and transported in sealed containers.
	The provision of a wheel-washing facilities or high-pressure hose to ensure all vehicles leaving the site are in a satisfactory state of cleanliness. Note: Dry wheel cleaning is recommended, unless adequately treated water can be reused.
Exhaust Emissions	Regular maintenance and inspection for all construction plant, vehicles and vessels (to be documented and checked by site supervisor's representative).
	Routinely check equipment for smoky exhausts, and recommend appropriate corrective actions.
	Implement energy reduction practices in the operation of the vehicles and ensure that exhaust function correctly
	Smoky equipment to be given defect notices until repaired and approved for re-deployment by site supervisor.
	Modern machinery, with adequate emission control equipment will be used.
	Suitable fuels will be used for construction machinery, vessels and vehicles (particularly low sulphur diesel).
	Trained personnel will operate machinery properly and efficiently.
	Minimise idling of construction machinery, maximise efficiency of trip times.
	Plant maintenance will be carried out off-site in appropriate premises, unless in emergency situations, to contain a spill.
	Construction roads in the site will be designated and made clear to the drivers with signage for directions and speed limits placed all along the roads.
	Deliveries of equipment/plant to the site will be efficiently managed to reduce the number of trips.
	Exhaust fumes and particulates emitted from trucks and vehicles will be minimised by assuring the use of good condition vehicles. Vehicles entering the site for the first time will be inspected for their worthiness and where necessary will not be permitted to enter the site.
Volatile Emissions, Odours	Volatile fuels and chemicals will be in sealed containers. On site storage of large quantities of volatile fuels will be avoided, equally prolonged exposure to direct sun and heat will be avoided.
	Chemical storage areas will be purpose built and well maintained. A data log of all chemicals with MSDSs will be provided at the storage facility within easy access.
	Pump out any stagnant waters from excavations.
	Adequate and sufficient sanitary facilities for site workers must be provided. The placement of the facilities should be downwind of residential areas and should be regularly maintained.

5.7.2 Operation

Table 5-32 Air quality – Mitigation and Monitoring Measures during the Operational Phase

Impact / Source	Mitigation / Monitoring Measures
Stack Emissions	The Gas Turbines will be equipped with a Low NOx Combustion System, which will ensure a high quality of combustion to reduce the generation of NOx.
	During commissioning, the stack emissions will be tested for NO_2, SO_2, PM_{10} and CO to ensure that the control systems are operating correctly and that emission values comply with Jordanian, EU IED and IFC EHS standards/guidelines.
	During operation there will be continuous monitoring of stack emissions, by CEMS systems particularly NOx, SO2, CO, and PM_{10}, to ensure compliant conditions are maintained through appropriate process controls. In addition the monitoring of other stack parameters such as oxygen, and temperature will also ensure that the plant is operated efficiently to maintain compliance with the specified air emission standards
	Regular scheduled maintenance activities will be undertaken to ensure that equipment is operating in its most effective manner, to reduce emissions.
VOC Emissions	Fugitive emissions from the plant will be controlled by an inspection and maintenance programme that will be detailed within the OESMP developed at the start of operations, to include monitoring of potential VOC gases.
	Back up fuel storage tanks will be equipped with vapour recovery systems to ensure that any volatile vapour loses to the air are recovered and input to the tank as liquid.

Note: Stack height is considered optimum in design, based upon the equipment and will not be further optimised, or increased in height.

5.8 Residual Impacts

5.8.1 Construction

Table 5-33 Air Quality – Residual Impacts – Construction Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact Significance
Dust from Earthworks	Minor Negative	Local Industrial Facilities	Low	Negligible to Minor	Yes	**Negligible**
		Local Commercial Premises	Medium	Minor	Yes	**Negligible to Minor**
		Residential Receptors	High	Minor to Moderate	Yes	**Minor**
Dust from Vehicle Movements	Minor Negative	Local Industrial Facilities	Low	Negligible to Minor	Yes	**Negligible**
		Local Commercial Premises	Medium	Minor	Yes	**Negligible to Minor**
		Residential Receptors	High	Minor to Moderate	Yes	**Minor**
Gaseous and emissions from Vehicles	Minor Negative	Local Industrial Facilities	Low	Negligible to Minor	Yes	**Negligible**
		Local Commercial Premises	Medium	Minor	Yes	**Negligible to Minor**
		Residential Receptors	High	Minor to Moderate	Yes	**Minor**
VOCs and other hazardous volatiles	Negligible Negative	Local Industrial Facilities	Low	Negligible to Minor	Yes	**Negligible**
		Local Commercial Premises	Medium	Negligible to Minor	Yes	**Negligible**
		Residential Receptors	High	Minor	Yes	**Negligible to Minor**
Odour	Negligible Negative	Local Industrial Facilities	Low	Negligible to Minor	Yes	**Negligible**
		Local Commercial Premises	Medium	Negligible to Minor	Yes	**Negligible**
		Residential Receptors	High	Minor	Yes	**Negligible to Minor**

5.8.2 Operation

For operational power plant emissions please note that the air quality modelling was undertaken with the inclusion of emissions control technology, for example the Dry Low NOx burners. Such technology is incorporated to the gas turbines.

Table 5-34 Air Quality – Residual Impacts – Operational Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact Significance
Stack Emissions from Natural Gas Combustion	Minor Negative	Local Industrial Facilities	Low	Negligible to Minor	Yes	**Negligible to Minor**
		Local Commercial Premises	Medium	Minor	Yes	**Minor**
		Residential Receptors	High	Minor to Moderate	Yes	**Minor**
Stack Emissions from LDO Combustion	Moderate Negative	Local Industrial Facilities	Low	Minor	Yes	**Minor**
		Local Commercial Premises	Medium	Moderate	Yes	**Minor to Moderate**
		Residential Receptors	High	Moderate to Major	Yes	**Moderate**
VOC Emissions & Odour	Negligible Negative	Local Industrial Facilities	Low	Negligible to Minor	Yes	**Negligible**
		Local Commercial Premises	Medium	Negligible to Minor	Yes	**Negligible**
		Residential Receptors	High	Minor	Yes	**Negligible to Minor**

6 NOISE AND VIBRATION

6.1 Introduction

Noise and vibration are environmental parameters that can be generated via many processes, naturally or via anthropogenic activities, and can be considered a disturbance for humans and fauna.

Noise and vibration are typically considered to be key environmental parameters associated with industry, as industrial processes often include the use of high-powered equipment and multiple moving parts. Construction and transportation processes also have the potential to result in impacts of variable magnitudes. Noise and vibration can result in significant impacts upon surrounding receptor locations where excessive levels are generated, leading to nuisance and degradation of local ambience.

Noise is transmitted as a pressure wave and vibration is a repeated elastic oscillation. Both have the potential to act at distance upon other receptors (vibration to a far lesser extent). Where optimal topographic and land use conditions for noise distribution prevail (e.g. flat land/water with open space and little vegetation), noise from a source can be received at great distances.

This chapter includes the following:

- Noise and Vibration standards & guidelines;
- Baseline Environmental Conditions;
- Identified receptors;
- Potential impacts relating to the projects construction;
- Potential impacts relating to the projects operation;
- Noise Modelling Summary;
- Impact Assessment;
- Mitigation & Management Measures (Construction and Operation); and
- Assessment of residual impacts following the application of Mitigation & management measures.

6.2 Methodology

The main objective of this chapter is to assess the impacts associated with the generation of noise during both construction and operational phases of the Project. This assessment has been informed through a desktop study, site visit, and an overall understanding of existing noise generators locally, as well as monitoring and identification of sensitive receptors within the projects areas of impact.

Operational related impacts have been assessed by noise modelling, based on the provided noise outputs of key noise generating equipment on site.

Mitigation & Management Measures for the construction and operational phase have been considered in addition to those that are already included to the projects design. Further to the implementation of mitigation measures, the residual impact significance has been assessed.

Where applicable, the cumulative impacts of noise from the future decommissioning of the existing HTPS have been assessed. Such decommissioning would be undertaken during the operational phase.

6.3 Noise Standards and Guidelines

The applicable environmental standards in relation to noise and vibration which will be considered as part of the ESIA include the following:

Jordanian

- Instruction for Reduction and Prevention of Noise for the year 2003.

Lenders

- The IFC EHS General Guidelines (2007) for noise represent guideline noise values that should not be exceeded at receptors.

The Jordanian noise standards detailed in the table below have been categorised in regard to the receptor category noise is emitted to and the time of day.

Table 6-1 Jordanian Prevention of Noise Standards, 2003

Area	Highest Permissible Limits of Equivalent Sound Level (dB(A))	
	Day	Night
Residential in Urban	60	50
Residential in Sub-Urban	55	45
Residential in Rural	50	40
Residential having Small industries, Offices and Public Buildings	65	55
Industrial	75	65
Schools, Hospitals, Mosques and Churches	45	35

European (EBRD) Standards

The European Commission Environmental Noise Directive (Directive 2002/49/EC) relating to the assessment and management of environmental noise and is the main EU instrument to identify noise pollution levels and to trigger the necessary action both at Member State and at EU level. The Directive applies to noise to which humans are exposed, particularly in built-up areas, in public parks or other quiet areas in an agglomeration, in quiet areas in open country, near schools, hospitals and other noise-sensitive buildings and areas. It is important to note, however, that the Directive does not set limit or target values, nor does it prescribe the measures to be included in the action plans, thus leaving those issues at the discretion of the competent Member State authorities.

International (IFC) Standards

The table below indicates the Ambient Noise Standards as established by the IFC/World Bank General EHS Guidelines (2007) which are applicable to the Project, both during construction and operational phases. These relate to the most sensitive point of reception and not the plant boundary. Noise impacts should not exceed the levels presented above, or result in a maximum increase in background levels of 3 (dBA) at the nearest sensitive receptor location off-site.

Table 6-2 World Bank/IFC EHS Guidelines, 2007 - Noise

Receptor	One Hour LAeq (dBA)	
	Daytime 07:00 – 22:00	Night time 22:00 – 07:00
Residential, Institutional, Educational	55	45
Industrial, Commercial	70	70

6.4 Baseline Environmental Conditions

Noise Survey

In order to determine the baseline noise levels at and around the proposed Hussein TPS project were monitored on the following dates for the given purpose.

Table 6-3 Baseline Noise Monitoring Surveys

Survey ID	Date	Scope of Survey and Purpose
1	27th January 2016	As per the initial survey plan for short term daytime monitoring of 5-minute periods at 6 locations (N-1 to N-6)
2	15th – 16th March 2016	Additional noise monitoring (1-hour for daytime and night time periods at 3 locations N-1, N-3 & N-5) undertaken following feedback during the scoping consultation exercise in regard to a need for a longer monitoring period.
3	10th – 12th April 2016	Further noise monitoring in regard to MoE response to the scoping report. The request from MoE was to monitor noise for 3 consecutive days and night for 1-hour at each location (N-1 to N-6)

During the surveys, noise measurements were taken at several locations to monitor the existing noise levels and to determine the influence of existing noise sources. The monitoring was undertaken using a Cirrus CR: 811C sound level meter (S/N D20575FD), which has been UKAS calibrated at an accredited laboratory in the UK. The noise meter was secured to a tripod at a height of 1.5m and the microphone sensor directed towards the most significant source of noise received at that location. Directing the microphone sensor towards these noise sources allowed for an assessment of the worst-case noise impacts acting upon the monitoring location, in addition to other background sources of noise (e.g. traffic, nature sounds etc.). Measurements were taken for a continuous period (either 5-minutes or 1-hour as outlined in the table above) at each monitoring station using a broadband noise setting, within a measurement range of 30-100 db. The noise meter was securely attached to a tripod at a height of 1.5m and located away from reflective surfaces. A wind muffler is placed over the microphone to minimise the recording of background wind and air turbulence.

Details of the noise monitoring locations are recorded in the following table, with the locations illustrated in the satellite image below. The monitoring locations were chosen to represent typical noise levels for the boundaries of the proposed project as well as the areas around the proposed plant, including sensitive receptor locations such as the nearest residential property and the CEGCO accommodation area.

Table 6-4 Noise Monitoring Locations

Monitoring Station	Location	Photograph	Co-ordinates
N - 1	Located inside the site, on the north-east corner of the fuel storage tank area and approximately 200m to the north west of the proposed construction site for the new plant.		32° 7'13.17"N 36° 7'37.32"E
N - 2	Located inside the site, on the eastern parameter of the Hussein power plant site and directly next to the proposed construction site for the new plant.		32° 7'6.91"N 36° 7'47.12"E
N - 3	The monitoring location is in the most north-western corner of the site and is in close proximity to the entrance for the nearby refinery. The location is approximately 940m away from the proposed construction site for the new plant		32° 7'27.30"N 36° 7'13.29"E
N - 4	Located outside of the site in a residential area for CEPCO Engineers, almost 600m south-west of the proposed construction site for the new plant.		32° 6'51.93"N 36° 7'27.45"E

Monitoring Station	Location	Photograph	Co-ordinates
N – 5 a	Located outside of the site in a residential area, approximately 500m north-east of the proposed construction site for the new plant. Positioned on the first floor roof of a residential property. *Note: AC Unit in photograph was not operational in January at time of measurement (external temperature 10°C)*		32° 7'19.66"N 36° 7'45.10"E
N – 5 b	Located outside of the site in a residential area, approximately 300m north-east of the proposed construction site for the new plant, south of the local road (approximately 50m from the nearest sensitive receptor).		32° 7'19.11"N 36° 7'41.66"E
N - 6	Located outside of the site in-between a steel works and a factory, approximately 600m east of the proposed construction site for the new plant.		32° 7'1.68"N 36° 8'3.32"E

Note: Monitoring Location N-5a was utilised during the initial short duration noise survey on 27th January 2016. For the March and April noise surveys the location was moved closer to the project site and in close proximity of the nearest noise receptor (to the proposed power block area). The change in location was primarily due to access to the residential monitoring location at night, but also to ensure a higher level of accuracy in the monitoring process.

Figure 6-1 Noise Monitoring Locations

Satellite Image Source: Google Earth

The results of the noise monitoring surveys are presented below. This includes observations regarding the background noises that were observed during this period.

Survey 1 – 27th January 2016 (Daytime – 5-minute monitoring)

Table 6-5 Baseline Noise Monitoring Results (Daytime – 5-minute monitoring)

ID	Date	Time	Measured Noise Level			Field Observations
			Leq dB(A)	Lmax dB(A)	Lpeak db(C)	
N - 1	27/01/2016	10:30	47.60	57.70	75.90	Calm conditions. Dogs barking from adjacent land. Minor noise from groundwater remediation works on-site. Light vehicle movements inside the HTPS area.
N - 2		10:59	42.40	49.90	82.60	Few apparent noises. Distant noise from highway the key discernable source. Occasional dog barks form adjacent plot.
N - 3		11:17	57.00	67.90	93.30	Continual vehicle noise and HGV's, particularly fuel trucks from the adjacent petrochemical. Vehicle noise varies as the traffic signals operate (i.e. louder noise when vehicles accelerate)
N - 4		11:39	49.50	61.10	79.80	Few apparent noises, however some banging noises observed from the adjacent CEGCO central stores. Noises from vehicles adjacent to the graveyard roads
N - 5		12:25	56.90	68.70	89.20	Light breeze: 1-2m/s. Noise form the petrochemical refinery discernable, sounds of steam release, flares etc. Infrequent passing cars on local routes. Dog barks in local residential area.
N - 6		12:43	57.20	79.60	93.40	Heavy vehicles entering steelworks close to monitoring location. Light winds 2-3 m/s. Animal noises from land to the south with some grazing sheep

Survey 2 – 15th/16th March 2016 (Daytime and Night time – 1-hour monitoring)

Table 6-6 Baseline Noise Monitoring Results (Daytime – 1-hour monitoring)

ID	Date	Time	Measured Noise Level			Field Observations
			Leq dB(A)	Lmax dB(A)	Lpeak db(C)	
N – 5	16/03/2016	08:11	57.40	70.80	97.90	Windy (speed approximately 5m/s), Occasional passing vehicles. Noise reading does not accurately reflect the likely local noise due to the wind speed.
N – 3		10:14	60.40	80.60	109.70	Windy (speed approximately 5m/s). Peak noises during HGV horns. Much vehicle noise from queuing of fuel trucks for refinery U-turn adjacent.
N – 1		11:17	61.50	79.00	112.60	Windy (speed > 5m/s approaching 10m/ gusts). Few discernable noises over wind turbulence.

Note: Noise monitoring data for this period is largely unreliable due to the excessive wind speeds with gusts over 5m/s.

Table 6-7 Baseline Noise Monitoring Results (Night time – 1-hour monitoring)

ID	Date	Time	Measured Noise Level			Field Observations
			Leq dB(A)	Lmax dB(A)	Lpeak db(C)	
N – 5	15/03/2016	21:07	50.90	59.50	95.20	Light wind (approximately 3-4m/s), Background noise fro refinery and barking dogs. And occasional passing vehicles.
N – 3		22:14	54.40	69.30	99.40	Light breeze (approximately 2-3m/s). Discernable noises form refinery and passing traffic, particularly HGV's with horn sounds.
N - 1		23:18	44.90	66.50	100.20	Light breeze (approximately 2-3m/s). Distinctively quitter than other monitoring areas, however distant noise of refinery and highway apparent.

Survey 3 – 10th – 12th April 2016 (Daytime and Night time – 1-hour monitoring)

Table 6-8 Baseline Noise Monitoring Results (10th April Daytime – 1-hour monitoring)

ID	Date	Time	Measured Noise Level			Field Observations
			Leq dB(A)	Lmax dB(A)	Lpeak db(C)	
N - 1	10/04/2016	12:15	55.3	80.5	105.7	Light winds (4 m/s) Noise from Construction & Earthworks at NEPCO training centre | 2x passing light vehicles within the existing HTPS site area. Distant noises from cars on Highway and local road to North of the project area.
N - 2		13:20	59.5	82.0	103.1	Construction & Earthworks at NEPCO training centre the predominant noise source.
N - 3		14:25	48.2	63.3	100.1	Continual vehicle noise and HGV's, at traffic lights, including horns, revving when traffic accelerates. Noise louder when the lights turn green and vehicles accelerate.
N - 4		15:35	48.1	59.6	96.2	Light breeze approximately 2-3m/s.
N - 5		16:40	59.6*	79.0*	110.7*	*Stopped after 13 minutes due to rain. Numerous passing vehicles and noise of rainfall affecting results.
N - 6		-	-	-	-	Cancelled due to rain

Table 6-9 Baseline Noise Monitoring Results (10th April Night time – 1-hour monitoring)

ID	Date	Time	Measured Noise Level			Field Observations
			Leq dB(A)	Lmax dB(A)	Lpeak db(C)	
N - 1	11/04/2016	04:35	45.0	68.7	100.9	Loud insects (e.g. crickets) | Flare from the refinery discernable Continual barking of dogs | Noise from thunder
N - 2		03:30	43.6	60.4	86.2	Few discernable continual noise sources. Noise from thunder | Insects | Flare from refinery
N - 3		02:25	55.7	79.6	99.8	Moderate vehicle flows on adjacent highway, lots of HGV and vehicle horns | flare from refinery | Guard tower door slammed and some noise from infrequent passing of vehicles on local road to the north | Noise from thunder
N - 4	10/04/2016	23:00	49.3	64.9	98.8	Dogs Barking | Slight breeze
N - 5	11/04/2016	01:15	50.1*	65.9*	86.2*	*Stopped after 21 minutes | 25 passing vehicles
N - 6		00:10	47.0	67.5	97.8	Dogs barking | Distant thunder | 1 x passing vehicle

Table 6-10 **Baseline Noise Monitoring Results (11th April Daytime – 1-hour monitoring)**

ID	Date	Time	Measured Noise Level Leq dB(A)	Lmax dB(A)	Lpeak db(C)	Field Observations
N - 1	11/04/2016	10:00	58.4	85.9	101.6	Crane moving past monitoring station | Earthworks from nearby hillside | Dogs barking
N - 2		11:05	49.1	67.8	94.4	Dogs barking | light vehicle passing close by | Vehicle horns | Slight breeze | Earthworks on nearby hillside
N - 3		12:10	58.7	83.9	100.2	Busy traffic lights + heavy vehicles passing | Car horns | Slight breeze |
N - 4		13:20	46.8	60.5	97.1	Slight breeze | Birdsong | Earthworks below
N - 5		15:35	57.7	80.7	103.0	35 passing vehicles | Shepard whistling | Geese being rounded up
N - 6		14:30	53.2	67.0	101.8	Slight breeze, factory machinery | Heavy vehicles leaving steel works | 1x passing vehicle

Table 6-11 **Baseline Noise Monitoring Results (11th April Night time – 1-hour monitoring)**

ID	Date	Time	Measured Noise Level Leq dB(A)	Lmax dB(A)	Lpeak db(C)	Field Observations
N - 1	12/04/2016	04:25	44.8	62.7	108.3	Dogs barking | Cats fighting | Slight breeze
N - 2		03:20	41.7	55.6	84.3	Dogs barking
N - 3		02:15	55.1	74.6	92.8	Vehicles at traffic lights | Car braking heavily | Flare from refinery
N - 4	11/04/2016	23:00	41.0	56.4	74.2	Electrical buzz from nearby pylons | Dogs barking
N - 5	12/04/2016	01:05	55.6	70.6	94.6	27 passing vehicles | Dog barking
N - 6		00:10	49.5	59.1	76.9	Steel plant operations | Dogs barking | 3x passing vehicles

Table 6-12 Baseline Noise Monitoring Results (12th April Daytime – 1-hour monitoring)

ID	Date	Time	Measured Noise Level			Field Observations
			Leq dB(A)	Lmax dB(A)	Lpeak db(C)	
N - 1	12/04/2016	-	-	-	-	Winds to strong to monitor noise accurately (>5m/s)
N - 2		14:35	56.0	72.6	102.4	*Stopped after 8 minutes due to wind influence | Dogs barking
N - 3		13:30	60.5	80.6	110.2	Windy conditions. Car horns at the traffic lights | Heavy vehicles | Banging noises from car showroom outside site | Waiting tankers
N - 4		10:15	45.8	60.6	92.0	Location more sheltered from wind. Birdsong | Helicopter passing overhead
N - 5		11:25	58.2	84.4	105.1	Dogs barking , Chicken noises | 50 passing vehicles in 10 minutes | Slight breeze | Small metal works conducted by nearby shepherds | Pigeon calls
N - 6		12:30	54.0	68.6	94.9	4x passing vehicles | Factory machinery noise | Steel works operations

Table 6-13 Baseline Noise Monitoring Results (12th April Night time – 1-hour monitoring)

ID	Date	Time	Measured Noise Level			Field Observations
			Leq dB(A)	Lmax dB(A)	Lpeak db(C)	
N - 1	13/04/2016	02:25	41.1	55.9	79.5	Slight breeze | Dogs barking
N - 2		03:30	44.6	54.5	71.6	Dogs barking
N - 3		04:35	53.8	65.8	85.1	Banging from car workshop | Refinery Operations noise | Speeding vehicles from highway
N - 4	12/04/2016	23:00	41.6	52.7	77.6	Slight breeze | Tyre noise from highway | Dog barking
N - 5	13/04/2016	01:15	52.3	71.4	87.7	Light vehicles | Dogs barking
N - 6		00:10	53.5	72.6	87.3	Dogs barking | Steel works and heavy vehicles

<u>Summary of Results</u>

During the monitoring surveys, noise was found to vary considerably due to several factors including wind speed, location of the monitoring site, and time of day.

At times of high winds, the monitored noise reading were excessive and do not accurately reflect the local noise sources. This was particularly the case for the monitoring in March 2016.

The consistently noisiest monitoring location was N-3, close to the highway and the entrance of the adjacent refinery. During both day and night time monitoring activities there was a constant flow of traffic through this area, which consisted of many HGV's, mainly fuel trucks en-route to the refinery. Such noises at this location are characterised by idling engines whilst traffic lights are red, and sounds of acceleration and horns when the lights turn green.

Another monitoring point that observed comparably high noise levels for the local area was N-5, outside of the project site in the local residential area of Hashmiyeh. A key background noise at this location was the rumbling and flare sounds from the refinery, whilst occasional passing vehicles also contributed to the slightly higher noise readings. A constant source of noise during most of the noise monitoring sessions, particularly at location N-5 was the barking of stray dogs, which were occasionally in close proximity to the noise meter. Such barking sounds do not necessarily contribute to a continuous background noise, but they are particularly loud, short and sharp.

With respect to the location of the refinery, it is clear that the view shed of the residential area to the north of the project is within direct sight and is unblocked form the refinery. AS such, there is no topographical abatement of refinery noise at this location, which results in the continuous background humming.

Figure 6-2 View shed to N-5 b

Source: Google Earth View shed Function

The unblocked path of refinery noise to monitoring location N-5b and the wider Hashemiyeh residential area is considered to be a key factor to the increased noise level at this locaiton compared to locations such as N-1 and N-2 which are sheltered topographically, as shown below.

Figure 6-3 View shed to N-2

Source: Google Earth View shed Function

In general, noise at night was significantly lower than during the daytime due to a reduced presence of human and animal activity, with lower vehicle flows and calmer atmospheric conditions generally accounting for this. Noise at the proposed power block site (N-1 and N-2) was between 40 and 45 dB(A) at night under calm conditions, whilst daytime noises typically varied between 50 - and 60 dB(A) due to the presence of workers on the site, or local works at in the area (e.g. construction at NEPCO training centre).

Generally, noise levels are just below the limit of compliance at the site for the IFC noise guidelines and are within the Jordanian noise limits. Off-site locations such as the residential areas of Hashmiyeh, are under influence of noise form the highway and the nearby refinery, with noise levels slightly exceeding the IFC noise guidelines for both day and night time periods. Such minor exceedances are attributed to the industrial nature of the local area, with other small influences from vehicles and human & animal activity to lesser extent.

The extensive noise monitoring campaign is considered to have provided representative noise measurements for the project area and local areas off-site.

Table 6-14 Baseline Noise Monitoring Summary Results

ID	Comparable Receptor Type*	General Range of Results (Leq)	Jordanian Standards		IFC EHS Guidelines		Compliance Review
			Day	Night	Day	Night	
N - 1	Industrial	50-60 dB Day 40-45 dB Night	75	65	70	70	Compliant to Jordanian & IFC
N - 2	Industrial	50-60 dB Day 40-45 dB Night	75	65	70	70	Compliant to Jordanian & IFC
N - 3	Industrial	59-61 dB Day 54-56 dB Night	75	65	70	70	Compliant to Jordanian & IFC
N - 4	Residential having Small industries, Offices and Public Buildings	45-50 dB Day 40-45 dB Night	65	55	55	45	Compliant to Jordanian & IFC
N - 5	Residential having Small industries, Offices and Public Buildings	55-60 dB Day 50-55 dB Night	65	55	55	45	Compliant to Jordanian Not complaint to IFC
N - 6	Industrial	53-57 dB Day 47-55 dB Night	75	65	70	70	Compliant to Jordanian & IFC

**Comparable receptor type considers the lotion of the monitoring location in regard to the categories of receptors outlined by the Jordanian Prevention for Noise Standards (2003). All residential areas locally relate to 'Residential having Small industries, Offices and Public Buildings' due to the presence of several heavy industries in the local area.*

Vibration

In terms of a baseline, a specific study for vibration was not undertaken as detailed in the Environmental Scoping Report. However, no noticeable vibrations were encountered during the site visits. Despite being located in an industrial/commercial area, there are few processes that require heavy dropping, shifting, or otherwise interactions with the ground surface that may cause vibrations. Therefore, it is generally not expected that vibrations are generated in noticeable magnitudes. Isolated vibrations may be present immediately adjacent to road sides, where heavy vehicles; particularly the continuous stream of fuel tankers from the adjacent petrochemical refinery operate on these routes.

6.4.1 Noise and Vibration Receptors

Table 6-15 Noise and Vibration – Sensitivity of Receptors

Receptor	Sensitivity	Justification
Local Industrial Facilities	Low	By nature, industrial facilities tend to be noisy and these are unlikely to be sensitive to further noise impacts. Noisy facilities may drown out incoming noise.
Local Commercial Premises	Medium	Commercial facilities (e.g. in the local area) are typically only frequented for periods throughout the day by limited number of people and are not locations where humans reside or sleep.
Residences	High	As a settlement, permanent residences are very sensitive to noise impacts and fluctuations in noise levels. Noise levels at these receptors are within the respective Jordanian standards, but are still elevated and exceeding the IFC guidelines at for day and night.

6.5 Significance of Impacts

6.5.1 Construction

Construction activities normally result in temporary and short duration increases in the noise and vibration levels of a site. Noise will be created and emitted to the surrounding environment via a range of processes. Pertinent construction activities in relation to noise and vibration are likely to include earthworks, piling, site levelling, laying of concrete, installation of services, etc.

Increases in traffic during construction may also lead to increases in the noise level particularly due to the very low existing flows of vehicles in the local areas. Where areas of congestion already exist, impacts from vehicular noise may also be exacerbated.

During construction it is envisaged that the work activities, are likely to include the following:

- Site preparation - back-filling, levelling and grading and the removal of made ground in areas where foundations are to be installed. It is assumed that these activities will require the use of dozers, excavators and muck-away lorries.
- Civil Works – It is assumed that piles will be required for some of the building foundations during this phase. In the absence of detailed information on construction methodologies it is assumed that cast in-situ bored piles and driven piles may be required.
- Construction and Installation - This phase of works is assumed to involve the casting of reinforced concrete slabs 'in-situ', block work, steel/scaffold erection. It is assumed that these works will require the use of concrete truck mixers, compressors, generators, heavy lifting equipment (including cranes) and hand tools.
- Drainage and road paving - This stage of the works will comprise of several operations that will likely include excavation for and laying of drainage pipes and road surfacing, to include use of planers, dozers and pavers.

Examples of potential plant are listed below with reference to expected noise levels as per guidance from BS:5228 for construction noise.

Table 6-16 Noise Levels of Anticipated site plant/Equipment

Construction Plant	BS:5228 Noise level at 10m (db(A))	BS:5228 Reference
Excavator	79	C.2, 14
Loader	82	C.6, 33
Motor lorry	80	C.2, 34
Scraper/leveller	82	C.5, 8
Roller	80	C.5, 19
Asphalting machine	84	C.5, 32
Truck mixer	80	C.4, 18
Concrete-pumping machine	80	C.4, 29
Truck crane	77	C.4, 53
Stationary crane	77	C.4, 49
Generator	84	C.4, 84
Motor-driven compressor	75	C.3, 19
Fork Lift	67	C.4, 57

The accumulation of noise from the above sources will impact upon local receptors, particularly where works are not attenuated and undertaken in close proximity to receptor locations. It is known that noise levels dissipate with distance and as such, noise impacts will significantly decrease with distance from the noise source, with lesser impacts to receptors that are at distance of blocked by intervening structures/slopes.

Noise impacts relating to heavy vehicle movements have the potential to occur along routes where a significant increase in traffic flows will arise due to increase dedicated movement of vehicles to the project site. The major transport routes used during construction are likely to be along the main road from Amman to the project site. This route passes along the west of the existing HTPS. A short existing link of approximately 600m will connect this road to the new site entrance, located in the north of the proposed project. Due to the existing high flows of heavy vehicles along the main road to the west of the existing HTPS, noise impacts may only be significant along the short link from this road to the new site entrance, which has a lower existing flow of HGV's.

When considering noise impacts from vehicle flows, a doubling in the vehicle flow from a road will only increase noise levels by 3dB. Over a short-term period, the UK's Highways Agency Design Manual for Roads and Bridges (DMRB) guidance considers a 3dB(A) change as a Moderate impact.

Vibration

Certain construction processes, particularly those involved with site preparation and civil works, e.g. breaking, levelling and excavations, have the potential to create vibrations within the vicinity of the works. Vibrations are also anticipated to occur sporadically around the construction site due to the movement of materials and equipment. However, like noise, it should be noted that vibrations dissipate rapidly as they spread due to losses of energy radiating 360 degrees from the source, as well as deeper though the soils.

Due to the vast majority of construction works being at significant distances away from the nearest existing residential receptors (typically over 100m), this is not anticipated to result in an impact of significance.

Table 6-17 Noise and Vibration - Magnitude of Construction Impacts

Impact	Magnitude	Justification
Construction noise (adjacent to site)	**Moderate Negative**	Construction noise adjacent to the site, could be noisy upon occasions and may have an impact upon the local receptors.
Construction Vibration	**Negligible Negative**	Very minor vibration impacts may occur during construction activities, which will be limited to the site.
Construction Vehicle Noise	**Negligible Negative**	Adverse impacts may occur to receptors adjacent to the link road from the main highway to the new site entrance.

Table 6-18 Noise and Vibration - Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Construction noise	Moderate Negative	Local Industrial Facilities	Low	**Negligible to Minor**
		Local Commercial Premises	Medium	**Minor**
		Residences	High	**Moderate to Major**
Construction Vibration	Negligible Negative	Local Industrial Facilities	Low	**Negligible to Minor**
		Local Commercial Premises	Medium	**Negligible to Minor**
		Residences	High	**Minor**
Construction Vehicle Noise	Negligible Negative	All local residences	High	**Minor**

6.5.2 Operation

The operation of proposed plant will include the use of heavy equipment throughout the power production process. Such processes have the potential to emit high levels of noise, which are likely to be continuous and sustained during daily activities, due to the 24-hour operation of the plant.

The main sources of noise are likely to be emitted from the Gas Turbines, HRSG's, Steam Turbines and ACC fans amongst other sources, such as pumps and mobile vehicles on site. The ACC is a key source of noise on the site, with the noise level being reduced as far as practically possible by implementing specialised low noise fans into the design.

Due to the continuous nature of the operations, it is anticipated that the noise impacts (off the site) are likely to resemble humming noises, combined with sporadic noises from certain processes, mobile equipment and moving vehicles. Noise levels may increase during transient (start-up) operation, with the potential for the facility noise to greatly exceed the noise limits if left un-attenuated. Noise levels of the major new equipment on site will be specified to be under 85dB(A).

The nearest residential receptor to the power block area is located approximated 200m to the north. Further to this receptor, the main residential cluster in Al Hashemiyah village starts at approximately 400m from the proposed power block area (the nearest residential receptor is 200m). Key noise sources at the plant are located in the power block area (i.e. GT, HRSG, ST), with the ACC's immediately to the south of these and slightly further from the receptors.

Based on the baseline noise monitoring described, the local area already has some exceedances of the IFC EHS Guidelines at receptors.

Noise Modelling Study

By taking into account the source noise levels of key equipment provided by the equipment manufacturers, the area of acoustic or non-acoustic enclosures (where available) and the intervening distance to the receptor, a noise model was constructed using proprietary software IMMI2016, using the methodology outlined in ISO9613 (ISO 9613-2 "Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation" describes a detailed procedure, to calculate sound levels from point sources. Area and line sound sources are divided into component point sound sources).

ISO 9613-2 computes long-term average sound levels in octave bands with nominal mid-band frequencies from 63 to 8000 Hz. ISO 9613-2 makes a difference between calculation of short-term and long-term levels. If the first are calculated in downwind conditions (favourable propagation of sound with significant positive wind from source to receiver), the latter are calculated using the same formulas but corrected by means of the meteorological correction term $\mathbf{C_{met}}$.

The guidance given by ISO 9613-2 on how to determine the meteorological correction term C0 is rather unsatisfactory and therefore the following global parameters are included in the noise model:

- Temperature 10°C; relative Humidity 70%;
- Light downwind propagation towards the receptor;
- No soft ground attenuation

The noise model is based upon combined cycle operation and represents the worst case due to the inclusion of noise from the HRSG's, Steam Turbine and Air Cooled Condenser's. Noise impacts under open cycle operation are therefore expected to be significantly lower than in combined cycle operation, and has therefore not been modelled.

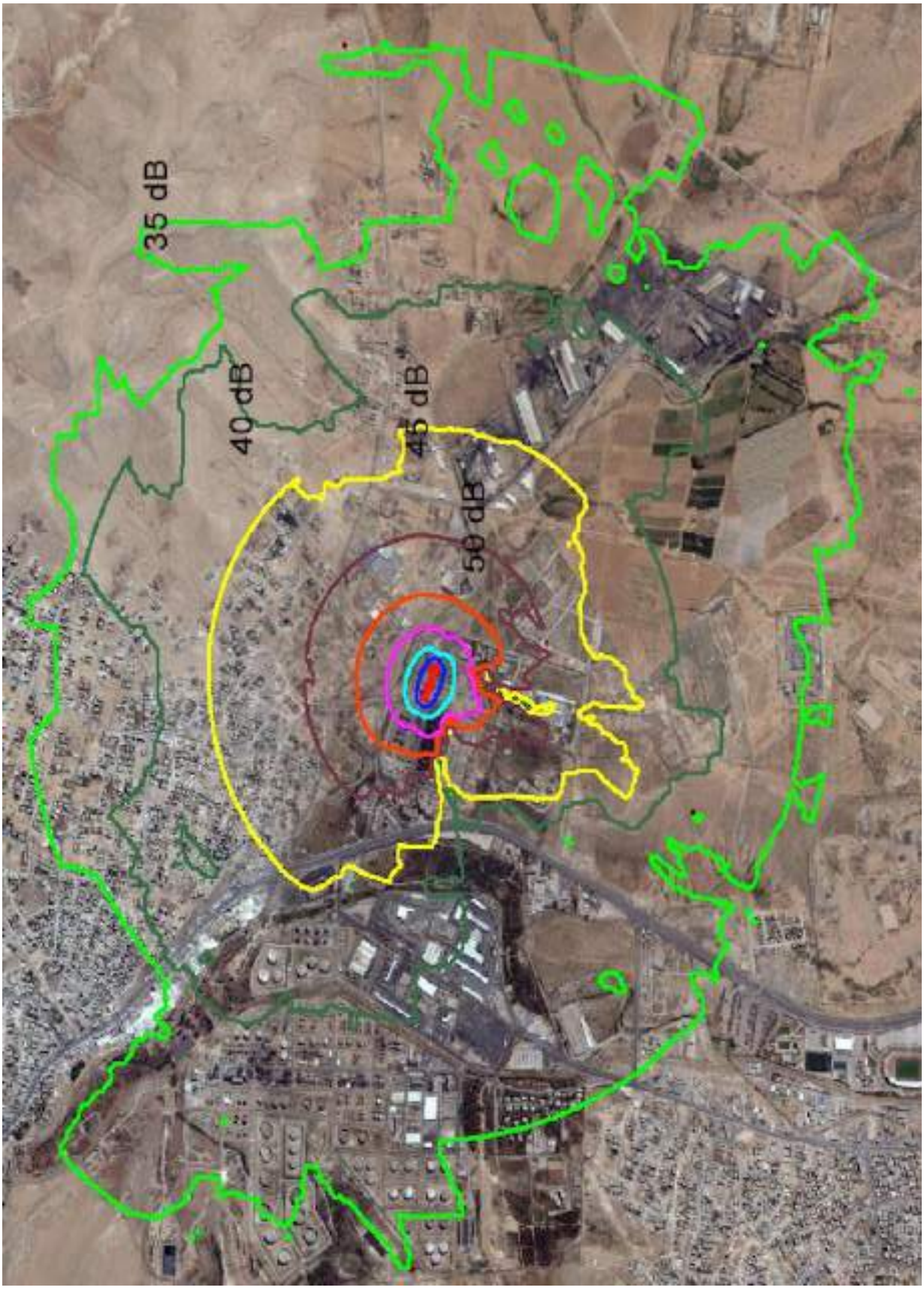
In terms of noise attenuation from buildings off-site, information on these were not available and therefore a worst-case free propagation model was constructed. The results of the noise modelling at representative receptors and general receptor areas as a result of the project processes only are as follows.

Table 6-19 Receptor Noise Levels, dB(A) (Base Load, including design mitigation)

Modelled Receptors			Noise Standards per Receptor	
First Floor (4.5m)	**Receptor Type**	**Noise Level, dB $L_{Aeq,T}$ Day/Night**	**Jordanian**	**IFC**
Residential Cluster, Al Hashmiyeh (Centre of residential area)	Residential having Small industries, Offices and Public Buildings	39.1	65 – Day 55 - Night	55 – Day 45 - Night
Nearest Residential Receptor, in Al Hashmiyeh		51.9	65 – Day 55 - Night	55 – Day 45 - Night
Training Centre, NEPCO	Industrial	63.4	75 – Day 65 - Night	70 Day/Night
CEGCO Staff Accommodation	Residential having Small industries, Offices and Public Buildings	54.0	65 – Day 55 - Night	55 – Day 45 - Night
Jordon Petroleum Refinery Al Zarqa	Industrial	41.1	75 – Day 65 - Night	70 Day/Night
Education Centre	Schools, hospitals, mosques and Churches	37.1	45 – Day 35 - Night	55 – Day 45 - Night
Prince Mohammed Sports Stadium	Recreational (Institutional)	34.6	65 – Day 55 - Night	55 – Day 45 - Night
Steel Works	Industrial	39.1	75 – Day 65 - Night	70 Day/Night

The above noise levels represent the noise from the proposed CCGT plant only and do not account for background sources. The addition of background sources to these values has been discussed and assessed below.

Figure 6-4 Noise Model Plot (Project Process Contribution Only) – With Topography



As can be seen from the above table, noise levels are modelled to be within the adopted criteria for the daytime standards (Jordanian and WHO Guidelines) at all modelled receptors, for the proposed plant contribution noise only.

At night, there is compliance with all Jordanian standards, however several off-site residential receptors to the north (in Al Hashemiyah) and the CEGCO accommodation area may be exposed to noise levels in excess of the WHO noise guidelines (i.e. >45dB(A)).

In total there are approximately 350 properties within or on the extent of the 45dB(A) contour line of the projects process contribution. *Note: This is an estimated figure and something that cannot be accurately defied. The estimation is based upon the number of roofed structures, or visible property boundaries.*

The only other receptor that may be exposed to exceeding limits at night is the Education centre in Zarqa, however, this is not considered to be open at night and therefore not applicable for consideration of exceedances.

Please note: the full noise modelling assessment is provided in Appendix J.

<u>Cumulative Noise Model Impacts</u>

In order to determine the cumulative noise impacts (Process Contribution + Background), an additional noise model has been run in this regard in line with the baseline monitoring data collected.

For this purpose, the model has been re-run with background noise levels of 55dB(A) for daytime and 50dB(A) for night time. Due to the existing baseline exceedances, the noise model plot below shows the location of the +3dB(A) contour as a result of the proposed project. The orange line shows the predicted +3dB(A) contour in the daytime and the red line shows the +3dB(A) contour at night.

Figure 6-5 Cumulative Noise Impacts (+3dB(A) Noise – Daytime and Night time)

Based on the figure above, it is possible to determine the number of residential properties potentially affected by the project in terms of impacts ≥+3dB(A) noise increases.

As is shown in the figure below, there are no residential properties that fall within the predicted +3dB(A) daytime contour, however, there are up to 6 separate residential properties that are located within or on the extent of the +3dB(A) night time contour. These are marked in yellow as per the figure below.

Figure 6-6 Cumulative Noise Impacts (+3dB(A) Noise – Daytime and Night time) – Affected Residences

In general, the proposed project is predicted to have a potential impact of ≥+3dB(A) at up to 6 separate residential receptors. Other structures in this contour are commercial/industrial premises.

Although not specifically calculated in the model, it is expected that the additional noise from the proposed project will be up to +5dB(A) at the worst affected receptor at night.

Steam Venting

Steam venting may occur in abnormal situations on an extremely rare basis. In such situations the noise form the vents will be audible, however it is noted that the vents are fitted with silencers, which will limit the noise of any vented steam as far as practically possible. It is expected that any stem venting would be completed in short duration, and would only pose a temporary and very short term impact to noise (i.e. minutes to an hour in duration). Such events are generally not expected to occur and the systems are in place for venting in emergency situations only.

Historic Noise Levels in Zarqa

Based on previous field visits to the project site and existing HTPS HFO plant, it is known that noise receptors in the project area (e.g. Al Hashimeyah residences) were subject to additional noise for the previous HTPS HFO plant.

The existing HTPS HFO plant operated on boilers and steam turbines, all of which had become dated prior to the closure of operations in December 2015. The noise propagation from these turbines and boilers was considerable and despite there being no available monitoring data to demonstrate this, it is known that the plant was audible externally.

Although it cannot be quantified, it is expected that predicted noise from the proposed project will be reduced in magnitude compared to the previous HTPS HFO plant (due to modern Gas Turbine plant and better noise attenuation), and as such will provide a comparably better situation in regard to noise impacts.

Table 6-20 Noise and Vibration - Magnitude of Operational Impacts

Impact	Magnitude	Justification
Operational Noise	**Moderate Negative**	As a worst case it is expected that the project may result in noise exceedances of the IFC EHS Guideline values at night, with up to 6 residences affected by ≥+3dB(A).

Table 6-21 Noise and Vibration - Significance of Operational Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Operational Noise	Moderate Negative	Local Industrial Facilities	Low	**Minor**
		Local Commercial Premises	Medium	**Moderate**
		All local residences	High	**Moderate to Major**

6.6 Recommended Mitigation & Management Measures

6.6.1 Construction

Table 6-22 Noise – Mitigation & Management Measures during Construction

Impact	Mitigation Measure
Construction Noise and Vibration	The EPC contractor and their sub-contractors will, at all times, carry out all work in such a manner as to keep any disturbance from noise and vibration to a minimum.
	Activities emitting the highest noise levels will be undertaken during daylight hours between Sunday and Thursday and not during official holidays. In addition, as per the "Instruction for Reduction and Prevention of Noise for the year 2003" highest noise level construction activities should not be undertaken between 8pm and 6am.
	Where possible, the highest noise emitting activities should be undertaken in a central site area, or within an enclosed structure. For example, fabrication of materials before moving to other areas.
	All operatives will receive training in regard to the impacts of noise, methods to reduce noise on site, and this will be further indicated in tool box talks.
	Diesel engine vehicles and compression equipment will be equipped with effective silencers.
	Electrically powered plant will be preferred, where practicable, to mechanically powered alternatives. All mechanically powered and pneumatic plant should be fitted with suitable silencers.
	Where necessary, bored piling techniques will be preferred to impact piling. Where vibratory piling techniques are required, as modern vibrating hammer will be used.
	Delivery vehicles will be prohibited from waiting outside the site with their engines running. The movement of heavy vehicles during the night will be avoided wherever practical.
	All construction plant will be maintained and operated according to the manufacturers recommendations, in such a manner to avoid causing excessive noise.
	Items of plant on site operating intermittently will be shut down in the intervening periods between use.
	Where appropriate, noise barriers /attenuation to be employed (e.g. for generators) to ensure that the maximum noise level at 1m distance from a single source will not exceed 85dB(A).
	Where noise levels exceeds 85dB(A) noise protection devices will be provided to personnel on-site.
	Notices and letters should be provided to local residents, informing them of working hours and any activities that will potentially cause excessive noise and /or vibration, as per the SEP. Including key activities of these and what measures are being taken to reduce such impacts.
Construction Vehicle Noise	All Mitigation & management measures as per the traffic and transportation Chapter of this ESIA regarding the reduction and staggering of vehicles entering the site shall be implemented to reduce instances of additional noise from construction vehicles.

6.6.2 Operation

As per the baseline, the project area is already subject to noise levels above the specified night time WHO guidelines. The noise model has predicted that the additional impact of the project may result in impacts up to ≥+3dB(A) at 6 residences to the immediate north of the project. The worst case affected receptor will experience an approximate +5dB(A) impact at night time from the baseline. The worst affected receptor is located approximately 200m north of the proposed power block area. Therefore, in order for a neutral impact, a reduction of noise in the range of 5dB(A) would be required. If considering a +3dB(A) from baseline as an acceptable impact, the reduction of noise would need to be approximately 2dB(A) at the worst affected receptor.

Further to ISSUE 1 of the ESIA and clarifications with the lenders and lenders technical advisors, ACWA Power has confirmed that a noise barrier will be installed at the project perimeter, specifically on the northern boundary of the power block area. The Noise barrier will be 10m in height and will have a sound insulation quantity of up to 25dB(A), but at least 10dB(A) as a minimum. It is specified that in order to improve the appearance of the barrier, the upper most section of it will be transparent. Please note: noise abatement potential of the noise barrier was not included to the noise modelling study.

The installation of a noise barrier, particularly of this height is considered to be the most practical solution to reduce noise from the power block area. The power block area has most of the nosiest equipment at a lower elevation and as such, the barrier will abate this noise. Noise will still be emitted from taller structures, such as stacks (and will bypass the noise barrier), however such noise levels are not as significant as those at lower levels and have installed silencer abatement.

Besides the additional noise fence referenced above, ACWA Power and the EPC have confirmed that the project design (as modelled) has included a significant amount of noise abatement measures, such as noise enclosures, silencers. Low noise fans on the ACC's and silencers on emergency plant items (i.e. steam vents).

Based on the inclusion of the noise barrier, this mitigation alone is expected to result in a reduction of noise of at least 10dB(A). As such, there is expected to be a neutral/imperceptible impacts above existing baseline conditions. A potential design for the noise barrier as provided by SEPCO III is presented in Appendix U.

Table 6-23 Noise –Mitigation & Management Measures for Operation

Impact	Mitigation Measure
Operational Noise	All equipment has been specified to limit near field noise to 85dBA at 1m. As per manufacturer guarantees, in line with the EPC Contract.
	Where nearfield noise levels are found to be in exceedance of 85dB(A), additional noise abatement (e.g. insulation, new silencers) should be considered within building structures, or noise barriers should be provided.
	Silencer performance specifications will be provided to allow the plant to maintain compliance with the noise limits during unit start-up.
	The steam turbines will be provided with a soundproofing enclosure to ensure noise is below 85dB(A) at 1m.
	The ACC's have been designed to include specific low noise fans.
	Installation of 10m noise barrier to the north of the power block.
	Deliveries of materials and removals of waste are to be undertaken during daylight hours where possible to reduce night time vehicle noise.
	Operational noise monitoring at selected local sensitive receptors will be undertaken during operation to monitor compliance to the relevant standards and guidelines. Where non-compliant levels are identified (as a result of the proposed project) – (i.e. above the standard or >+3dB(A) from baseline), consideration will be given to the further application of practical mitigation & management measures at the site itself, or at the receptor location.

6.7 Residual Impacts

6.7.1 Construction

Table 6-24 Noise and Vibration – Residual Impacts – Construction Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact Significance
Construction noise	Moderate Negative	Local Industrial Facilities	Low	Negligible to Minor	Yes	**Negligible**
		Local Commercial Premises	Medium	Minor	Yes	**Negligible to Minor**
		Residences	High	Moderate to Major	Yes	**Moderate**
Construction Vibration	Negligible Negative	Local Industrial Facilities	Low	Negligible to Minor	Yes	**Negligible**
		Local Commercial Premises	Medium	Negligible to Minor	Yes	**Negligible**
		Residences	High	Minor	Yes	**Negligible to Minor**
Construction Vehicle Noise	Negligible Negative	Residences	High	Minor	Yes	**Negligible to Minor**

6.7.2 Operation

Table 6-25 Noise and Vibration – Residual Impacts – Operational Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact Significance
Operational noise	Moderate Negative	Local Industrial Facilities	Low	Minor	Yes	**Negligible**
		Local Commercial Premises	Medium	Moderate	Yes	**Negligible to Minor**
		Residences	High	Moderate to Major	Yes	**Minor**

7 SOIL, GEOLOGY AND GROUNDWATER

7.1 Introduction

Different projects have varying levels of interaction with geology, soils and groundwater, which can occur both at the construction and operational phases. For static facilities (such as power plants) the interaction with soils and groundwater is typically not prevalent following the construction phase as the above ground facilities are static, with few further excavations or earthworks required.

For the proposed project however, there will be an interaction with the groundwater during operation, as groundwater will be abstracted from wells for primary process water supply. It is recognised that the potable source of water for the plant will be delivered under a water supply agreement with the Water Authority of Jordan (WAJ), which may be used for process water in emergency situations.

Please note, that the assessment of groundwater in this chapter is in relation to potential impacts upon its quality, not impacts upon its resource use. Impacts upon resources use of groundwater are assessed in the following water and wastewater management chapter.

This section includes the following:

- Soil & Groundwater quality/contamination standards & guidelines;
- A summary of baseline data;
- Baseline soil and groundwater quality monitoring;
- Identified receptors;
- Potential impacts relating to the projects construction;
- Potential impacts relating to the projects operation;
- Impact Assessment;
- Mitigation & Management Measures (Construction and Operation); and
- Assessment of residual impacts following the application of Mitigation & management measures.

7.2 Applicable Environmental Legislation

<u>Jordanian Requirements</u>

The applicable environmental legislations in relation to geology, soil and groundwater includes the following:

- Soil Protection Regulation No. (25) of 2005
- Groundwater Control Regulation No. 85 for 2002 and its amendments thereof
- Jordanian Legislations Water Authority Law No. 18 for 1988 and its amendments thereof; and
- Instructions for the Protection of Water Resources Allocated for Drinking Purposes of year 2006.
- Drinking Water Standards' JS 286/2008

As groundwater will be the primary source of process water for the project, it is necessary to consider regulation relating to water resources and the management of these resources. As outlined below.

As part of the national regulations, there are no guidelines establishing soil and groundwater quality standards. In the absence of established soil and groundwater standards in Jordan, reference to the internationally recognised Dutch Soil Guidelines is recommended. The Dutch Standards identify maximum allowable concentrations for contaminants in soil and groundwater. The soil remediation intervention values indicate when the functional properties of the soil for humans, plants and animals is seriously impaired or threatened. They are representative of the level of contamination above which a serious case of soil contamination is deemed to exist. Groundwater target values provide an indication of the benchmark for environmental quality in the long term, assuming that there are negligible risks for the ecosystem.

The Dutch Standards for the most significant pollutants are presented in the following table. Where a parameter is not covered by the Dutch Standards, other appropriate international standards shall be used.

Table 7-1 Dutch Soil Guidelines

Parameters	Soil (mg/kg dry matter)		Groundwater (µg/l)	
	Target value	Intervention value	Target value	Intervention value
Heavy Metals				
Arsenic	29	55	10	60
Barium	160	625	50	625
Cadmium	0.8	12	0.4	6
Chromium	100	380	1	30
Copper	36	190	15	75
Lead	85	530	15	75
Molybdenum	3	200	. 5	300
Nickel	35	210	. 15	75
Zinc	140	720	. 65	800
Mercury	0.3	10	. 0.05	0.3
Other Inorganic Substances				
Chloride	-	-	100 mg/l	-
Cyanide free	-	20	5	1500
Cyanide Complex	-	50	10	1500
Thiocyanate	-	20	-	1500
Aromatic Compounds				
Benzene	-	1.1	. 0.2	30
Ethyl benzene	-	110	. 4	150
Toluene	-	320	. 7	1000
Xylene (sum)	-	17	. 0.2	70
Styrene (vinyilbenzene)	-	86	. 6	300
Phenol	-	14	. 0.2	2000
Cresols (sum)	-	13	. 0.2	200

The target values for soil are adjusted for the organic matter (humus) content and soil fraction <0.2 µm (lutum - Latin, meaning "mud" or "clay"). The values below are calculated for a 'Standard Soil' with 10% organic matter and 25% lutum.
A case of environmental contamination is defined as 'serious' if >25 m³ soil or >100 m³ groundwater is contaminated above the intervention value.
Source: Groundwater target values and soil and groundwater intervention values, 2009. Annex 1

European (EBRD) Requirements

The EBRD PR3 on Resource Efficiency and Pollution Prevention and Control establishes general requirements pollution prevention as follows:

- The assessment process must identify technically and financially feasible pollution prevention and control techniques that are best suited to avoid or minimise adverse impacts on human health and the environment and are appropriate to the nature and scale of the project's adverse impacts and issues; and
- The Project must meet the relevant EU substantive environmental standards, where these can be applied at the project level. Where no EU substantive environmental standards at project level exist, the Project will identify, in agreement with the EBRD, other appropriate environmental standards in accordance with GIP.

International (IFC) Requirements

IFC/World Bank General EHS Guidelines (2007) establish management approaches for land contamination due to anthropogenic releases of hazardous materials, wastes or oil, including naturally occurring substances in Section 1.8 Contaminated Land. Land is considered contaminated when it contains hazardous materials or oil concentrations above background or naturally occurring levels. Contaminated land is a concern because of the potential risks to human health and ecology as well as he liability that it may pose to the polluter/business owners. General management measures include:

- Land contamination should be avoided by preventing or controlling the release of hazardous materials, hazardous wastes or oil to the environment. When contamination of land is suspected or confirmed during any project phase, the cause of the uncontrolled release should be identified and corrected to avoid further releases;
- Contaminated lands should be managed to avoid the risk to human health and ecological receptors. The preferred strategy for land decontamination is to reduce the level of contamination at the site while preventing the human exposure to contamination.

7.3 Baseline

Soil

Soil Condition 2012 - 2016

Areas of the proposed site (i.e. Site Sections 1 & 3, as per the site section breakdown in the project description) have historically been used for the temporary storage of waste and scrap material, from operation and maintenance at the existing Hussein TPS.

The first soil sampling event in September 2012 followed initial site visits by 5 Capitals and was undertaken to determine the presence of any surface soil contamination of the areas that were being used for temporary storage of hazardous and non-hazardous wastes. The subsequent soil sampling study which was undertaken in October 2012, sought to determine whether instance of subsurface soil contamination existed to a depth of 5 metres.

Table 7-2 Soil Sample Locations

ID	GPS Co-ordinates		Collection Date	Comment
	Northing	Easting		
A1	32° 7'7.90"N	36° 7'43.40"E	September 2012	All samples were collected from the subsurface, 10-15cm deep
A2	32° 7'6.20"N	36° 7'44.50"E		
A3	32° 7'10.00"N	36° 7'39.80"E		
B1	32° 7'7.90"N	36° 7'43.40"E		
B2	32° 7'17.50"N	36° 7'31.80"E		
B3	32° 7'18.80"N	36° 7'31.90"E		
B4	32° 7'16.30"N	36° 7'33.90"E		
A1	32° 7'7.90"N	36° 7'43.40"E	October 2012	Percussion drill used to collect samples Total drill depth: 5 meters Soil samples were collected at 1 m interval from each sampling location Total of 6 sampling locations (A1, B1, C1, 2,3,4)
B1	32° 7'17.00"N	36° 7'33.30"E		
C1	32° 7'1.82"N	36° 7'36.77"E		
C2	32° 7'1.54"N	36° 7'33.88"E		
C3	32° 6'50.82"N	36° 7'33.33"E		
C4	32° 6'55.66"N	36° 7'34.64"E		

Plate 7-1 2012 Soil Sampling Locations

Discussion of the September 2012 Soil Analytical results

Since no Jordanian standards or guidelines are available for heavy metal concentrations in soils, the National Oceanographic and Atmospheric Administration's (NOAA) Screening Quick Reference Table (SQuiRT) and Dutch Soil Standards were used for evaluating the recorded levels.

When assessing the calculated percentages, the following breakdown was developed to describe the degree of heavy metal concentration.

- 0-100% Normal to Marginal
- 100-500% Moderate
- 500-1000% High
- >1000% Very High

Table 7-3 Measured Heavy Metal Levels, mg/Kg

Parameter	SITE							SQUIRT
	A1	A2	A3	B1	B2	B3	B4	
Arsenic	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	5.2
Barium	146.7	204.3	130.6	86.7	102.5	66.0	32.0	440
Beryllium	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	0.63
Boron	164.2	148.6	86.2	75.3	92.4	100.9	21.2	26
Cadmium	2.0	<2.0	4.7	<2.0	2.5	<2.0	<2.0	-
Chromium	11.1	1.1	35.5	9.1	8.3	<1.0	2.0	37
Cobalt	83.0	5.6	3.0	4.9	5.4	36.0	<2.0	6.7
Copper	40.5	9.9	<1.0	19.8	16.8	13.5	1.5	17
Cesium	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
Lead	<1.0	<1.0	<1.0	8.5	<1.0	27.0	<1.0	16
Iron	13,500.0	19,600.0	12,000.0	18,000.0	14,000.0	19,700.0	3,900.0	18,000
Manganese	152.0	538.9	237.1	420.3	358.5	292.7	25.6	330
Mercury	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	0.058
Molybdenum	3.1	<1.0	6.0	2.6	1.3	<1.0	1.6	-
Selenium	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	0.26
Thallium	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	8.6
Vanadium	134.8	45.9	160.1	10,100.0	66.5	29.6	23.3	58
Nickel	48.1	25.4	32.0	2,652.3	25.3	13.5	5.3	13
Strontium	207.4	552.3	350.7	217.0	203.1	95.9	122.6	120
Zinc	69.8	56.7	80.9	443.7	70.4	58.4	10.4	48

Review of the measured values against the SQuiRT guidelines revealed the following:

- Vanadium, Nickel, Strontium and Zinc are almost consistently high across all sites.
- High levels of Cobalt, Copper, Manganese and Iron were recorded at several sites, although not consistently within each site.
- One high level of Lead was recorded, at Site B3.
- Boron was consistently high at 6 of the 7 sites tested.

- All other metals were either below the laboratory detectable levels, or below the SQuiRT guideline.

Table 7-4 Percentage up take of SQuiRT Guideline

Parameter	SITE							SQUIRTS
	A1	A2	A3	B1	B2	B3	B4	mg/kg
Arsenic	Below Detectable (BD)							5.2
Barium	33.3%	46.4%	29.7%	19.7%	23.3%	15.0%	7.3%	440
Beryllium	Below Detectable							0.63
Boron	631.5%	571.5%	331.5%	289.6%	355.4%	388.1%	81.5%	26
Cadmium	No Guideline							-
Chromium	5.4%	BD	12.7%	BD	6.8%	BD	BD	37
Cobalt	1238.8%	83.6%	44.8%	73.1%	80.6%	537.3%	BD	6.7
Copper	238.2%	58.2%	BD	116.5%	98.8%	79.4%	8.8%	17
Cesium	No Guideline							-
Lead	6.3%	6.3%	6.3%	53.1%	6.3%	168.8%	6.3%	16
Iron	75.0%	108.9%	66.7%	100.0%	77.8%	109.4%	21.7%	18,000
Manganese	46.1%	163.3%	71.8%	127.4%	108.6%	88.7%	7.8%	330
Mercury	Below Detectable							0.058
Molybdenum	No Guideline							-
Selenium	Below Detectable							0.26
Thallium	Below Detectable							8.6
Vanadium	232.4%	79.1%	276.0%	17413.8%	114.7%	51.0%	40.2%	58
Nickel	370.0%	195.4%	246.2%	20402.3%	194.6%	103.8%	40.8%	13
Strontium	172.8%	460.3%	292.3%	180.8%	169.3%	79.9%	102.2%	120
Zinc	145.4%	118.1%	168.5%	924.4%	146.7%	121.7%	21.7%	48

Review of the calculated percentages against the SQuiRT guidelines revealed the following:

- Vanadium, Nickel and Strontium ranged from normal to moderate across all sites, except for B1 where Vanadium and Nickel were very high. Vanadium was approximately 174 times the SQuiRT guideline, and Nickel was approximately 204 times the guideline.
- Levels of Zinc were moderate across all the sites, except for B1 where it was high.
- Levels of Boron were moderate to high across all sites, except B4 which was normal.
- Levels of Copper were variable, ranging from non-detectable to normal, marginal and moderate.
- Cobalt was also variable. Two sites, B3 and A1 registered as high and very high, respectively. Whilst the other sites ranged from non-detectable to normal.
- Levels for Manganese ranged from normal for 4 samples and moderate for 3 samples.
- Levels for Strontium were moderate at two sites and marginal for the remaining sites.
- Levels for Lead were within the normal range for all sites, except B3 which was considered moderate.
- Levels for Iron were within the normal to moderate range for all sites.
- Levels for Barium and Chromium fell within the normal range for all tested sites.

Overall, Site B1 has high to very high levels of Zinc, Vanadium and Nickel. Elevated levels for Boron, Cobalt, Copper and Strontium were also recorded at several sites.

Where guidelines are available for the remaining metals these were within the normal to marginal range.

Five of the tested metals were non detectable at all sampled sites.

Finally, samples collected from Site A, generally had higher levels of metals than the samples collected from Site B, with Cobalt registering 12 times higher than the SQuiRT guideline.

Table 7-5 Percentage up take of Dutch Soil Guidelines

Parameter	SITE							Dutch Soil Guideline	
	A1	A2	A3	B1	B2	B3	B4	Optimum	Action
Arsenic	BD							0.90	55.00
Barium	91.7%	127.7 %	81.6%	54.2%	64.1%	41.3%	20.0%	160.00	625.00
Beryllium	BD							1.10	30.00
Boron	No Guideline							-	-
Cadmium	250.0%	BD	587.5%	BD	312.5%	BD	BD	0.80	12.00
Chromium	2921.1 %	289.5 %	9342.1 %	2394.7 %	2184.2 %	BD	526.3 %	0.38	220.00
Cobalt	3458.3 %	233.3 %	125.0%	204.2%	225.0%	1500.0 %	BD	2.40	180.00
Copper	1191.2 %	291.2 %	BD	582.4%	494.1%	397.1%	44.1%	3.40	96.00
Cesium	BD							-	-
Lead	BD	BD	BD	15.5%	BD	49.1%	BD	55.00	530.00
Iron	No Guideline							-	-
Manganese	No Guideline							-	-
Mercury	BD							0.30	10.00
Molybdenum	103.3%	BD	200.0%	86.7%	43.3%	BD	53.3%	3.00	190.00
Selenium	BD							0.70	100.00
Thallium	BD							1.00	15.00
Vanadium	321.0%	109.3 %	381.2%	4040.0 %	158.3%	70.5%	55.5%	42.00	250.00
Nickel	1850.0 %	976.9 %	1230.8 %	2652.3 %	973.1%	519.2%	203.8 %	2.60	100.00
Strontium	No Guideline							-	-
Zinc	436.3%	354.4 %	505.6%	126.8%	440.0%	365.0%	65.0%	16.00	350.00

Review of the calculated percentages against the Dutch Soil guidelines revealed the following:

- Levels for Vanadium, Nickel and Zinc were all greater than the Dutch Action guideline for these heavy metals. The exceedances were all noted at Site B1. The percentage of increase was categorised as Very High for Vanadium and Nickel and Marginal for Zinc.

- Nickel was also categorised as very high to high with respect to the optimum guideline, across the remaining sites, except for B4.
- Zinc was also categorised as Moderate to High across the remaining sites, except for B4.
- Chromium levels were categorised as very higher at 4 of the 7 sites surveyed. The remaining 3 sites varied from non-detectable to high.
- Cobalt and Copper levels had similar variability to Chromium. The categorisation ranged from very high to non-detectable, with a dominance of high and moderate.
- Molybdenum, Cadmium and Barium were categorised as normal to moderate across the sites.
- The categorisation for Barium was normal.
- Generally, according to the Dutch guidelines, the following heavy metals were categorised as high to very high at the majority of the sites:
- Chromium,
- Cobalt,
- Copper, and
- Nickel

Site B1 is considered contaminated with Zinc, Nickel and Vanadium, as the analysed levels exceeded the Action guideline. Chromium and Copper were also well above the optimum guideline.

The results recorded at Site A indicated higher levels of heavy within the samples, with a greater incidence of the 'very high' categorisation.

The results from Site B, indicated more localised contamination with B1 being contaminated

Discussion of the October 2012 Soil Analytical results

The September 2012 soil analysis revealed that surface contamination was present at Site B (exceedance of Dutch Action values) and that elevated levels of heavy metals were recorded at Site A.

Consequently, a second soil investigation study was carried out in October 2012 for Site A, B in order to verify if the heavy metals had migrated to deeper soils. A new site C was also added to expand to survey area. On this occasion, sampling at sequential discreet depths was undertaken, with soil samples collected at each meter interval, up to a maximum depth of 5m.

Results were compared against Dutch soil quality standards.

While some values were higher than optimum, none required intervention in the form of remediation works.

The results showed some variation between depths with marginally higher values at 4m for Site A and B, although again these did not require remedial works.

Site C recorded lower levels of heavy metals than Site A and B, and the top 2 meters of soil, had the highest concentrations for heavy metals.

Table 7-6 Soil Analysis at Depth vs Dutch Standards Site A1

Parameter	SOIL results in (mg/kg)					Dutch Soil Guideline				
	A1-1m	A1-2m	A1-3m	A1-4m	A1-5m	Optimum	Action	Min	Max	Average
Arsenic	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**0.90**	**55.00**			
Barium	82.84	74.26	31.37	23.90	19.28	**160.00**	**625.00**	19.28	82.84	46.33
Beryllium	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**1.10**	**30.00**			
Boron	156.61	183.67	215.57	237.67	262.34			156.61	262.34	211.17
Cadmium	2.79	<2.0	< 2.0	2.89	2.48	**0.80**	**12.00**	2.48	2.89	2.72
Chromium	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**0.38**	**220.00**			
Cobalt	11.88	26.09	22.88	29.00	28.28	**2.40**	**180.00**	11.88	29.00	23.63
Copper	34.04	52.87	73.73	153.98	80.74	**3.40**	**96.00**	34.04	153.98	79.07
Cesium	< 1.0 %	< 1.0 %	< 1.0 %	< 1.0 %	< 1.0 %					
Lead	< 1.0	<1.0	<1.0	< 1.0	<1.0	**55.00**	**530.00**			
Iron	24752.97	42278.86	39060.94	60593.94	49860.11			24752.97	60,593.94	43,309.36
Manganese	415.21	511.74	476.52	486.95	531.57			415.21	531.57	484.40
Mercury	<1.0	<1.0	<1.0	<1.0	<1.0	**0.30**	**10.00**			
Molybdenum	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**3.00**	**190.00**			
Selenium	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**0.70**	**100.00**			
Thallium	<1.0	<1.0	<1.0	<1.0	<1.0	**1.00**	**15.00**			
Vanadium	80.05	35.48	47.35	86.99	78.04	**42.00**	**250.00**	35.48	86.99	65.58
Nickel	54.90	105.95	86.41	85.39	91.43	**2.60**	**100.00**	54.9	105.95	84.82
Strontium	217.46	89.30	98.90	98.89	95.32			89.3	217.46	119.97
Zinc	66.37	62.77	68.63	70.79	67.45	**16.00**	**350.00**	62.77	70.79	67.20

Table 7-7 Soil Analysis at Depth vs Dutch Standards Site B1

Parameter	SOIL results in (mg/kg)					Dutch Soil Guideline				
	B1-1m	B1-2m	B1-3m	B1-4m	B1-5m	Optimum	Action	Min	Max	Average
Arsenic	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**0.90**	**55.00**			
Barium	76.53	75.47	79.11	93.27	68.9	**160.00**	**625.00**	68.9	93.27	78.66
Beryllium	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**1.10**	**30.00**			
Boron	30.06	28.09	28.33	49.41	36.55			28.09	49.41	34.49
Cadmium	3.31	2.65	3.69	4.45	4.32	**0.80**	**12.00**	2.65	4.45	3.68
Chromium	10.85	13.99	13.37	14.09	14.98	**0.38**	**220.00**			
Cobalt	2.04	< 2.0	< 2.0	4.19	2.86	**2.40**	**180.00**	2.04	4.19	3.03
Copper	4.67	3.99	4.2	8.39	5.85	**3.40**	**96.00**	3.99	8.39	5.42
Cesium	< 1.0 %	< 1.0 %	< 1.0 %	< 1.0 %	< 1.0 %					
Lead	< 1.0	<1.0	<1.0	< 1.0	<1.0	**55.00**	**530.00**			
Iron	6200.24	5267.89	6254.99	11212.54	8187			5267.89	11,212.54	7,424.53
Manganese	142.81	123.45	96.47	151.32	96.95			96.47	151.32	122.20
Mercury	<1.0	<1.0	<1.0	<1.0	<1.0	**0.30**	**10.00**			
Molybdenum	< 1.0	< 1.0	< 1.0	< 1.0	1.24	**3.00**	**190.00**			
Selenium	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**0.70**	**100.00**			
Thallium	<1.0	<1.0	<1.0	<1.0	<1.0	**1.00**	**15.00**			
Vanadium	63.2	26.79	39.11	51.99	39.74	**42.00**	**250.00**	26.79	63.20	44.17
Nickel	12.94	12.2	12.87	20.14	17.67	**2.60**	**100.00**	12.2	20.14	15.16
Strontium	177.15	146.94	151.64	148.84	129.81			129.81	177.15	150.88
Zinc	33.74	25.39	31.52	42.27	39.04	**16.00**	**350.00**	25.39	42.27	34.39

Table 7-8 Soil Analysis at Depth vs Dutch Standards Site C1

Parameter	SOIL results in (mg/kg)					Dutch Soil Guideline				
	B1-1m	B1-2m	B1-3m	B1-4m	B1-5m	Optimum	Action	Min	Max	Average
Arsenic	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**0.90**	**55.00**			
Barium	80.31	135.97	60.09	36.62	45.00	**160.00**	**625.00**	36.62	135.97	71.60
Beryllium	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**1.10**	**30.00**			
Boron	39.6	79.99	34.69	14.29	16.73			14.29	79.99	37.06
Cadmium	3.06	3.69	< 2.0	< 2.0	< 2.0	**0.80**	**12.00**	3.06	3.69	3.38
Chromium	22.25	30.57	18.5	10.92	6.94	**0.38**	**220.00**			
Cobalt	2.35	4.6	< 2.0	< 2.0	< 2.0	**2.40**	**180.00**	2.35	4.60	3.48
Copper	4.53	11.61	3.82	1.84	2.31	**3.40**	**96.00**	1.84	11.61	4.82
Cesium	< 1.0 %	< 1.0 %	< 1.0 %	< 1.0 %	< 1.0 %					
Lead	< 1.0	<1.0	<1.0	< 1.0	<1.0	**55.00**	**530.00**			
Iron	6604.15	13993.65	4039.19	2391.58	2698.13			2391.58	13,993.65	5,945.34
Manganese	150.64	219.83	139.97	73.24	141.38			73.24	219.83	145.01
Mercury	<1.0	<1.0	<1.0	<1.0	<1.0	**0.30**	**10.00**			
Molybdenum	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**3.00**	**190.00**			
Selenium	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	**0.70**	**100.00**			
Thallium	<1.0	<1.0	<1.0	<1.0	<1.0	**1.00**	**15.00**			
Vanadium	200.02	201.97	49.19	18.56	29.57	**42.00**	**250.00**	18.56	201.97	99.86
Nickel	30.13	41.09	18.2	7.03	8.96	**2.60**	**100.00**	7.03	41.09	21.08
Strontium	196.53	182.61	218.96	150.84	156.31			150.84	218.96	181.05
Zinc	49.98	79.1	26.39	15.88	14.34	**16.00**	**350.00**	14.34	79.10	37.14

Soil Condition 2016

Between 2012 and 2016 a portion of Site Section 1 had returned to use as a scrap storage area, however the scarp was sold to scrap merchants and removed from site in early March 2016.

Following the removal of all scrap in 2016 and also the removal of the initial top layer of soil, further soils quality sampling and analysis was undertaken at the surface to confirm the uncontaminated nature of the site.

Soil samples were collected from the site on 13th March 2016, and sealed inside double zip lock bags for delivery to an accredited laboratory in Jordan. The locations of soil samples are detailed in the table below.

Table 7-9 Soil Sampling Locations (March 2016)

Sample ID	Easting	Northing
1A	0360744.4	3207143
1B	0360441.5	3207093
2	0360738.3	3207044
3A	0360733.0	3207122
4A	0360717.3	3207246

Figure 7-1 Soil Sampling Locations (2016)

Satellite Image Source: Google Earth

Table 7-10 Soil Sampling Locations (March 2016)

Sample ID	Depth	Soil Class	Moisture	Odour	Staining	Comments
1A	Surface	Hard, stony	None	None	None	Some small metal fines
1B	20cm	Loose sand	None	None	None	Clean soil
2	10cm	Sandy/gravel	None	None	None	Clean sandy gravel
3A	10cm	Sandy/gravel	None	None	None	Disturbed ground including green stones and ash
4A	10cm	Sandy/gravel	None	None	None	Area formerly tree nursery – trees died when refinery stopped supplying water

Samples were analysed for a suite of heavy metals as per the results below. Please note: that as per the above table no samples or other surface areas on the site were found to have oily contamination, as a result, analysis for hydrocarbon based parameters was not undertaken. The full laboratory certificates are presented in Appendix K.

It is clarified that no signs of asbestos were noted at the site during inspection of the scrap metal areas prior to removal in 2016, and hence analysis for asbestos was not undertaken.

Table 7-11 Soil Analysis (2016)

Parameter	Unit	Concentration				
		1A	1B	2A	3A	4A
Arsenic	mg/kg	<7.5	<7.5	<7.5	<7.5	<7.5
Barium	mg/kg	301	183	224	114	150
Cadmium	mg/kg	6.02	3.97	4.98	<1.0	<1.0
Chromium	mg/kg	678	98.7	45.4	42.9	54.8
Cobalt	mg/kg	5.66	<5.0	<5.0	<5.0	6.47
Copper	mg/kg	1772	27.2	11.4	13.1	19.0
Lead	mg/kg	157	10.4	<5.0	19.3	13.2
Nickel	mg/kg	508	62.6	25.9	212	36.3
Mercury	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Zinc	mg/kg	1040	164	40.3	78.0	87.1

The soil results from the 2016 soil survey indicate that site soils at locations 1B, 2A, 3A and 4A are uncontaminated when compared to the respective Dutch soil standards 'Intervention Values'. For site 1A, there are several parameters which do exceed the 'Intervention Values', including Chromium, Copper, Nickel and Zinc. This is only the case at location 1A, which was previously used for the storage of scrap material.

Other soil sampling sites do have elevated but compliant concentrations of metals, but not to the extent of site 1A. It was further noted in the sampling notes (transcribed above) that small metal fines were noted to be scattered across this area of the site. These are apparent from the previous storage of scrap metal in this area.

The extent of the high heavy metal values is expected to be very defined due to the previous fencing off of the scrap storage area at site 1A. The expected extent of the high metal concentrations is shown on the satellite image below. This area is the extent of the scrap storage area.

Figure 7-2 Expected Extent of High Metal Concentrations

Satellite Image Source: Google Earth

Since reporting of the ESIA findings in ISSUE 1, CEGCO have committed to remediating the area of contaminated soil before the end of June 2016. As it stands (at the time of writing) CEGCO have applied for a permit to Zarqa Municipality in regard to the transportation and disposal of this waste at the Al Swaqa hazardous landfill site, a lined, cell structure landfill site in Jordan, regulated by the Ministry of Environment. In addition, CEGCO have received quotations from local hazardous waste contractors in regard to the removal of the soil and transportation to a licensed municipality landfill site. All that remains is for the permit to be granted and for the remediation to take place.

Upon removal of the soil (expected to be undertaken before end of June 2016), CEGCO will ensure that all Chain of Custody forms regarding the soil movements are recorded and that further sampling of soli and analysis in the contaminated area 1A are undertaken to confirm that the remediation has removed the residual contamination.

Groundwater

Groundwater Quality – Existing Wells

The HTPS operated for approximately 40 years with its water source coming from relatively shallow wells bored on the Hussein TPS landholding. The water source is understood to come from the first aquifer layer underlying the surface at a depth between 50-80m.

It was identified in 2012 that two of the wells at the existing Hussein TPS were pumping a small volume of oil, which indicated contamination of the groundwater (these were wells #8 & #9). An extensive specialist survey in 2014/2015 identified the cause of the groundwater contamination as a leaking oily water drain from the existing boilers at the Hussein TPS. The surveys indicated that the extent of contamination is contained to an area underlying the Hussein TPS landholding at a depth of approximately 50m. Several additional boreholes close to the plants boundaries confirmed that the contamination had not spread to these boundary locations.

Figure 7-3 Location of Existing Wells at the ACWA Power Zarqa CCGT Project Site with Previous Contamination

Satellite Image Source: Google Earth

In order to remediate the groundwater CEGCO undertook a regime of treatment and pumping of the groundwater to the on-site oil/water separator. Within a short space of time the pumping removed the visible groundwater contamination. Pumping of the groundwater continued during January, February and March of 2016 for 2 hours each day via a pump operating at a capacity of approximately 90m^3 per hour; with approximately 180m^3 per day of targeted removal from the contaminated wells.

Daily laboratory analysis at the CEGCO on-site laboratory were conducted with records maintained. Analysis results from as early as February 2016 retuned results lower than detectable limits for hydrocarbons. Further to internal laboratory testing, samples of the groundwater were taken in March 2016 from existing wells 1, 8 & 9, and analysed at a local accredited laboratory in Jordan for, TPH, oils & grease and PAH. All results were returned with concentrations of the above parameters as less than detectable, which indicates that the groundwater contamination has been remediated. The laboratory certificates are presented in Appendix L.

Further to this remediation, testing and independent laboratory analysis, the existing wells have been capped and are now not in use.

Other wells have existed on the proposed ACWA Power Zarqa CCGT project site, including wells at the proposed evaporation pond and storage tank areas, but have since been capped.

Groundwater Quality – Proposed Boreholes

It is recognised that the proposed process water source for the Project will be groundwater from 3 new boreholes to be drilled at the proposed site adjacent to existing wells that were used for the HTPS. The 3 boreholes will access the same shallow aquifer at depths of 95m, 110m and 220m. As a worst case in the winter with the plant operation on LDO fuel, a volume of 117.2m^3/hr will be required.

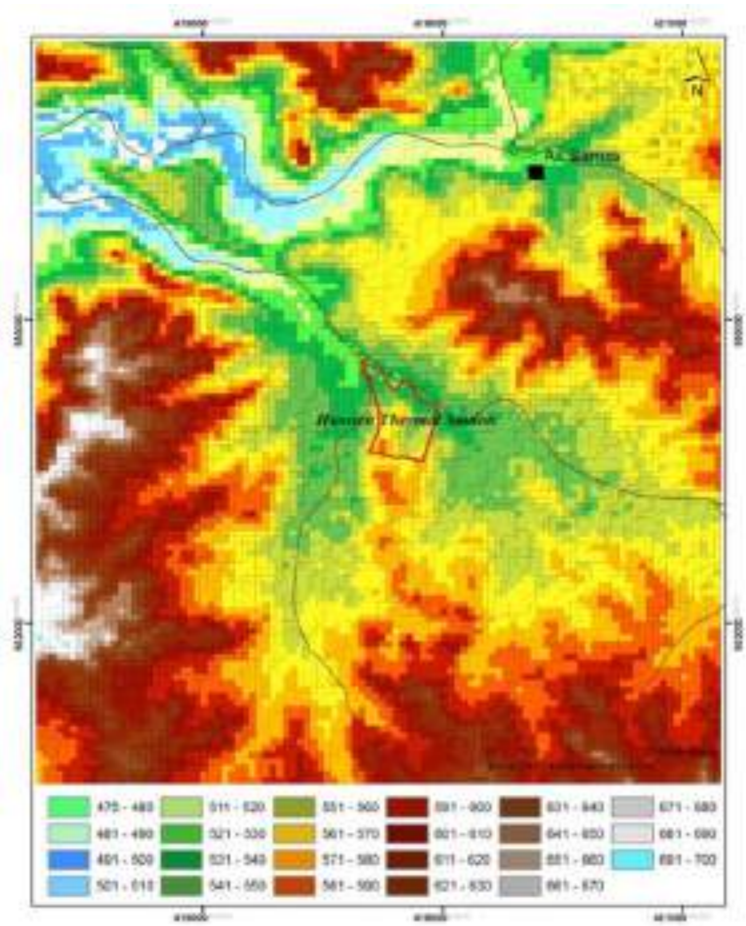
According to the records of the Ministry of Water and Irrigation, the average depth of groundwater wells ranges from 86m to 280m with a static water level between 480 and 490m.

Based on existing records over the past 40 years of operation at the HTPS, the baseline quality of the groundwater from this aquifer is known to be suitable, but has increased in Total Dissolved Solids (TDS) over time.

Topography

The project site is located within Amman Zarqa ground and surface water basins. The approximate elevation of the site is 530 to 580m ASL. The surrounding topography ranges from a high point of 690m ASL, 3km southwest of the PROJECT, whilst the lowest point is 475m ASL 3km northwest of the project. The following topographic model depicts the elevations of the project site and surrounding area.

Figure 7-4 Elevation of the site and surrounding



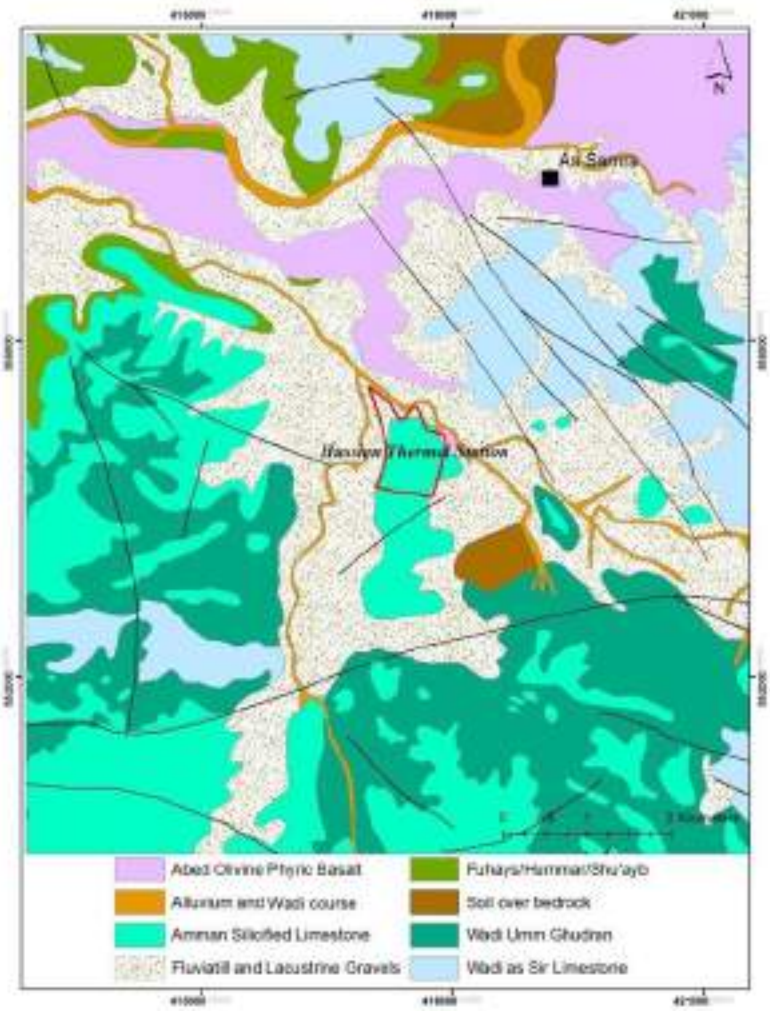
Note: Figure References Hussein Thermal Station. The ACWA Power Zarqa CCGT project is located along the northern most section of this red outline.

Geology

It is understood that the geology underlying the site is consistent with the surrounding local geology, and is not of any particular geological value, or subject to any geological designations.

The geologic outcrops in the study area are shown in the figure below. The dominant geologic units are of late Cretaceous age composed of limestone, marl and marly limestone belonging to Ajlun and Balqa groups. In places they are covered by quaternary soil, alluvium and lacustrine gravels.

Figure 7-5 Geological Outcrops in Local Area



Note: Figure References Hussein Thermal Station. The ACWA Power Zarqa CCGT project is located along the northern most section of this red outline.

In the northern parts of the area a Tertiary basaltic flow crops out and extends from Samra treatment plant to the north along Zarqa River. The geological succession is given in the Table below.

Table 7-12 Local Geological Succession

Formation	Symbol	Group	Period	Era	Stage
Soil over bedrock	S		Quaternary	Cenozoic	Holocene - Recent
Alluvium and Wadi Sediments	Al		Quaternary	Cenozoic	Holocene - Recent
Fluviatill and Lacustrine Gravels	Pl		Quaternary	Cenozoic	Pleistocene
Abed Olivine Phyric Basalt	AOB	Safawi	Tertiary	Cenozoic	Miocene
Amman Silicified Limestone	ASL	Belqa	Late Cretaceous	Mesozoic	Campanian
Wadi Umm Ghudran	WG	Belqa	Late Cretaceous	Mesozoic	Santonian
Wadi as Sir Limestone	WSL	Ajlun	Late Cretaceous	Mesozoic	Turonian
Fuhays/Hummar/Shu'ayb	FHS	Ajlun	Late Cretaceous	Mesozoic	Cenomanian

According to the geo-technical survey undertaken in 2012, the bedrock underlying the site belongs to the either the B2 or the B Geologic Formation. The bedrock relating to the B-2 Geologic Formation of Lower Belqa Group of the Campanian Age consists of limestone with bands of chert. The bedrock relating to the B Geologic Formation of Quaternary Period consists of black basalt. These Formations extend to more than 20 to 30m below existing ground level, the maximum depths of borings.

7.4 Sensitive Receptors

The table below outlines the identified receptors in relation to soil, geology and hydrogeology as well as the determined sensitivity of those receptors.

Table 7-13 Soil and Groundwater - Receptor Sensitivity

Receptor	Sensitivity	Justification
Soil (Quality)	Medium	The site is a brownfield, and exceeding heavy metal concentrations (compared to the Dutch standards) have been recorded at the location of the previous scrap metal storage area (an approximate 30*50m portion of the proposed power block area). Other areas have elevated levels for certain metals too (but not exceeding the Dutch soils Intervention values. *Note: Soil remediation to be completed by CEGCO prior to the end of June 2016.*
Upper Aquifer Groundwater (Quality)	Medium	Minor contamination has been recorded in the past, but recent remediation has indicated that GW quality has improved significantly.

7.5 Significance of Impacts

7.5.1 Construction

There are a range of construction related activities that could pose a threat and lead to changes in the chemical properties of the soil and groundwater, resulting in potential contamination. Impacts can occur from the spillage of liquid materials used during construction, improper management of generated construction waste, and cross contamination of soil and groundwater at the site. Adequate waste management and soil and groundwater protection measures must be outlined in the EPC's CESMP prior to the start of construction activity. These control measures are required in order to prevent the risk of soil and groundwater contamination at the proposed development site.

Spillage: During the construction phase, the risk of accidental spillage and leakage of various chemical products, paints, oils, fuels, lubricants, vehicle oil changing or re-fuelling, sanitary wastewater from worker compounds and cleaning agents is present. Impacts of this can take place at the storage areas of the construction site as well as during the transportation of such materials on site. Improper methods of storing, transferring, and handling of these products can result in spillage to the ground and result in soil contamination. Depending on the volume of the spill and the characteristics of the pollutants, the contamination may reach the groundwater. Once contamination has reached the groundwater, the volume of contaminated soil and groundwater can increase quite rapidly. This is a function of the physical and chemical properties of the contaminants and the velocity of the groundwater. Prior to mitigation, these impacts could be temporary to permanent and be considered of moderate negative significance.

Waste Management: Construction of power plants involves activities that generate solid and hazardous waste on-site. Waste generated during these activities poses a threat to the soil and groundwater. Of special concern is the management of hazardous waste generated during the construction phase. Although the hazardous fraction of construction waste such as used oil, machinery lubricants, paints and sludge, represents a relatively small proportion of the total amount of construction waste, it requires special attention. If the temporary storage and handling of such waste on the construction site is inadequate prior to being removed for disposal, the risk of soil and groundwater contamination increases. Prior to mitigation, these impacts could be temporary to permanent and be considered of moderate negative significance.

Cross Contamination of Soil: During construction work, cross contamination is the transfer of contaminated earth from one location to another, thereby exacerbating any existing environmental problem through poor management. As per the baseline sampling, the soil conditions on site are varied, with elevated concentrations of several metals and a hotspot of exceeding metals compared to the Dutch Standards (at the existing scrap storage area).

If this contaminated soil is relocated during construction activities, the potential for the transfer of contaminants can occur, which could lead to a negative environmental impact. In addition, if contaminated soil is dispersed through dust generation as a result of construction activities like ground excavation, then further spreading of contaminants will also occur. This impact is considered of minor negative significance prior to the implementation of appropriate measures.

Table 7-14 Soil, Geology and Hydrology – Magnitude of Construction Impacts

Impact	Magnitude	Justification
Spillage	Minor for Soil / Negligible for Groundwater	The volumes and quantities of hazardous materials being transported and handled during the construction phase is low, however poor handling practices will increase the likelihood of spills. Impacts could be temporary to permanent.
Inadequate waste management	Minor	Small volumes of hazardous wastes will be generated during the construction phase. If these wastes are not properly handled, separated, stored and then disposed, contamination is very likely to occur in hotspots to site soils.
Cross contamination of soils	Minor	During ground preparation works, levelling of the site, or disposal of soils to off site areas, there is a minor risk of cross contamination if management and monitoring mechanisms are not implemented.

Table 7-15 Soil, Geology and Hydrology – Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Spillage	Minor	Soil	Medium	Minor
	Negligible	Upper Aquifer Groundwater (Quality)	Medium	Negligible to Minor
Inadequate waste management	Minor	Soil	Medium	Minor
	Negligible	Upper Aquifer Groundwater (Quality)	Medium	Negligible to Minor
Cross contamination of soils	Minor	Soil	Medium	Minor

7.5.2 Operation

Geology

Following the completion of construction activities, the site will be static (i.e. no further excavation activities) and as a result no direct impacts to geology will not occur.

Soil Quality

During the operational phase the potential for uncontrolled releases to soils from a number of sources is possible. Such releases have the potential to occur during transportation, handling, and storage as well as during cleaning activities and accidental spillages to the ground. Potential contamination sources will likely include:

- Stored back up liquid fuel;
- Waste oils (e.g. oily sludge, spent maintenance oils);
- The use of solvents/cleaning fluids;
- Accidental release of untreated wastewater;
- Poorly treated wastewater effluents for irrigation;
- Runoff of any landscaping additives (e.g. pesticides, herbicides, fertilisers etc. if used.).

In general, there will be few significant sources that could result in widespread contamination to the site soils. The most significant source of contamination is the storage of back up fuel. The projects design will ensure that there is suitable impermeable capacity (110%) for retention of any leaks and spills, including catastrophic leakage, within storage area bunding.

A large proportion of the main power plant site will protect underlying soils due to the predominant impermeable nature of its hard standing surfacing (i.e. tarmac, concrete). Where hazardous materials, hazardous wastes, wastewater effluents and liquid fuels are to be stored, these will be contained in sealed bunded structures. Consequently, the risk of contamination to the soil and groundwater is therefore unlikely, unless there is poor construction of such surfaces and containment areas.

Fuel and other chemical pipelines (e.g. linking alkali and acid storage tanks) outside of their storage areas will not be afforded bunding and may have the potential to result in leaks, particularly at connection points.

The use of solvents/cleaning fluids is likely to be fairly limited, however, attention will be paid to proper storage, handling and transportation of these to avoid spills or leaks.

Groundwater Quality

Pollution pathways

The project will have a direct interaction with groundwater resources due to the drilling of 3 new boreholes at the project site.

By way of creating new boreholes it is possible that a pathway for pollution will be opened whereby any contaminants from the surface or other aquifer layers can migrate and potentially cross contaminate the various layers. The local areas carry a potential risk for contamination (e.g. adjacent petrochemical refinery) and it has been document that recent remediation works at the project site for oil contamination in the groundwater has been undertaken successfully.

In regard to the design of the new wells, it is understood that the wells will be suitably lined with impermeable materials (as per the applicable building codes) to ensure that the risks of such pathways are minimised. The use of such impermeable well linings will ensure that to the aquifer layers do not enter this potential pathway. It is noted that other potential site based pollutants we be suitably managed via the design and additional Mitigation & management measures to ensure that suitable containment of hazardous material/liquids and fuels, with appropriate drainage of any oily storm water away from site soils and other pollution pathways to groundwater.

Abstraction Impacts to Quality

Groundwater has the potential to adversely affect the quality of the remaining groundwater. For instance, depletion of groundwater could increase the TDS, thereby affecting the quality of such water for drinking or agriculture purposes. It is noted however that there are currently no users of this groundwater layer (confirmed by well data in the hydrogeology study presented in Appendix M).

Table 7-16 Soil, Geology and Hydrogeology - Magnitude of Operation Impacts

Impact	Magnitude	Justification
Spills and Accidental Releases	**Moderate Negative**	A catastrophic release of fuel or chemicals could result in severe localised contamination within the site and immediate surroundings of the project.
TSE Irrigation	**Negligible Negative**	TSE will be used for irrigation of the landscaped areas, if adequate management and water quality monitoring is not carried out, long-term gradual deterioration of the soil quality and potentially groundwater quality could occur.
Landscaping Additives	**Negligible Negative**	Certain additives for landscaping may be added to the site to control certain pests. Persistent Organic Pesticides (POPs) as described in the Stockholm Convention will not be applied to the site. Fertilisers and soil enhancers are unlikely to be used on the landscaped areas since they will be irrigated with TSE which will contain nutrients including nitrate and phosphate.
Pollution Pathway - Boreholes	**Moderate Negative**	Potential pollution pathways from the surface and other aquifer layers
Abstraction impacts to groundwater quality	**Minor Negative**	Groundwater abstractions from the new wells will be minimised through re-use of treated wastewater on site.

Table 7-17 Soil, Geology and Hydrogeology - Significance of Operation Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Spills and accidental releases	Moderate Negative	Soil (Quality)	Medium	**Moderate**
		Upper Aquifer Groundwater (Quality)	Medium	**Minor**
TSE Irrigation	Negligible Negative	Soil (Quality)	Medium	**Negligible to Minor**
		Upper Aquifer Groundwater (Quality)	Medium	**Negligible to Minor**
Landscaping Additives	Negligible Negative	Soil (Quality)	Medium	**Negligible to Minor**
		Upper Aquifer Groundwater (Quality)	Medium	**Negligible to Minor**
Pollution Pathway - Boreholes	Moderate Negative	Upper Aquifer Groundwater (Quality)	Medium	**Minor to Moderate**
Abstraction impacts to groundwater quality	Minor Negative	Upper Aquifer Groundwater (Quality)	Medium	**Minor**

7.6 Recommended Mitigation & Management Measures

7.6.1 Construction

Table 7-18 Soil and Groundwater – Mitigation & Management Measures during Construction

Impact	Mitigation Measure
Spillage/ Leakage	All permanent or semi-permanent hazardous materials storage areas must have suitable leak tight bunding, to contain 110% of the total stored volume, in the event of a spill or leakage.
	Spill Prevention and Spill Response Plans will be established. The plans will outline methods for the prevention of incidents, response and remediation of any contamination. Where appropriate for applicable risks, this should be consistent with the sites Emergency Preparedness and Response Plan.
	The clean-up of any spillage or leakage will be made by spill absorbents, available at all fuel, hazardous material and hazardous waste storage locations on the site. Absorbents and other clean up material/provision will be contained within accessible and clearly marked spillage kits. Training on spillage response will be provided to site personnel, and will be covered in tool box talks.
	Refuelling of equipment and tanks (e.g. in laydown areas) will only be conducted in designated areas following specified procedures, and not at the working locations to minimise potential spillages.
Cross contamination of soils	Implementation of good housekeeping practices during construction activities including procedures and requirements for proper handling, storage, and transport of hazardous materials and waste.
	If contaminated soils are observed during construction activity, the identified contaminated soil should be excavated separately, and stored or disposed of in accordance with environmentally adequate measures for waste management, to avoid cross-contamination.
	Contaminated aggregate wastes or excavation material will be disposed through licensed waste contractors at licensed facilities.
	Washing of equipment, machinery and vehicles will only be permitted in designated areas, with impermeable surfaces and separate drainage systems that lead to separate treatment facilities and/or lined evaporation ponds. The use of evaporation ponds will require the removal of sludge residues as solid hazardous waste by a licensed waste contractor.
Storage and waste management	All hazardous materials or waste being temporarily used or otherwise stored outside of its designated storage areas should be kept in well-equipped, leak-tight containers with drip protection to avoid leaks to the ground.
	Wherever possible, the EPC and sub-contractors will reduce the quantity of chemicals and fuel stored on site to minimum practical level. Infrequently used chemicals should be ordered in suitable quantities only when required.
	Excavated materials will be kept in the stockpiles for as short a time as possible.
	No hazardous materials are to be stockpiled.
	The EPC contractor and sub-contractors will provide training relating to the management, transportation and handling of hazardous materials and wastes – in line with any procedures developed to guide the on-site management of such activities.

7.6.2 Operation

Table 7-19 Soil and Groundwater – Mitigation & Management Measures during Operation

Impact	Mitigation Measure
Spillage/ Leakage	The liquid fuel tanks, and all chemical/hazardous material and liquid storage tanks will be afforded impermeable bunded protection. Bunds will contain 110% of the maximum volumetric tank capacity.
	All drainage systems within bunded areas will be separated and will be directed to the oily wastewater, or chemical wastewater treatment facilities as per the contents type.
	In general, the site will be hard standing. This will reduce pollution pathways to soils and groundwater in the event of spillage.
	Leakage monitoring systems will be installed on key tanks (e.g. fuel oil and any large chemical tanks) in order to determine leaks at an early stage.
	Spill kits and clean up materials will be well located and visible in key areas of the site (e.g. chemical stores and close to any fuel storage areas). Larger provisions for spill clean-up and control should be available in the event of significant spills.
Storage and Waste Management	Effective waste management as per the waste management mitigation will be implemented through a site specific waste management plan/ The WMP will include measures to limit instances of contamination to soils and groundwater.
	Hazardous waste storage areas will be well constructed with impermeable bunded protection to soils, separate drainage system and a rain shelter to avoid any potential instance of runoff, or leakage of runoff.
Landscaping additives: TSE, Fertiliser and Pesticide Application	If used in landscaped areas, the application of fertilisers and pesticides must be limited and monitored; • Use of any toxic/non-biodegradable pesticides will be prohibited in accordance with the Stockholm Convention on banned chemicals; • Only organic, chloride free and environmentally friendly fertilizers should be applied. • DDT must not be used due to its listing as a banned chemical (re: Stockholm Convention for a full lists of POPs).
	Routine monitoring of the irrigated TSE water quality will be undertaken. The TSE water quality monitoring should be undertaken for pH, BOD, COD, oils & greases and TPH as a minimum.
Storm water Management	Oily storm water from the fuel storage areas, fuel unloading areas and other potential areas of oils open to rainfall will be directed to the on-site oil water separator for treatment, prior to entering the evaporation pond.
	Site drains for clean storm water shall include built in traps for oils and greases.
Pollution Pathway - Boreholes	In regard to the design of the new wells, it is understood that the wells will be suitably lined with impermeable materials (as per the applicable building codes) to ensure that the risks of such pathways are minimised.

7.7 Residual Impacts

7.7.1 Construction

Table 7-20 Soil, Geology and Groundwater – Residual Impacts – Construction Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact Significance
Spillage	Minor Negligible	Soil	Medium	Minor	Yes	**Negligible to Minor**
		Upper Aquifer Groundwater (Quality)	Medium	Negligible to Minor	Yes	**Negligible**
Inadequate waste management	Minor Negligible	Soil	Medium	Minor	Yes	**Negligible to Minor**
		Upper Aquifer Groundwater (Quality)	Medium	Negligible to Minor	Yes	**Negligible**
Cross contamination of soils	Minor	Soil	Medium	Minor	Yes	**Negligible to Minor**

7.7.2 Operation

Table 7-21 Soil, Geology and Groundwater – Residual Impacts – Operational Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact Significance
Spills and accidental releases	Moderate Negative	Soil (Quality)	Medium	Moderate	Yes	**Negligible**
		Upper Aquifer Groundwater (Quality)	Medium	Minor	Yes	**Negligible**
TSE Irrigation	Negligible Negative	Soil (Quality)	Medium	Negligible to Minor	Yes	**Negligible**
		Upper Aquifer Groundwater (Quality)	Medium	Negligible to Minor	Yes	**Negligible**
Landscaping Additives	Negligible Negative	Soil (Quality)	Medium	Negligible to Minor	Yes	**Negligible**
		Upper Aquifer Groundwater (Quality)	Medium	Negligible to Minor	Yes	**Negligible**
Pollution Pathway - Boreholes	Moderate Negative	Upper Aquifer Groundwater (Quality)	Medium	Minor to Moderate	Yes	**Negligible**
Abstraction impacts to groundwater quality	Minor Negative	Upper Aquifer Groundwater (Quality)	Medium	Minor	No	**Negligible to Minor**

8 WATER AND WASTEWATER MANAGEMENT

8.1 Introduction

This chapter identifies the main issues associated with water consumption and the management of the wastewater generated by the construction and operational phases of the proposed CCGT Project.

The recommendations and Mitigation & management measures outlined as a result of the impacts assessment in this chapter will be utilised in the preparation of the CESMP and OESMP, to ensure that appropriate management is achieved during construction and operation.

8.2 Methodology

The assessment has been conducted by identifying the relevant local and international standards and best practice relating to water and wastewater management during the construction and operational phases of the proposed facility. Estimates and figures relating to wastewater volumes and proposed treatment processes have been based on the data available from the project design data provided by the EPC Contractor.

This section is concerned with the project's water use, the possibilities for contamination of soil and groundwater and the risks of erosion at the boundaries of the project and the Wadi located at the northern boundary of the project site.

8.3 Applicable Legislation

8.3.1 Water Resources

Jordanian Requirements

The Environmental Protection Law No.52 of 2006 establishes requirements for the protection, improvement and prevention of the deterioration or pollution of the elements of the environment including the air, the water, the soil, natural beings and humans, and the resources thereof. The associated water resources regulations are as follows:

- Groundwater Control Regulation No. 85 for 2002 and its amendments thereof
- Jordanian Legislations Water Authority Law No. 18 for 1988 and its amendments thereof; and
- Instructions for the Protection of Water Resources Allocated for Drinking Purposes of year 2006.
- Drinking Water Standards' JS 286/2008

Additionally, Jordan's National Water Strategy 2016-2030 was recently developed by the Ministry of Water and Irrigation (December 2015). The Water Strategy outlines a strategic and integrated approach to the sustainable management of Jordan's water resources, analysing the current status and future challenges of water demand and supply for domestic use, irrigation and energy generation as well as for the industrial and tourism sectors. The Water Strategy also gives consideration to the generation of wastewater and sanitation services.

European (EBRD) Requirements

The EBRD PR3 on Resource Efficiency and Pollution Prevention and Control establishes general requirements for minimising water consumption and improving efficiency in its use as follows:

- The Project must seek to minimise water use and utilise water for technical purposes that is not fit for human consumption, where feasible;
- The Project must identify technically and financially feasible techniques for water minimisation, reuse and recycling in accordance with GIP, which should be implemented as part of the project design;
- The Project must consider the potential cumulative impacts of water abstraction upon third party users and local ecosystems;
- For projects with a high water demand (greater than 5,000 m^3/day), a detailed water balance must be developed, maintained and reported annually to the EBRD. This should include an assessment of the specific water use (measured by volume of water used per unit production) must be assessed

International (IFC) Requirements

IFC/World Bank General EHS Guidelines (2007) establish requirements for water conservation: '*Water conservation programs should be implemented commensurate with the magnitude and cost of water use. These programs should promote the continuous reduction in water consumption and achieve savings in the water pumping, treatment and disposal costs. Water conservation measures may include water monitoring/management techniques; process water recycling and reuse; and sanitary water conservation techniques*'.

8.3.2 Wastewater

Jordanian

As the proposed project will re-use or recycle all process wastewater streams, the only applicable standards in regard to wastewater relate to those for the re-use of treated effluent. Treated effluents will either be re-used as make up water, for irrigation or will be evaporated.

Jordanian Standard JS 202-2007 Water: Industrial Reclaimed Wastewater details the general requirements and standards for 'Industrial Wastewater Reuse Criteria'. The maximum allowable concentration limits are set out in the Table below. In addition, the re-use for irrigation standards are also referenced from JS 893-2006 Water: Reclaimed Domestic Wastewater.

The Jordanian standards relevant to discharges to rivers, wadis and catchment areas have been included in the event that storm water run off is diverted off the site to the external drainage/wadi channel.

Table 8-1 Industrial Wastewater Reuse Criteria

Parameter	The maximum allowable concentration limit (mg/l)	
	Reuse for Irrigation	Discharge to Rivers, Wadis and Catchment areas
BOD_5	-	50
COD	-	150
DO	1	1
TDS	2000	3000
TSS	100	50
pH	6.5-8.4	6.5-9
Colour	-	15
Temperature	-	-
Oil & Grease	5	-
Phenol	0.002	0.002
Industrial Detergents	-	25
$NO_3 - N$	30	12
$NH_4 - N$	5	5
Total N	50	-
$PO_4 - P$	-	15
Cl	350	500
SO_4	400	500
F	-	1.5
HCO_3	500	-
Na	-	-
SAR	9	-
Al	5	5
As	0.1	0.05
B	1	1
Total Cr	0.1	0.1
Cu	0.2	2
Fe	5	1
Mn	0.2	0.2
Ni	0.2	0.2
Pb	1	0.1
Se	0.02	0.02
Cd	0.01	0.01
Zn	2	15
CN	0.1	0.1
Hg	0.001	0.001
TCC (MPN/100 ml)	-	-
TFCC (MPN/100 ml)	1000	1000
Nematodes (Eggs/L)	<1	<1

European (EBRD) Requirements

The EBRD PR3 on Resource Efficiency and Pollution Prevention and Control establishes general requirements for wastewater management as follows:

- The Project must seek to minimise water usage in order to minimise wastewater generation; and
- The Project must identify technically and financially feasible techniques for reusing and recycling effluents in accordance with GIP, which should be implemented as part of the project design.

The European Commission highlights the importance of water re-use as a method of reducing the abstraction of water. The European Commission states the following in regard to water re-use:

'The potential role of treated wastewater reuse as an alternative source of water supply is now well acknowledged and embedded within European and national strategies. Water reuse is a top priority area in the Strategic Implementation Plan of the European Innovation Partnership on Water, and maximisation of water reuse is a specific objective in the Communication "Blueprint to safeguard Europe's water resources".

Reuse of treated wastewater can provide significant environmental, social and economic benefits. According to the Blueprint, water reuse can improve the status of the environment both quantitatively, alleviating pressure by substituting abstraction, and qualitatively, relieving pressure of discharge from UWWTP to sensitive areas. Moreover, when compared to alternative sources of water supply such as desalination or water transfer, water reuse often turns out to require lower investment costs and energy, also contributing to reduce greenhouse gas emissions

International (IFC) Requirements

IFC/World Bank General EHS Guidelines (2007) establish general requirements for direct or indirect discharge of process wastewater, wastewater from utility operations or storm water to the environment.

'Projects with the potential to generate process wastewater, sanitary (domestic) sewage, or storm water should incorporate the necessary precautions to avoid, minimize, and control adverse impacts to human health, safety, or the environment'.

However, wastewater effluent pollutant limits are only established for sanitary wastewater for discharge to the sanitary sewer systems. The following table provides the indicative values for treated sanitary wastewater effluent limits as established by the World Bank General EHS Guidelines (2007). Water effluent limits in industrial wastewater for discharge to surface waters are established only for the power sector in World Bank EHS Guidelines for Thermal Power Plants (2008).

8.4 Baseline

8.4.1 Water Resources

Natural freshwater and potable sources of water in Jordan are scarce and being rapidly depleted by irrigation, commercial and domestic use. There are few surface water sources, and as such the majority of water is abstracted from groundwater. There is limited connectivity to the Red Sea in and around the Aqaba area, which provides limited desalination capacity from seawater resources.

Note: An overview of groundwater quality is provided in the baseline section of the "Soil, Geology and Groundwater" chapter.

Groundwater Resource Availability

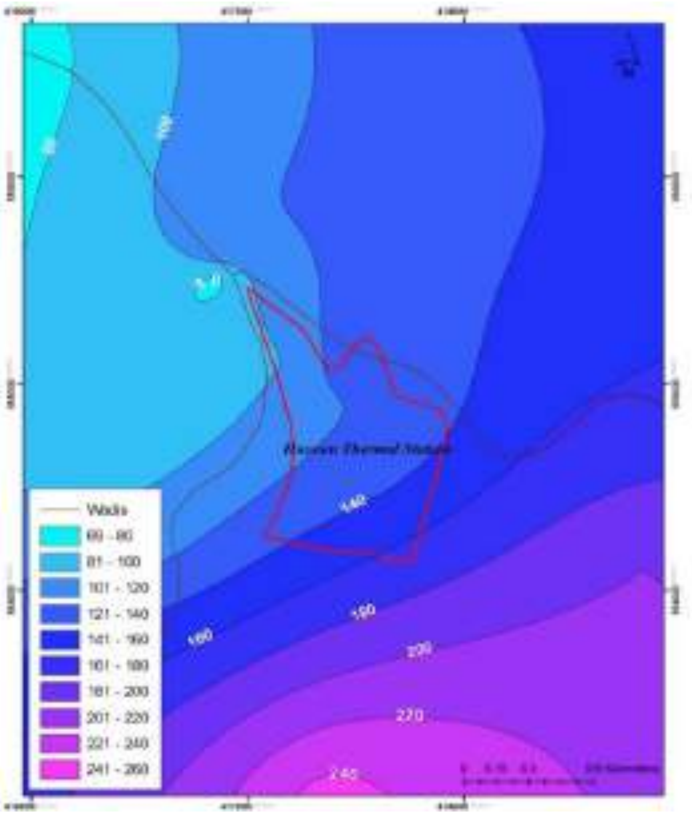
A hydrogeology study was prepared in 2012 for the local area was during the feasibility stage, to investigate the potential sources of water for a new project. The hydrogeology study is presented in Appendix M and outlines the underlying aquifers, the flow and recharge rates that the aquifers experiences, as well as several other factors. A summary of the hydrogeological study is provided below.

The main hydrogeological units are:

1. The composite aquifer of the Wadi Sir Lime stone A7 and Amman Silicified Limestone B2 units, which are high productive units. The average thickness is 130m within the thermal station.
2. Um Ghudran chalky Limestone unit (B1) positioned between the B2 and A7 aquifers is a semi aquifer, but it hydraulically connects the overlying B2 with the underlying A7 aquifers, building the B2/A7 composite aquifer system.

The base of this productive composite aquifer system is located at a depth of 80 m in the north-western section of the area, and increases gradually to a maximum of 240m in the southern part of the area.

Figure 8-1 Depth to the base of B2A7 aquifer unit



Note: Figure References Hussein Thermal Station. The ACWA Power Zarqa CCGT project is located along the northern most section of this red outline.

Within the landholding of the project footprint, the base level of this unit is restricted between depths of 100m to 160m giving a maximum well depth of 160m in the southern portion of the plant, on the areas of land for the proposed power generation Project.

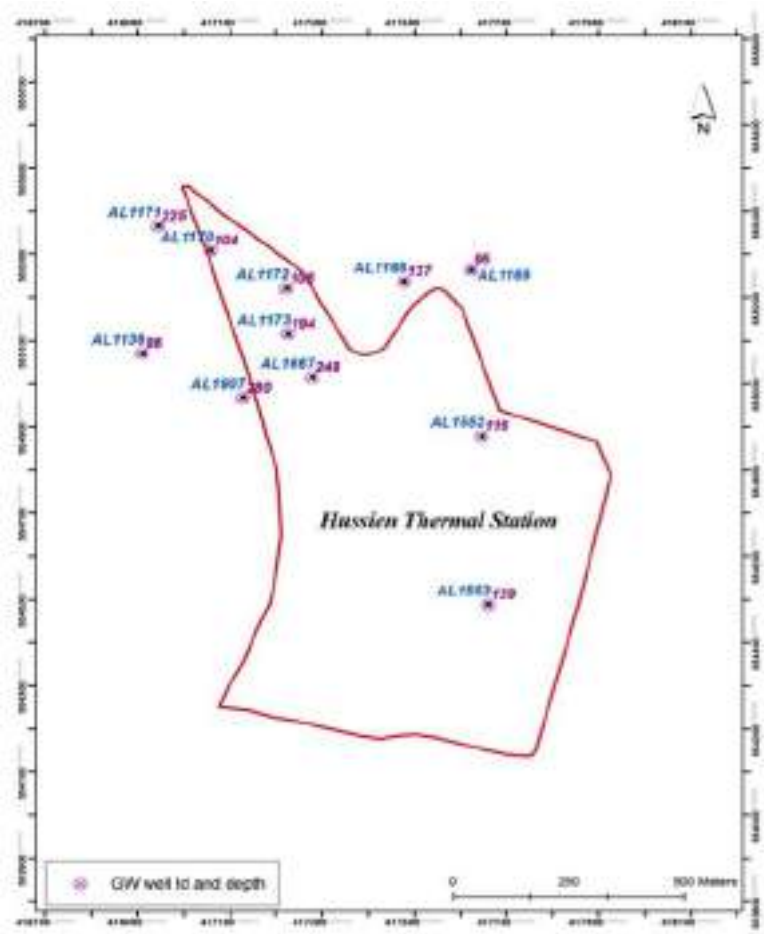
In the project footprint few wells have been drilled to a depth exceeding 200 m to tap a second productive groundwater aquifer, known as Hummar Formation (A4) in the middle Ajlun group.

The B2 A7 aquifer and the A4 systems are separated by the A5 A6 Aquitard unit.

The thickness of the A5 A6 Aquitard unit is calculated to be in a range of 100m to 108m, and due to its low permeability it prevents any hydraulic connection between the two B2A7/A4 aquifer systems.

Previously, the existing HTPS extracted water from several groundwater (GW) on-site. These wells penetrate mainly in the upper B2A7 limestone aquifer, with partial penetration into the A4 aquifer for some of the wells, as shown in the below figure. Since the closure of the existing HTPS, wells on site, have now been capped. For wells that were subject to oily contamination, this followed a period of remediation and monitoring as detailed in the Groundwater Quality section of the previous chapter.

Figure 8-2 Groundwater wells location and depth



Note: Figure References Hussein Thermal Station. The ACWA Power Zarqa CCGT project is located along the northern most section of this red outline.

The HTPS included 11 wells, which have been conformed during site visits. It is noted that these 11 wells do not appear to match those shown in Figure 8-2 (as some of these are shown to be outside of the landholding), however Figure 8-2 does locate 11 separate wells. It is therefore expected there are no additional 3rd party wells in the immediate vicinity of the project site, and the wells shown on the above figure are all within the previous HTPS boundary. Based on discussions with CEGCO, these wells have since been capped, or are in the process of being capped.

According to the records of the Ministry of Water and Irrigation the average depth of groundwater wells ranges from 86m to 280m with a static water level between 480m and 490m ASL (Above sea level).

Groundwater Quantity

Based on records from the Ministry of Water and Irrigation (MWI), groundwater flow maps were generated which show that the aquifers in the Hashmiyeh area are being extracted at a higher rate than the recharge (expected to be from previous abstractions at the HTPS). This resulted in a sink drawing groundwater from neighbouring areas to enable recharge.

Equally, the discharge from the Samra wastewater treatment plant has created a recharge mound and is infiltrating the upper aquifer system. This has resulted with a water table level as high as 550m ASL.

The surrounding water levels in the southern parts of the area are also relatively high with a water table of 510m ASL generating a groundwater flow towards the power station.

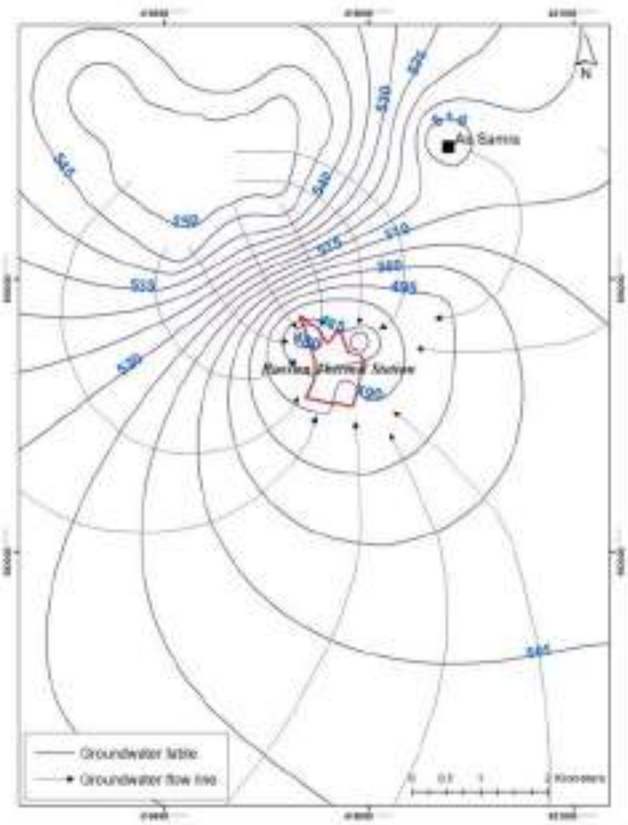
Based on a cross section of the Samra recharge mound, it was shown that the hydraulic gradient is very high, in the range of 3%, whilst the recharge gradient from the southeast is lower at around 0.4%. Finally, the hydraulic gradient from for the groundwater flowing from the oil refinery to the thermal station is around 1.2%.

This high hydraulic gradient has formed due to two factors:

- The groundwater abstraction in the vicinity of the HTPS (prior to HTPS closure); and
- The discharge from Samra wastewater treatment plant effluent creating a recharge mound raising the water table approximately 50 meter above the average groundwater table in the area.

Consequently, the water table within the power station ranges from 480m ASL to 550m ASL.

Figure 8-3 Groundwater flow pattern of the B2A7 aquifer



Note: Figure References Hussein Thermal Station. The ACWA Power Zarqa CCGT project is located along the northern most section of this red outline.

8.4.2 Wastewater Resources

The proposed project will also include new dedicated treatment systems for wastewater streams including oily, chemical and industrial.

Previous boreholes which existed in the ACWA Power Zarqa CCGT project footprint (for HTPS abstraction) have now been capped and are out of service.

The As-Samra wastewater treatment facility, the largest wastewater treatment facility in Jordan is located approximately 5km north east of the proposed site, which serves a population of approximately 2.2 million people living in the Greater Amman and Zarqa areas. With a peak flow of 840,000m^3 each day, the facility treats an average flow of 267,000m^3 of wastewater on a daily basis. An expansion project expected to be opened in 2016 will increase the average daily treatment capacity to 365,000m^3 per day. The construction of As-Samra WWTP relieved most parts of Jordan by providing safe reuse of water for irrigation. It also eliminated the odours that were being released from the former Wastewater Stabilisation Ponds (Source: As-Samra Wastewater Treatment Plant (WWTP), Jordan, http://www.water-technology.net/projects/as-samra-wastewater-treatment-plant-jordan/, accessed on 11th March 2016).

Storm water runoff from within the local catchment is directly by overland flow to a drainage channel (also known as a wadi) that is located immediately to the north of the proposed project boundary. The wadi is characteristically dry, however is subject to visible water flows during heavy rainfall.

It is recognised that this wadi has been managed for the installation of an external sewerage line (within the base of channel). The channel appears to have also been managed for its size, to ensure that it has suitable flow capacity. The wadi is dry for the majority of the year, but under rainfall, flow is ultimately conveyed to the Zarqa river.

8.5 Sensitive Receptors

The table below outlines the identified receptors in relation to wastewater as well as the determined sensitivity of those receptors.

Table 8-2 Sensitive Receptors

Receptor	Sensitivity	Justification
Soil and Groundwater	Medium	In the event of any spills or leaks of non treated wastewater, contamination to both soil and groundwater may occur.
Wadi	Medium	The adjacent Wadi is the channel for the local catchment from the existing HTPS plant and Hashmiyeh area to the north of the project. It is recognised that this channel has been managed for volume and the installation of an external sewerage line (within the wadi).
Groundwater (Resources)	Medium	Although not documented, some neighbouring residential areas and local agricultural uses may rely on groundwater for potable water and irrigation. Such water is taken from the top aquifer layer (up to 200m depth).
Local Water Resources	Medium	Water is a valued commodity in Jordan and there is growing demand for such resources.
Al Samra Wastewater Treatment Plant	Low	The Al Samra wastewater treatment plant is in close proximity to the project site and is undergoing an expansion to increase treatment capacity.

8.6 Significance of Impacts

8.6.1 Construction

Water Use

The key uses of water during the construction and commissioning phases are expected to be for personal consumption, domestic use, dust control, civil works (e.g. lubrication) and commissioning for hydro testing and steam cleaning.

The expected water use quantities are likely to vary during the course of construction and the types of works being undertaken, which will largely depend on the number of workers on site, as well as the works being undertaken. During commissioning, the hydro testing and steam cleaning will require large volumes of water, which may not be available for re-use.

During construction water will primarily be delivered to the site (construction site and accommodation area) by tanker. Where the water connection via the pipeline from WAJ becomes available during construction, this is likely to provide a water source.

In general, few processes will require significant volumes of water during construction and commissioning. Where certain works do require large volumes of water, there will be a need to ensure that suitable local supplies are available.

Wastewater

Wastewater generation during the construction and commissioning phases will include the following key streams:

- Sanitary and Domestic Wastewater;
- Commissioning Wastewater (hydro testing & Steam Cleaning);
- Storm water;

For sanitary and domestic wastewater, it is anticipated that there will be a significant number of workers at the peak period of the construction (estimated up to 1,500 personnel). The quantities of sanitary & domestic wastewater can be estimated as an average of 100 litres/person/day. It´s estimated that 12.5% of the human consumption is evaporated or absorbed by the body, so it does not end up in the sanitation facilities. Therefore, sanitary wastewater is estimated to total 150 m^3 up to at peak periods of construction. The actual amount of wastewater generation is likely to be less than this, as the wastewater will not all be generated on-site or at the accommodation area. Wastewater generated on-site or at the accommodation area will be stored within septic tanks for removal by a licensed wastewater contractor to the Al Samra wastewater treatment facility in Zarqa.

A large portion of the water used during commissioning will be for the testing of the pipes and tanks (hydro testing) and for the cleaning of the equipment (steam cleaning). Such wastewater is expected to contain oily/grease residues and perhaps concentrations of heavy metals. This wastewater will be directed to the on-site evaporation pond.

Storm water has the potential to run off into areas containing hazardous materials and either leach these into the soil or carry these off the site, potentially contaminating other areas and groundwater. However, heavy rainfall is not frequent and only a low number of rainy days per year occur in this region. Storm water during construction is expected to runoff into site soils for infiltration. It is likely that storm water will naturally reach the drainage channel/wadi for the local area immediately north of the site boundary. During construction storm water may increase the total of suspended solids being discharged to the local drainage system, due to open soils and earthworks.

Flooding at the site is not an issue, and is unlikely to change as a result of construction activities. Mainly due to the existing runoff of storm water to the local drainage channel/wadi. During construction the majority of the site will remain with open soils prior to the implementation of the roads and storm water systems (latter in construction). Until this point in time, there will be few changes to runoff flows and rates. Upon full construction of the on-site storm water system (directed to the adjacent drainage channel/wadi), runoff rates will be faster, from the site, however there will be little change to the total volume of runoff entering the channel, as this is the existing drainage channel for the catchment.

Other water uses like watering temporary roads for dust prevention or earthworks will not generate wastewater, as it will be used to wet the soil and will evaporate.

Table 8-3 Water and Wastewater – Magnitude of Construction Impacts

Impact	Magnitude	Justification
Construction water	Minor	The relative quantity of water needed during construction is low, but will increase during commissioning.
Sanitary & Domestic Wastewater	Moderate	Such impacts may result in a moderate but temporary impact to soil and groundwater due to potentially high levels of nutrients and pathogens.
Flooding	Negligible	The site is already graded and a storm water system is in place. Also rain events are infrequent and of short duration.
Siltation	Minor	Construction will temporarily disturb soils, and during a storm event these will be more likely to become suspended.

Table 8-4 Water and Wastewater – Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Sanitary Wastewater	Moderate	Soil and Groundwater	Medium	Moderate
		Al Samra WWTP	Low	Minor
Construction water	Minor	Local Water Resources	Medium	Minor
Flooding	Negligible	Wadi	Medium	Negligible or Minor
Siltation	Minor	Wadi	Medium	Minor

8.6.2 Operation

Water Consumption

Due to the limited water resources locally and in the region, the project design has sought to limit the need for water. This has included specific water efficient features, such as the use of Air Cooled Condensers (ACC) for the cooling of the HRSG/Steam Turbine water/steam cycle.

In addition, the re-use of water where possible has also been considered, to avoid the consumption of additional resources.

Despite this, water is a key resource required for the operation of the Power Plant. It will be used in several processes and will be sourced primarily from the new boreholes located on-site. Potable water will be supplied by the incoming water pipeline provided as an associated facility by the WAJ, under a water supply agreement.

The new boreholes will be drilled adjacent to previous wells used at the HTPS and to the same depth as these previous wells (i.e. 95m, 110m and 220m), to access the same aquifer layer. Data on local wells from the Ministry of Water indicates that the only local wells in the immediate project vicinity were the ones previously used for HTPS abstractions, and have since been capped. The project will include water storage tanks, primed for supply to the process water uses, with ability to store 7 days of project water requirements.

If required, there will be an amount of flexibility in the process water supply, which could use a portion of the potable water supply form the WAJ. The WAJ potable water supply is up to 2,450m3 per week and could help supplement well provision, or stored water, if required. Such a situation would only occur in emergencies, and is highly unlikely (e.g. failure of all 3 borehole pumps).

Baseline studies have indicated that during the HTPS operation, there was a reduction in the availability of groundwater and a lowering in the depth of the water table in the project area. These previous wells are now no longer in operation and have all been capped (or are in the process of being capped).

Expected water consumption of the proposed CCGT project will be 160,000m^3 per annum. This expected value is based on seasonal fluctuations of water consumption, as well as use of LDO fuel for a maximum of 40 days per year.

The project is therefore expected to significantly reduce water consumption from that of the HTPS, which had operated from the same aquifer with a water consumption of approximately 430,600m^3 per annum.

Water abstraction will therefore be reduced from previous rates, and is not expected to pose a concern for the projects on-going operation, availability of supply, or restriction of use in regard to any other 3rd party uses.

Water Balance

A water balance document for the plant operation is presented in Appendix C. This document details specific water balance flows under 5 operational conditions.

The maximum hourly consumption rates of water as make up water for the plant are as follows:

- Natural Gas Summer (Evap Cooler ON): 25.3 m^3/hr
- Natural Gas Summer (Evap Cooler OFF): 8.07 m^3/hr
- LDO Summer (Evap Cooler ON): 67.63 m^3/hr
- LDO Summer (Evap Cooler OFF): 50.40 m^3/hr
- LDO Winter (Evap Cooler OFF): 69.74 m^3/hr

The following units constitute the water treatment plant that will be used onsite to meet the project's water needs:

Activated Carbon Filter and RO system

The treatment process will comprise of a carbon conditioning system, microfiltration, and reverse osmosis. The concentrated liquid resulting from this first step of osmosis will be treated again to minimize the final water flow to be poured in the evaporation ponds. The first step of reverse osmosis will also treat the water that will be further processed to obtain demineralized water.

Demineralized water unit

The water treated in the previous osmosis process will subject to chemical conditioning system, microfiltration, a second step of the reverse osmosis and an electro deionization stage.

Wastewater

A key characteristic of note, is that the plant will not discharge process wastewater streams. In this instance, no process wastewater will be discharged outside of the plants boundaries, due to either re-use, evaporation, or irrigation; all occurring on-site. The exception to the zero liquid discharge is sanitary and domestic wastewaters, which will be treated by the municipality treatment plant, via pipeline connection. Storm water will be discharged to the adjacent wadi following treatment via a sediment and grease trap.

Wastewater Generation and Treatment

All liquid effluents produced in the HTPS are collected in a separate network for either re-use or neutralisation before being sent to the evaporation ponds. The design and operation of the plant has ensured that re-use of water is optimised so that the number and size of evaporation ponds can be minimised. The following wastewaters will be generated in the plant.

Table 8-5 Estimate Peak Wastewater Production (m^3/hr)

Wastewater Stream	Estimated Peak Production
From Pre-treatment, RO and Demineralisation	25
From boiler make up water	12.5
DM water for HVAC	1.2
GT Evaporative cooler	13
Domestic Wastewater (to be sent off-site)	1

The BOP drainage system will collect the different wastewater streams produced during the plants operation and send them to specific treatment processes depending on the effluent's nature followed by final discharge to the evaporation ponds.

The drainage network will be designed to allow the separation of the effluents with the aim of applying the most appropriate treatment to each one, it will therefore comprise of the following:

- Collection systems
- Retaining bunds at sump outlet
- Light Hydrocarbons Separator from the Power Island
- Neutralization and Homogenization basin
- Discharge network to the evaporation pond

The way in which each of the above wastewater streams will be treated is discussed below:

Sludge treatment

The sludge generated in the floatation equipment by dissolved air will be piped to a static thickener. The clarified of the thickener will be returned for physical-chemical pre-treatment, while the thickened sludge will be directed to a centrifugal decanter. The clarified of the centrifuge will be pumped to the floatation chamber of the pre-treatment.

Treatment of oily water

The water from the oily water storm tank will be channelled to an oily water treatment system.

In the separator the effluent enters into a first feeding chamber, where the separation of the large solids drops starts, and passes to a second chamber through a coalescent plate's package where the smaller solids are separated.

Treated water will be sent to the effluent treatment plant, where it will join with the rest of the effluents and channelled to the evaporation pond.

Sanitary and Domestic Wastewater

In order to estimate the sanitary water total flow to be treated, the following data have been considered as design basis:

- Estimated number of workers: 50 people
- Generation rate: 100 l/(person/day)

An average of 5 m^3/d of sanitary water is expected.

The sanitary wastewater will be directed off-site and will connect with the main sewerage line to be forwarded to the Municipality operated Al Samra Wastewater Treatment Plant.

Boiler blow down

The flow from the steam boiler blow down will be channelled, together with the treated oily waters towards the homogenization / neutralization pit of the Effluents Plant, where these discharges will be neutralized before being driven jointly to the evaporation ponds.

Concentrates of reverse osmosis

The concentrate of the reverse osmosis, together with the rejection generated in the purge treatment, will be channelled to the evaporation pond.

Evaporation pond

The evaporation pond has been designed to collect the effluent from the plant, it will be located in the north section of the site. The evaporation area of the pond is 44,000m^2. The ponds will have a depth of 1.86m. The ponds will be allowed to fill to a depth of 1.5m, with a reserve of 0.36m to the crown on the least favourable side.

The following parameters are expected in the effluent:

- pH: 7,6
- Conductivity: 5,200 µS/cm
- TDS: 3,500 ppm
- SS: 25 ppm

The pond will not be filled from any other sources than those generated in the plant and outlined above and from any direct rainfall over their surface area.

The impermeability of the pond is assured by a 1.5 mm thick high-density polyethylene (HDPE) geo-membrane sheet. This sheet will be laid over a geo-drain made from a 250 g/m^2 non-woven geo-textile sheet. Deep drainage will be located under the ponds connected with a perforated pipe, so that any leaks could be promptly detected.

Storm water Management

Storm water from roads and roofs (i.e. storm water from areas not subject to oily residues) will collect in storm water drains on-site and be directed off-site to the adjacent drainage channel/wadi, immediately to the north of the plant boundary. Prior to discharge the storm water will be treated in oil/grease and sediment traps.

The routing of storm water to the drainage channel/wadi is not expected to result in additional flows, as current storm water already drains to this channel. Storm water may be diverted at a faster rate due to lack of retention in soils and the vegetation, however, an amount of storm water will also be collected and managed via the oily wastewater system (from potentially 'oily' areas), thereby slightly reducing the flow of storm water to the drainage channel/wadi.

The impact upon the drainage channel/wadi is considered to be neutral.

Wastewater streams Monitoring

Continuous monitoring equipment will be installed at the discharge point to the Neutralization and Homogenisation basin, for analysis in accordance with the National discharge requirements.

- Continuous: pH, Temperature, conductivity, and flow rate.
- Bi-weekly basis: COD, Oils, TSS, Nitrogen, Phosphorous.
- Every three months; heavy metals.

Table 8-6 Water and Wastewater - Magnitude of Operational Impacts

Impact	Magnitude	Justification
Raw Water Consumption	Minor	The project will use dry cooling technology, which greatly reduces the need for water in the plant process
Plant Wastewater	Negligible	The plant will not discharge process wastewater streams. All plant process wastewater will be treated, re-used or evaporated. Minor volumes of sanitary and domestic wastewater will be generated and will be directed off-site for treatment at the local Al Samra WWTP.
Sanitary & Domestic Wastewater		
Flooding	Neutral	The project will not change catchment characteristics. Hard standing surfaces may reduce lag time of runoff entering the natural drainage channels, but an amount of oily storm water being managed on-site, will also reduce total flows to the drainage channel/wadi.
Storm water Contamination	Minor	Any storm water that comes into contact with contaminated soils, or flows into equipment rooms or overflow of the oil water separator may result with contamination of the storm water.

Table 8-7 Water and Wastewater - Significance of Operational Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Raw Water Consumption	Minor	Groundwater Resources	Medium	Minor
Plant Wastewater	Negligible	Al Samra Wastewater Treatment Plant	Low	Negligible
Domestic Wastewater				
Flooding	Neutral	Wadi	Medium	Neutral
Storm water Contamination	Minor	Wadi	Medium	Minor
		Soil and Groundwater	Medium	Minor

8.7 Mitigation

8.7.1 Construction Waste & Wastewater Mitigation

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Water resources	The most suitable source of water will be identified for each required water stream (e.g. drinking water, water for construction, water for road wetting). Where appropriate available local water resources will be identified, to reduce the additional transportation requirements of water from greater distances. However, it is of primary importance that the supply of water is from a source, which will not deprive any population/habitat its necessary water requirements, or will lead to depletion in such water resources.	EPC Contractor	CEMP – Planning & Management
Sanitary wastewater	Toilet blocks with in-built septic tanks will be installed on site and at the labour accommodation and administration buildings. The septic tanks will be above ground where possible, though if buried will be placed in secure areas, away from general vehicle traffic, in order to prevent any damage to the tanks.	EPC Contractor	CEMP – Planning
	The number of toilet blocks and septic tanks will be increased in proportion to the increased number of workers on site.	EPC Contractor	CEMP – Planning and monitoring
	No treated or untreated sanitary wastewater shall be discharged on site or directly to areas off site, e.g. the adjacent wadi.	EPC Contractor	CEMP – Monitoring
	Site inspections will be carried out regularly by the EPC contractor to ensure that all wastewater generated is properly managed, and no leakages or spill over occur. In the event of a spill or overflow, immediate action will be taken in accordance with spill containment procedures and clean up procedures (to be developed in line with the CESMP).	EPC Contractor	CEMP – Monitoring
	In common with the IFC EHS Guidelines, effort will be made in training construction personnel to minimise water consumption for ablutions and to ensure an understanding of water resource and wastewater issues.	EPC Contractor	CEMP – Training
	Prior to demobilisation from the construction site, the EPC contractor will develop procedures for the removal of septic tanks to ensure that contamination to the site or accommodation area does occur during the demobilisation period.	EPC Contractor	CEMP – Management and planning
Construction Wastewater	Oily wastewater (e.g. from hydro testing and steam cleaning) will be treated via interceptors, or the on-site oil/water separator (if functioning at this time). A specialist contractor will remove the recovered oil for recycling. Any residual sludge will be taken to a local Municipality hazardous waste landfill.	EPC Contractor	CEMP – Management and planning
	A dedicated area for vehicle and machinery maintenance (lubrication, oil and filter changes,	EPC Contractor	CEMP – Planning

	repair work, etc.) will be provided on site. This is to include an impermeable surface and side bund/gutter collection.		
	Storage of wastewater in areas adjacent to the Wadi shall be avoided. Any such storage under specific circumstance permitted by the Environmental manager will be only temporary measures.	EPC Contractor	CEMP – Monitoring
	Considered should be given to the construction of a settlement basin to retain water until it particles have settled. Wastewater from the cleaning of concrete trucks that could include cement and concrete waste should be directed to this basin. The water part can be used for wetting down of unpaved roads, stockpiles and excavations. regular removal of sludge. Treated effluents that cannot be re-sued on site, must be taken to the authorised disposal point without the entrainment of soil, material or any other substance that could contaminate them.	EPC Contractor	CEMP – Management and planning
	Following the completion of construction, all wastewater storage provisions and containment systems must be duly dismantled. The dismantling shall include the final drainage of any existing water and sludge, removal of impermeable linings, filling of any excavated pits and assurance that the land is re-instated to its initial state. All excess products must be taken to an appropriate waste management facility for treatment/disposal.	EPC Contractor	CEMP – Management and planning
	Measures to minimise water use during commissioning, such as recycling shall be implemented by the contractor. These include re-use of the hydro-testing water, until this phase of testing is completed and the water is no longer serviceable. Subsequently, the wastewater will be sent to the evaporation pond.	EPC Contractor	CEMP – Management and planning
Flooding, Erosion, Siltation	Water flow will be channelled to limit run-off The site will be fenced to ensure that no soil disturbance occurs outside of the site area. Reduce height of embankments and slopes Recover vegetation on slopes and embankments From the outset of work, plan, select and define areas for clearing, stripping and access routes in order to minimise unnecessary stripping of vegetation. Reduce cut-offs and embankments.	EPC Contractor	CEMP – Management and planning

8.7.2 Operation

Several mitigation measures have been included in the design of the project to reduce water usage. As a result of this design, several loops have been designed in the plant water cycle to reuse water for plant processes and irrigation. It is also noted that the plants design allows for the wastewater streams to be appropriately treated before they are discharged into the evaporation pond.

The following measure will be implemented in the design and operation of the project:

Table 8-8 Operational Waste & Wastewater Mitigation

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Plant Wastewater Management	Oily wastewater will be treated via an oil/water separator. A specialist contractor will remove the recovered oil part for recycling. Any residual sludge will be taken to a Municipality hazardous waste landfill.[1]	O&M	OEMP – Design and management
	Any above ground tanks and basins will have overflow pipes to an impermeable effluent collection point (i.e. evaporation pond).	O&M	OEMP – Design
	Wastewater collection systems and oil water separators shall be inspected frequently, to ensure that no blockages could result in overflowing.	O&M	OEMP – Monitoring
	Sludge from all treatment systems will be disposed in accordance with Jordanian, EBRD and IFC regulations for the hazardous wastes.	O&M	OEMP – Design and management
Storm water Management	Waste management areas shall be designed in such a way that any runoff does not have a pathway to the soils, groundwater or external wadi.	O&M	OEMP – Design
	Prior to discharge to the adjacent wadi the storm water will be treated in oil/grease and sediment traps.	O&M	OEMP – Design and management
Raw Water Consumption	In common with the best practices, effort will be made in training employees including all sub-contractors at the site to minimise water consumption and ensure an understanding of wastewater issues.	O&M	OEMP – Management
	Mechanisms and management practices to further reduce the volume of water required in the plant (e.g. increased reuse rates of treated effluent) will be considered, as this would help decrease freshwater consumptions.	O&M	OEMP – Management and Monitoring

[1] According to SweepNet Country Report on the Management of Solid Waste Management in Jordan 2010, 'At Swaqa hazardous waste facility, the stabilized and inert solid waste is landfilled in specially lined cells'.

8.8 Residual Impacts

8.8.1 Construction

Table 8-9 Wastewater – Residual Impacts – Construction Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact
Sanitary Wastewater	Moderate	Soil and Groundwater	Medium	Moderate	Yes	Minor
		Al Samra WWTP	Low	Minor	Yes	Negligible to Minor
Construction water	Negligible	Local Water Resources	Medium	Minor	Yes	Negligible to Minor
Flooding	Negligible	Wadi	Medium	Negligible to Minor	Yes	Negligible
Siltation	Minor	Wadi	Medium	Minor	Yes	Negligible

8.8.2 Operation

Prior to mitigation, there are a number of design measures being implemented to reduce water resource use and to ensure appropriate treatment and management of wastewater. Following the implementation of the additional Mitigation & management measures (as above), the majority of the impacts will be further reduced.

Table 8-10 Water and Wastewater– Residual Impacts – Occupation Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact
Raw Water Consumption	Minor	Local Water Resources	Medium	Minor	Yes	Negligible
		Groundwater Resources	Medium	Minor	Yes	Minor
Plant Wastewater	Negligible	Al Samra Wastewater Treatment Plant	Low	Negligible	Yes	Negligible
Flooding	Neutral	Wadi	Medium	Neutral	Yes	Neutral
Storm water Contamination	Minor	Wadi	Medium	Minor	Yes	Negligible
		Soil & Groundwater	Medium	Minor	Yes	Negligible

9 SOLID AND HAZARDOUS WASTES

9.1 Introduction

This chapter provides an assessment of the environmental impacts that may occur as a result of waste generation during both the construction and operational phases of the PROJECT. Additionally, activity specific Mitigation & management measures are recommended to address the identified potential impacts.

Waste is an undesired by-product of every industrial development, contributing to a number of environmental problems, such as soil contamination from hydrocarbon leaks and heavy metals. If not properly disposed and/or contained, direct contamination to the soil and groundwater is possible and indirect contamination to sensitive receptors. With proper management, a large amount of discarded non-hazardous materials can be recovered and either reused directly or disassembled and their components reutilised. With regard to the hazardous material, these would be appropriately treated and disposed in order to prevent direct and indirect contamination events.

The construction and operational phases of the proposed Project will necessitate the proper management of solid and hazardous materials used or created on site. This also includes the generation of domestic waste and storage of hazardous and non-hazardous materials or wastes and the proper management of excavated material.

9.2 Methodology

The main objective of this chapter is to assess the impacts associated with the generation, handling, storage and transportation of waste material during both construction and operational phases of the Project. This assessment has been informed through a desktop study, site visit, and an overall understanding of waste management issues gained from assessing the environmental impacts of similar facilities. The following specific information has been reviewed as part of the desk study:

- Overview of waste management in Jordan and that of the local area;
- Assessment of applicable national standards and lender guidelines;
- Assessment of the proposed design, construction procedures and project features that may impact on both the society and environment in terms of waste generation; and

Based on the findings of the assessment, measures have been identified in order to mitigate any negative effects and promote positive effects associated with both the construction and operational phases. General waste management practices are evaluated with respect to legal requirements and where applicable, Mitigation & management measures resulting in the improvement of waste management and waste minimisation are recommended.

The main aims of the chapter are to identify the following:

- Options for the reduction, re-use, recycling and recovery of all waste streams;
- Opportunities to minimise waste streams from Project inception, thereby minimising the amount of waste sent to landfill;
- Specify methods for the segregation of waste streams within the facility; and

- Specify the requirement for a clear, comprehensive Waste Management Plan to be integrated into the CESMP and OESMP to manage the construction and operational phases respectively. Inclusion of detailed methods for appropriate storage, transfer and disposal of both hazardous and non-hazardous waste streams.

The assessment also includes a qualitative cumulative assessment regarding impact of waste generation where the decommissioning works at the existing HTPS HFO plant are undertaken in parallel with construction and operation of the proposed project.

9.3 Applicable Environmental Legislation

<u>Jordanian Requirements</u>

Jordanian Regulation No.27 of 2005 concerns the Management of Solid Waste Regulations. The regulations set out provisions which govern the management of solid waste in such a manner to protect the environment and public health. The Regulations specifically state that:

'Every party that conducts Solid Waste Management activities or from whose activities Solid Waste results shall be obligated to:

A. *Provide the qualified manpower resources for Solid Waste Management and public safety measures for its workers.*

B. *Provide the vehicles, containers and equipment needed for Solid Waste Management.*

C. *Monitor the collection of Solid Waste and setting the route thereof, and transportation thereof to locations designated for disposal thereof.*

D. *Place containers in the appropriate locations and maintain them, and replace them when destroyed.*

E. *Take the measures necessary to prevent hazardous waste reaching Solid Waste containers and transportation means.*

F. *Keep regular records in which are listed the quantities and sources of Solid Waste, and the methods of treatment thereof, and the vehicles operating in this field.*

G. *Supervise sorting, excavation and landfill activities, and monitoring the compliance with the stipulations appearing in Solid Waste Management contractors' contracts.*

H. *Forbid the burning of Solid Waste or the disposal thereof in an exposed manner.'*

Jordanian Regulation No.24 of 2005 concerns the Management, Transportation and Handling of Harmful and Hazardous Substances Regulations. The annex to this regulation, lists the banned substances, restricted substances and harmful & hazardous wastes, relevant to this regulation.

In addition, Article 11 of Regulation No.26 of 2005 for the Protection of the Environment from pollution in Emergency Situations Regulations states that:

'Facilities handling hazardous substances shall submit regular reports to the Local Operations Committee indicating the quantity, quality, potential hazard and location of such substances, as well as the location of control equipment therein.'

In accordance with this, an inventory of substances used on site that are listed in regulation no. 24, is required to be submitted to the Local Operations Committee.

Additionally, the following national regulations are also applicable:

- Instruction for Management and Handling of Consumed Oils, 2003;
- Instruction for Hazardous Waste Management, 2003; and
- Jordanian Standard 431/1985 on General Precautionary Requirements for Storage of Hazardous Materials.

<u>European (EBRD) Requirements</u>

The EBRD PR3 on Resource Efficiency and Pollution Prevention and Control establishes general requirements waste management as follows:

- The Project must strive to avoid the generation of hazardous and non-hazardous waste materials and reduce their harmfulness as far as practicable. Where waste generation cannot be avoided, the waste must be reused, recycled or recovered, or used it as a source of energy. Where waste cannot be recovered or reused, the waste must be treated and disposed of it in an environmentally sound manner;
- The Project must identify technically and financially feasible alternatives for the environmentally sound disposal of any hazardous waste considering the limitations applicable to trans boundary movement; and
- When waste disposal is transferred offsite and/or conducted by third parties, chain of custody documentation to the final destination must be obtained and only contractors that are reputable and legitimate enterprises licensed by the relevant regulatory agencies must be commissioned. The Project must ascertain whether licensed disposal sites are being operated to acceptable standards. Where this is not the case, alternative disposal options must be considered, including the possibility of developing their own recovery and disposal facilities at the project site.

The European Commission has extensive legislation in regard to solid waste that includes the following:

- Waste Framework Directive 2008/98/EC;
- Hazardous Waste Directive 91/689/EEC; and
- Waste oils Directive 75/439/EEC.

<u>International (IFC) Requirements</u>

World Bank Group EHS Guidelines for Waste Management Facilities (April, 2007) and IFC/World Bank General EHS Guidelines (2007) establish requirements for Waste Management. Specifically, Section 1.6 of the General EHS Guidelines covers waste management, whilst Section 1.5 covers Hazardous Materials Management. The waste management guidelines state that facilities that generate and store wastes should practice the following:

- Establish waste management priorities at the outset of activities based on an understanding of potential;
- Identify EHS risks and impacts and consider waste generation and its consequences;
- Establish a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes;
- Avoid or minimize the generation of waste materials, as far as practicable;
- Identify where waste generation cannot be avoided but can be minimized or where opportunities exist for, recovering and reusing waste; and
- Where waste cannot be recovered or reused, identify means of treating, destroying, and disposing of it in an environmentally sound manner.

9.4 Baseline

Solid waste generation in Jordan is growing rapidly due to significant industrial and economic growth. Consequently, responsible waste management is essential to minimise direct and indirect impacts upon the environment as a result of waste generation and resource consumption. Rapid economic development often precedes the required infrastructure to handle the wastes generated. Therefore, in order to allow sustainable and environmentally friendly economic development of Jordan, it is vital to consider the methods for handling, storage and management of waste generated in conjunction with progress in the country's economy.

Solid waste in Jordan is managed by the local municipalities in accordance with the "Municipalities Law No.13 of 2007" - this includes the collection of solid waste, transportation, and final disposal to landfills. Key municipal solid waste management facilities in Jordan include the Al Ghabawi landfill operated by Greater Amman Municipality, which manages the municipal waste generated in Amman, as well as from several other local municipalities. It Is understood that provision for recycling is becoming available at the Al Ghabawi complex, but is yet to be fully developed. The closest demolition and construction waste landfill will be outlined in the Waste Management Plan as part of the CESMP and OESMP when this is established on a site specific basis by the EPC Contractor and O&M Company.

On the other hand, hazardous waste is managed and regulated by Ministry of Environment. In accordance with the "Environmental Protection Law No. (52) of the year 2006" and the "Instruction for Management and Handling of Hazardous Waste of 2003", hazardous waste must be transported and disposed at designated landfills which are approved by the MoEnv through private companies which are also approved by the Ministry. In Jordan, there is currently one landfill for disposal of hazardous waste – the Swaqa Hazardous Waste Treatment Facility which is located in Amman Governorate.

Waste Characterisation

Waste can exhibit certain characteristics according to the process stream from which it is generated and any pre-treatment processes that are undertaken. Different types of waste require different management and disposal techniques according to the potential risk that the material poses to human health or the environment. In order to categorise the different risks to these receptors, it is often useful to demarcate the streams into 3 main categories that effectively equate to the level of the management and disposal which are required for each:

Hazardous waste - materials which pose a potential hazard to the environment or health of employees or the general public;

Non-hazardous wastes - solid materials which are not hazardous and degrade, chemically or biologically in the environment; and

Non-water soluble wastes - materials that do not breakdown in the environment, and are otherwise inert.

Hazardous waste exhibits any of the following characteristics:

- Ignitibility - Ignitable waste can create fires under certain conditions, are spontaneously combustible, or have a flash point less than 60 °C (140 °F). Examples include waste oils and used solvents.

- Corrosivity - Corrosive waste are acids or bases (pH less than or equal to 2, or greater than or equal to 12.5) that are capable of corroding metal containers, such as storage tanks, drums, and barrels.
- Reactivity - Reactive waste are unstable under "normal" conditions. They can cause explosions, toxic fumes, gases, or vapours when heated, compressed, or mixed with water. Examples include lithium-sulphur batteries and explosives.
- Toxicity - Toxic waste are harmful or fatal when ingested or absorbed (e.g., containing mercury, lead, etc.).

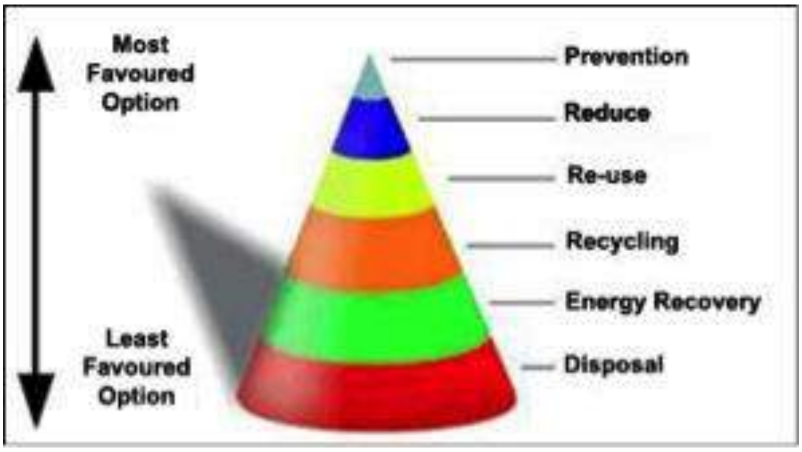
It is considered likely that the proposed CCGT project may use or generate hazardous materials in all of the categories listed above.

Waste Management Hierarchy

The waste management hierarchy is a key element of waste management. Minimising the amount of waste to be stored and disposed of not only protects the environment but also has the potential to reduce costs that may be incurred by the main contractor or the proponent for handling and disposing of the waste.

The waste hierarchy, typically expressed in the "3 R's" of waste management (Reduce, reuse, recycle) is illustrated in the following Figure.

Plate 9-1 Waste Hierarchy



In general, waste generation is evaluated according to the waste minimisation approach. This approach is common to various national and internal guidelines and principles and involves the following steps in decreasing order of importance.

- Prevention;
- Reduce;
- Reuse and recycling;
- Recover; and
- Land filling.

Initially, options to prevent or reduce waste should be considered. Where waste generation cannot be avoided or further reduced at source, opportunities for reuse of materials should be explored, either for use for the same or a different purpose. Disposal to landfill is the least favoured option in the waste hierarchy and is the last resort after all other options have been considered.

It is noted however, that waste management options for recycling and energy recovery are limited in Jordan, and as such the vast majority of waste is currently landfilled.

9.5 Sensitive Receptors

The Al-Ghabawi landfill (facility including lined landfill cells, landfill gas collection from capped municipal waste landfill and recycling sorting centre), the nearest demolition and construction landfill and Swaqa Hazardous Waste Treatment Facility (facility including lined landfill arranged in cells, with other treatment capability for wastes) represent potential sensitive receptors, since the construction and operational phases will result in an additional input of waste materials into these landfills. Both facilities referenced above are regulated by the Ministry of Environment. The generation of both hazardous and non-hazardous wastes will be expected.

The municipality of Zarqa has a licensed waste company that handles industrial and domestic wastes. The handling and disposal of hazardous wastes will follow the regulations of "Solid Waste Management Regulation No. (27) of 2005"; "Management, Transportation, & Handling of Harmful & Hazardous Substances Regulation No. (24) of 2005"; and will also meet international best practice (WBG/IFC EHS Guidelines).

The soil within the Project Site is also considered a sensitive receptor. In the event of any spills or leaks of hazardous waste materials, contamination to soils may occur.

Table 9-1 Solid and Hazardous Waste - Receptors sensitivity

Receptor	Sensitivity	Justification
Soil & Groundwater	Medium	Hazardous waste will be stored on site, in the event of any spills or leaks of hazardous waste materials, contamination to both soil and groundwater may occur.
Local Landfills	High	The construction and operation phases will result in an additional input of solid and hazardous waste materials into these landfills. Both hazardous and non-hazardous wastes will likely be generated. Licensed hazardous waste landfills regulated by the Ministry of Environment include mechanisms for pollution prevention consistent with the IFC EHS Guidelines for waste management facilities.

9.6 Significance of Impacts

9.6.1 Construction

During construction, waste would be generated during earthworks, construction of the fence, paths, road accesses and buildings, and connecting the power systems to the network. The main types of waste generated would be sand, gravel, concrete, asphalt, scrap steel, glass, plastic, wood, packaging materials and municipal waste from construction workers. Given the size of the facility, the amount of waste generated will be significant and if not properly managed will look unsightly, and may lead to contamination of the soils and groundwater.

SEPCO III have provided estimated quantities of construction waste as per the table below.

Table 9-2 Estimated Construction Waste Quantities

Type	Expected volume
Solid Non-Hazardous waste	2000 Kg / Month
Solid Hazardous waste	300Kg/ Month
Waste water (Sanitary & Domestic)	60KL / Month
Waste water from other construction	10KL/ Month
Commissioning waste water	1000Ltr /Month

Non-Hazardous Waste

During the construction phase, almost all activities will result in waste generation. The types of waste generated by these activities will likely include:

- Soil;
- Concrete;
- Asphalt paving;
- Scrap steel;
- Glass;
- Plastics;
- Packaging materials;
- Wood; and
- General waste from construction workers.

Concrete may be found in two forms on the construction site; structural elements containing reinforced concrete, while foundations have mass non-reinforced concrete.

Construction waste is often bulky and heavy and mostly unsuitable for disposal by incineration or composting. Other than the hazardous waste fraction, which is discussed in the following section, construction material is mainly inert and does not pose a threat to human health or the environment. However, proper management is required in order to reduce associated secondary impacts such as resource use, dust emissions, and habitat destruction. Increased pressure may be placed upon the demolition and construction landfill as well as the municipal solid waste landfill (Al Ghabawi) landfill and result in a reduced capacity for handling waste from municipal sources.

Prior to the implementation of Mitigation & management measures, it is considered that the generation of non-hazardous waste during the construction phase will result in a temporary impact, which may be of significance due to the continual quantities of wastes that will likely be generated.

Hazardous Waste

Although the hazardous fraction of construction waste represents a relatively small portion of the total amount of construction waste likely to be generated, its management requires careful consideration, as the impacts associated with hazardous waste can potentially result in contamination to soils and potentially groundwater. Typical hazardous waste streams that may arise during construction include:

- Solvent waste;
- Used and Spent oils;
- Hydraulic fluid;
- Resins and paints;

- Batteries;
- Waterproofing compounds;
- Adhesives;
- Machinery lubricants;
- Waste chemicals - used in the concrete forming process;
- Clean-up materials (such as spill kit wastes and rags) contaminated with the items listed above;
- Drums, containers and tins with remains of hazardous substances.

The hazardous fraction of the construction waste can potentially cause significant adverse impacts on human health and the environment if managed improperly. Inappropriate handling through lack of personnel training on site may lead to accidental spills or leaks to the soil or groundwater may lead to a contamination event, resulting in a potential health risk to workers and environmental impacts. Contamination may also arise a result of waste transportation by waste contractors who have not been approved by the MoE or disposal to unlicensed landfills. Increased pressure may be placed upon the Swaqa Hazardous Waste Treatment Facility and result in a reduced capacity for handling waste from municipal sources.

Therefore, prior to the implementation of Mitigation & management measures, it is expected that the hazardous waste generated during the construction phase of the Project will result in a temporary impact of moderate negative significance.

Table 9-3 Solid Wastes - Magnitude of Construction Impacts

Impact	Magnitude	Justification
Non Hazardous wastes	Moderate to Major	Given the size of the project and material quantities, hazardous wastes will be generated and if not appropriately disposed or handled may result with contamination and increased pressure on relevant landfills.
Hazardous Wastes	Moderate	Low volumes of hazardous wastes will be generated, and if not appropriately disposed or handled may result with contamination and increased pressure on relevant landfills.

Table 9-4 Solid Wastes - Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Non Hazardous wastes	Major	Land fill	High	Major
Hazardous Wastes	Moderate	Land fill	High	Moderate or major
		Soil and Groundwater Quality	Medium	Moderate

9.6.2 Operation

In general, few wastes will be generated during the operation of the power plant. Some of these will be direct products resulting from the operation and maintenance of the facilities, whilst other wastes will be the by-products of primary waste treatment processes, for example the sludge that results from wastewater treatment.

In addition to solid waste generation from the PROJECT, the operation of the proposed Project will generate domestic waste from the administration and office facilities. This waste can be classified as both recyclable and non-recyclable. Recyclable waste includes paper, tin cans, plastics, cartons, rubber, and glass, while non-recyclables will consist mainly of food residues and other organic waste.

It is noted that predicted waste generation quantities for the project have not been provided/estimated for inclusion to the ESIA. The following assessment is therefore based on the expected wastes common with power plants and their on-site facilities.

Industrial Non-Hazardous Waste

Industrial non-hazardous waste refers to waste generated by operational activities that do not exhibit any characteristics that could potentially harm human health or the environment. This type of waste can be classified further as recyclable and non-recyclable. Industrial non-hazardous waste generated during the operation of the PROJECT may include empty containers, general clean-up materials, packaging materials resulting from general, manufacturing or laboratory operations, and inert insoluble solid materials such as glass, rubber, and plastics.

Industrial Hazardous Waste

This fraction of waste can potentially cause significant adverse impacts on human health and the environment if improperly managed.

Examples of likely hazardous waste streams that may arise during the operation of the Project include the following:

- Sludge from the various waste water and waste oil treatment processes;
- Waste oil, oily rags, chemicals, solvents from general maintenance of on-site plant and machinery;
- Used chemical and fuel drums;
- Used filter mediums;
- Soil contaminated by potential spills and leaks;
- Miscellaneous wastes such as batteries; and
- General clean-up materials.

Hazardous waste streams generated during the operation and maintenance of the plant and machinery onsite represent the potential to be released into the environment. This subsequently represents a potential impact upon soil, in terms of contamination events. Potential sources, contamination pathways and appropriate Mitigation & management measures are addressed within the chapter for Soil, Geology and Groundwater.

Inappropriate handling through lack of personnel training on site may lead to accidental spills or leaks to the soil which may result in a contamination event, with associated health risks to workers and environmental impacts. Contamination may also arise off-site as a result of transportation by waste contractors who have not been approved by the regulator or disposal to unlicensed landfills. Increased pressure may be placed upon local hazardous waste landfills (Swaqa Hazardous Waste Treatment Facility).

The evaporation pond residuals will be accumulated in the pond as long as the water evaporates and they become concentrated. In this phase, it is not possible to estimate a quantity because the operation of the system has to consider also wind-blown dust/sand influence, but as the effluents have been treated previously (removal of oil and solid particles), the amount of residuals is expected to be insignificant. In any case, the system is designed to allow the removal of solids from the pond without interrupting operations. The pond will be empty only during short maintenance operation to evacuate solids, additionally the small percentage of oily /greasy substances in contact with the dust or sand become a solid substance which means it is not possible that the wind mobilizes residuals containing hazardous substances.

Sewage sludge produced may contain high levels of bacteria, nitrates and salts that can result in water contamination and can cause disease, such as hepatitis A or E. coli, if ingested. If the sludge is not properly disposed, contamination and health risks are likely.

The following table summarises the types of wastes, which will be generated.

Table 9-5 Solid Wastes - Magnitude of Operation Impacts

Impact	Magnitude	Justification
Non Hazardous wastes	Minor	The low number of staff employed at the site and type of daily activities will only generate small volumes of waste.
Hazardous Wastes	Minor	The project will generate small quantities of hazardous wastes calculated over years of accumulation, with the exception of sludge. The reduction of water usage for the cooling system will also decrease the volume of sludge produced.

Table 9-6 Solid Wastes - Significance of Operation Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Non Hazardous wastes	Minor	Land fill	High	Minor to Moderate
Hazardous Wastes	Minor	Land fill	High	Minor to Moderate
		Soil and Groundwater	Medium	Minor

9.7 Mitigation & Management Measures

9.7.1 Construction

The Mitigation & management measures provided refer to both hazardous and non-hazardous wastes. Whilst some Mitigation & management measures are specific to either hazardous or non-hazardous waste streams, many measures are applicable to both and therefore this section does not consider these measures separately, unless specified.

In order to minimise the impacts resulting from waste generation during the construction phase, the total amount of construction waste generated must be reduced to the greatest possible extent.

Waste Management Plan

A site specific Waste Management Plan will need to be included as part of the CESMP. In general, prevention can be achieved through proper planning with dedicated low-waste design, efficient material use involving careful selection, accurate ordering of materials, and effective process control. Reuse and recycling allows the recovery of usable components for subsequent use or for sale. Disposal of waste to landfills must be considered as the least preferable option and will only be resorted to for waste streams that cannot be recycled or reused. It is however understood that few options for recycling currently exist in Jordan.

The waste management plan will determine the estimated quantities of waste streams (municipal solid waste, construction waste, hazardous waste, etc.), expected during the construction and operation of the project respectively. Measure to identify waste, provisions for its on-site temporary storage shall be detailed. The preparation of the plan will follow coordination with the relevant municipality to identify the closest municipal and construction waste landfill (expected to be at Al Ghabawi) and ensure that such landfills have the capacity to handle the generated waste streams, etc.

In addition, the waste management plan must conform to the relevant local requirements and which include the following:

- Environmental Protection Law No. 52 of 2006
- Solid Waste Management Regulation No. (27) of 2005
- Management, Transportation & Handling of Harmful & Hazardous Substances Regulation No. (24) of 2005,
- Instruction for Management and Handling of Consumed Oils for 2003,
- Instruction for Hazardous Waste Management for the year 2003
- Jordanian Standard 431/1985 – General Precautionary Requirements for Storage of Hazardous Materials

Housekeeping

The construction waste management plan needs to establish good housekeeping practices to ensure that both hazardous and non-hazardous waste fractions are separated, properly handled, stored and subsequently transported, recycled or disposed by an approved waste management contractor to a licensed landfill or alternative disposal location.

The following Mitigation & management measures will contribute to the reduction of overall waste generated by the Project.

Table 9-7 Solid Wastes–Mitigation & Management Measures for Construction

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Solid waste volumes/quantities	Waste concrete and masonry can be re-used in road construction and base fillings; reasonable levels of utilisation is 80 to 90%	EPC Contractor	CESMP – Planning
	The amount of waste timber generated can be reduced through ensuring accurate measurements and orders are placed, and re-use for general construction purposes. It is estimated that 50 to 60% of this waste stream could be re-used	EPC Contractor	CESMP – Planning
	Waste metal can readily be recycled, 100% of this waste stream can be eliminated, through sale to local scrap metal dealers	EPC Contractor	CESMP – Planning
	It is conservatively estimated that 80% of oils can be refurbished or reused through energy recovery	EPC Contractor	CESMP – Planning
	Ordering materials that have reusable packaging and/or in bulk can significantly reduce waste generated	EPC Contractor	CESMP – Planning

	Suppliers will be requested to use minimal packaging. Chemicals will be ordered in returnable drums. "Buy-back" arrangements will be made with key suppliers so that any surplus chemicals or materials can be returned;	EPC Contractor	CESMP – Planning
	Refillable containers will be used, where possible, for collection of waste fluids such as waste oil, hydraulic oils, and used grease.	EPC Contractor	CESMP – Planning
Housekeeping	Separation of waste streams to facilitate recycling	EPC Contractor	CEMP – Monitoring
	Adequate storage facilities for non-hazardous waste storage in designated areas to prevent waste from dispersing throughout the site	EPC Contractor	CEMP – Planning
	Adequate hazardous waste storage in bunded containers stored in dedicated, covered storage areas with impermeable bases, sufficient containment capacity and equipped with spill kits	EPC Contractor	CEMP – Planning
	Immediate spill response protocol and contingency plans to detail the clean up of any spillages	EPC Contractor	CEMP – Training
	Procedures and rules for hazardous waste handling	EPC Contractor	CEMP – Training
	Mandatory training program for employees to increase their awareness of waste management protocols including proper handling and storage of waste, and emergency response and contingency plans.	EPC Contractor	CEMP – Training
Waste Storage	Food waste must be stored within a sealed metal or plastic skip or bin, in order to prevent vermin/pests gaining access;	EPC Contractor	CEMP – Planning
	Lightweight waste e.g. paper, cardboard, plastics: Must be stored within a skip sealed with a secured tarpaulin/netting sufficient to prevent any material being dispersed.	EPC Contractor	CEMP – Planning
	Heavy waste must be contained within an open skip, providing that segregation occurs effectively enough to remove all lightweight material that could be blown away.	EPC Contractor	CEMP – Planning
	Hazardous waste must be contained within impermeable containers with sufficient containment to prevent any spills. Storage containers will be bunded where necessary. The bunded base will have the capacity to contain 110% of the total volume of stored materials. This area must be placed away from any sources of ignition.	EPC Contractor	CEMP – Planning, training, monitoring
	All storage areas must be well organised and waste appropriately managed through segregation of hazardous and non-hazardous waste. Waste within each category will be further segregated by type (paper, plastic, metal) and whether the material is recyclable or non-recyclable. Construction waste will be separated into combustible and non-combustible, and all flammable substances must be kept away from sources of ignition.		
	For litter (food waste, domestic waste), an adequate number of bins will be placed throughout the site at locations where construction workers and staff consume food. These will be regularly collected and taken to the main waste storage area. On-going housekeeping training will be	EPC Contractor	CEMP – Planning, training, monitoring

	provided to all staff on the importance of the need to avoid littering.		
	Waste containers will be clearly marked with appropriate warning labels to accurately describe their contents and detailed safety precautions. Labels will be waterproof, securely attached, and written in English and Arabic. Wherever possible, chemicals will be kept in their original container	EPC Contractor	CEMP – Planning, training, monitoring
	Waste generated during construction will only be transported off-site for disposal by an appropriately licensed vendor. This contractor will follow the proper protocols to ensure that all waste handling and disposal from the site is carried out according to accepted environmental regulations. A record for all streams of generated waste will be kept onsite by EPC. This will be readily available for PME or concerned authority	EPC Contractor	CEMP – Planning, training, monitoring
	Regular training of site personnel in proper waste management and chemical handling procedures will be conducted at regular intervals.	EPC Contractor	CEMP – training
Hazardous Waste	Implement best practice and regulations procedures for adequate handling, establishment of secure temporary storage areas, and disposal of waste by approved contractors.	EPC Contractor	CEMP – Planning, training, monitoring

9.7.2 Operation

Suitable implementation of controls and procedures for handling, storage, transport and disposal of waste can prevent the generation of significant amounts of waste during operation. It is recommended that prevention or reduction at source, followed by reuse and recycling methods must be implemented on site to reduce the residual impacts of waste generated as a result of the Project. Adherence to guidance and recommendations set out by national guidelines and international best practices forms the basis of the Mitigation & management measures outlined in this section.

These measures will be fully described within, and implemented through a detailed site specific Waste Management Plan, within the Operation Environmental and Social Management Plan (OESMP) developed for the proposed Project O&M Company. The Mitigation & management measures presented will be cross-referenced within the Waste Management Plan and focus predominantly on the appropriate handling, storage, segregation, transport, and disposal of all waste. The following Mitigation & management measures are applicable during the operational phase:

Table 9-8 Solid Wastes –Mitigation & Management Measures for Operation

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Waste Volumes and Hazardous Wastes	Segregation and storage of different types of waste in separate labelled containers, to promote the re-use and/or recycling of materials. Use high quality raw material to reduce the quantities of waste generated.	O&M	OEMP – Planning and management
	Reduce packaging of materials and order in bulk. If appropriate, request supplier to minimise packaging. Recycle paper, metal, plastic and packaging.	O&M	OEMP – Planning and management
	Implement a recording system for the amount of wastes generated on-site.	O&M	OEMP – Monitoring
	Undertake regular inspections, audits, and monitoring of waste streams generated to ensure that all necessary Mitigation & management measures are being implemented.	O&M	OEMP – Monitoring
	Waste solvents, oils and other hazardous materials used at the site will be collected in suitably bunded and protected areas and reused where possible. Used lubrication oils are particularly suitable for re-use and it is understood that a number of suitable facilities exist in Jordan, although it is not known whether one is in the vicinity of the Project site. Such waste will be collected and transported by appropriately licensed transporters to approved hazardous waste disposal sites when re-use is not an option.	O&M	OEMP – Planning, training and monitoring
	Consignment details and records of the hazardous waste generated shall be maintained in the facility.	O&M	OEMP – Monitoring
	Waste disposal records and details of disposal locations will be maintained and kept on site to ensure that all waste streams (non-hazardous and hazardous) are disposed of in an appropriate way.	O&M	OEMP – Planning, and monitoring
	Only trained personnel will be permitted to handle hazardous waste.	O&M	OEMP –Training
	Implementation of spillage and leakage prevention measures such as a development of manuals for proper waste handling, regular inspection of containers and storage areas.	O&M	OEMP – Planning, training and monitoring
	General household and domestic waste generated by Project staff will be stored in area clearly marked. Separate colour coded and labelled waste bins will be installed at different locations throughout the Project site.	O&M	OEMP – Planning, and monitoring
	Mandatory training program for employees to increase awareness of waste management including proper waste; Training and orientation on waste minimisation, segregation and proper good housekeeping practice at the beginning of work and at regular interval will be conducted.	O&M	OEMP – Planning, training and monitoring

9.8 Residual Impacts

9.8.1 Construction

Following the implementation of the Mitigation & management measures detailed above and through effective implementation of the measures and protocols set out within the Waste Management Plan, the potential residual impacts of waste generated during the construction phase are evaluated below.

Table 9-9 Solid Waste– Residual Impacts – Construction Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact
Non Hazardous wastes	Major	Land fill	High	Major	Yes	Minor to Moderate
Hazardous Wastes	Moderate	Land fill	High	Moderate to Major	Yes	Minor
		Soil and Groundwater	Medium	Moderate	Yes	Minor

9.8.2 Operation

Following the implementation of the Mitigation & management measures detailed above, it is predicted that the residual impacts of the Project upon the local waste infrastructure, landfill capacities and human health and the environment are likely to be of minor to negligible negative significance.

Table 9-10 Solid Waste– Residual Impacts – Operation Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact Significance
Non Hazardous wastes	Minor	Land fill	High	Minor to Moderate	Yes	Minor
Hazardous Wastes	Minor	Land fill	High	Minor to Moderate	Yes	Minor
		Soil and Groundwater	Medium	Minor	Yes	Negligible

10 BIODIVERSITY CONSERVATION

10.1 Introduction

This chapter considers the baseline ecology within the boundary of the existing Hussein Thermal Power Station site, including the proposed development areas on which the new Hussein TPS will be constructed. The nearest sites designated for nature conservation value in Zarqa Province have also been identified to assess potential impacts on biodiversity for both the construction and operational phases of the Project. Where appropriate, Mitigation & management measures are proposed in order to minimise or avoid negative impacts and promote site biodiversity where possible.

Although the Project site is considered to be of relatively low ecological value, due to the heavily disturbed ground, sparse vegetation and low habitat diversity, within the industrial setting, it is prudent to confirm the habitat and floral types present and the fauna that was observed or maybe expected to occur in this area.

The project is not expected to impact upon any designated areas which are >70km to the east of the site. In addition, a very small tributary of the Zarqa River, which flows adjacent to the site boundary (on the outside of the wall) is currently of poor quality, impacted by wastewater from upstream facilities including a steel plant, road runoff and sewage overflows from the adjacent network.

10.2 Methodology

The terrestrial ecology of the Project Site and the sensitive bio-diverse areas in the region have been assessed by a combination of desk study and field survey observations.

Desk studies for the area included a review of ecological survey data from field survey, literature review of habitats and fauna of the Zarqa Region, and verification on the IUCN Red list of any vulnerable or near threatened species that may have been recorded in the area.

- A rapid ecological survey was conducted over the project site on the 15th/16th March 2016, in order to record baseline flora and fauna. Further to this, general site based observations have been made during the past 4 years of various site visits. The vegetation, fauna and any visible animal tracks were examined. The survey represented a snapshot of the ecological status of the site. Although, a full seasonal study was not practical, the level of industrial commercial and residential development surrounding the site and the relatively small size of the project area, would limit the opportunity for natural habitats, flora and fauna throughout the year. Bird sightings and incidental observations of invertebrates were recoded. No trapping or specimen collection was undertaken due to the disturbed nature of the habitats.

10.3 Applicable Regulations and Standards

Jordanian Requirements

The applicable national legislation that provide requirements for the protection, conservation and management of the ecological environment, including biodiversity, fauna and flora is as follows:

- Ministry of Environment:
  - Environmental Protection Law No. 52 of 2006
- Ministry of Agriculture

- Agriculture Law No. 44 of 2002
- Regulation for Categorizing Wild Birds and Animals Banded from Hunting No.43 of 2008

The Royal Society for the Conservation of Nature (RSCN) was established in 1966 and was the first non-profit organization to deal with biodiversity protection. RSCN is responsible for enforcing biodiversity and wildlife protection laws, the implementation of the International Convention on International Trade in Endangered Species (CITES) and the management of nature reserves in Jordan.

European (EBRD) Requirements

The EBRD PR6 on Biodiversity Conservation and Sustainable Management of Living Natural Resources establishes general requirements for the conservation of biodiversity and sustainable management of living natural resources covering aspects such as the assessment of issues and impacts on biodiversity.

Where applicable, the Project will intend to follow the targets set out by the EU Biodiversity Strategy including the Habitats Directive 92/43/EEC, the Birds Directive 2009/147/EC and the EU Regulation 1143/2014 on Invasive Alien Species. It is noted however that the targets are unlikely to be triggered by the Project due to the existing ecological conditions within the Project site.

International (IFC) Requirements

The assessment of impacts upon terrestrial ecology will be made with due consideration to the IFC Performance Standard 6 on Biodiversity Conservation and Sustainable Natural Resource Management which establishes requirements for protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources.

10.4 Baseline

10.4.1 National and Regional

There are 30 designated sites for nature conservation in Jordan (ref ProtectedPlanet.org) including 13 Nature Reserves, 10 Special Conservation Areas (SCAs) and 2 UNESCO Bio-sphere Reserves and several others such as a forest reserve and RAMSAR wetland. Within Zarqa Province, the closest sites are at Azraq Wetlands Reserve and Shaumari Wildlife Reserve which are approximately 70km to the east of the Hussein TPS site. Several other conservation sites to the north west of the project site include Dibeen Forest Reserve and Al Khayouf SCA, both being located around 30km from the site.

The locations of 4 nearest are shown in the figure below. There are no protected or designated areas at or within 30km of the site.

Figure 10-1 Protected Biodiversity Conservation Areas

Satellite Image Source: Google Earth

Dibeen Forest Reserve is situated just south of the Roman site of Jerash and covers an area of 8.5 square kilometres of rolling hills covered with pine-oak habitat. The area was protected as a nature reserve in 2004 under the initiative of the Royal Society for the Conservation of Nature (RSCN). The forest reserve contains one of the last remaining examples of a pine–oak forest in the Middle East. The species of the reserve's trees vary with elevation; Aleppo Pines inhabit the lower altitudes, the mixed pine–oak woodland (comprising Aleppo Pine and Palestine Oak).

Azraq Wetland Reserve is a nature reserve located 70km to the east of Zarqa. An oasis for migratory birds, Azraq was established in 1978 and covers 12 square kilometres. The natural springs dried up in 1992 and most migratory birds subsequently moved away from the area. Artificial springs are maintained today in order to keep the site a tourist destination.

Migratory birds come from Anatolia, Scandinavia, Siberia, and Africa. The partial restoration of the wetlands resulted in the return of several migratory species, such as the hoopoe lark, Cetti's warbler, the desert finch, and the marsh harrier. Among the 280 recorded migratory species in Azraq are the ruff, avocet, little stint, and the little ringed plover. Additionally, several birds of prey stop in Azraq, such as the European honey buzzard and Montagu's harrier.

River Catchment Habitat (non-designated)

Zarqa River Catchment – This is the third largest river in the region in terms of its annual discharge and its waters are extensively used for municipal water supply, irrigation an industrial needs. The small tributary adjacent to the Hussein power plant site has been heavily impacted by industrial, commercial activities and also by the route passing through residential areas of Zarqa. The disturbed ground and rock piles on the bankside and the low flow limits the opportunity for wetland birds, fish, or reptiles and amphibians. Habitat enhancement will have limited benefit until the water quality impacts are controlled.

10.4.2 Hussein TPS Project Site

The proposed power block will be located on predominantly open bare ground with narrow strips of vegetation that has avoided the frequent disturbance. Patches of *Plantago ovata* are scattered across the open areas. This is one of several species found on the site that grow in soils with high iron deposits, in addition to common herb and grass species, this area also has several large bushes of *Tamarix arabica* growing close to pipes where the ground has not been disturbed. The floral biodiversity is relatively low in this area together with little evidence or sightings of birds or lizards. The only mammal seen in this area was feral dog.

Plate 10-1 Main site area with little vegetation. *Plantago ovata* on bare ground

More than 25 species of flora, mainly herbs, were identified across the Hussein TPS site typical of disturbed and cultivated ground including *Geranium, Erodium* and Mallow species, *Anthemis* sp, *Crepis* spp, *Rumex* spp, *Chenopdium* sp and Sisymbrium as examples. The commonly occurring species did not include any with IUCN vulnerable or near threatened status. Existing Landscaped areas included non-native species such as *Eucalyptus* sp and *Olive* sp.

Plate 10-2 Example of *Tamarix arabica* bushes and close up view

The site on which the air-cooled condensers will be located is barren open ground with few examples of herb species, although common insects such as grasshoppers were seen in this location. Adjacent to the road the steep embankment supported few species with the exception of a well-adapted plant (*Neurada* sp.), which appears to be highly adapted for this type of dry habitat and has little competition on the embankment. This is one of the few examples of habitat within the Hussein TPS site that is likely to have remained undisturbed for several decades and hence may have species, which are adapted to this specific habitat.

Plate 10-3 Site for Air Cooled Condensers also showing bare ground and insects. The undisturbed ground of the embankments with adapted species

The site area that has been set aside for the storage tanks has generally greater biodiversity of flora compared with other locations inside the Hussein TPS site, however these are typically common species that are also characteristic of disturbed ground. The flora also includes examples of escapees from cultivation such as the herb *Eruca sativa*. Other common species in this location were *Pulicaria* sp. *Centurea pseudosinaica* and occasional specimens of the thistle *Cardus pycnocephalus*.

Plate 10-4 Greater vegetation cover at location set aside for the tanks. *Pulicaria* sp.

Plate 10-5 *Eruca sativa* and *Cardus pycnocephalus*

Plate 10-6 *Senecio glaucus* growing adjacent to the road inside Hussein site

The annual *Senecio glaucus* growing alongside safety barriers, providing iron rich habitat

The area of ground set aside for the evaporation pond has previously been used as a tree nursery although much of the site is now fallow disturbed ground. The trees were mainly pine species including recently planted saplings and semi-mature trees. Die back was evident among evergreen species due to lack of water. It was notable however that this location supported a wide range of insects including butterflies, beetles, grasshoppers, caterpillars etc.

Flora included garden escapees such as *Eruca sativa* and *Calendula* (marigold) together with several species of mallow.

Plate 10-7 *Eruca sativa* – likely escapee from cultivation

Plate 10-8 Phragmites australis growing at base of hillside below the existing tank farm

Plate 10-9 Mature Conifers by north western site boundary and conifer saplings in tree nursery

The conifer species planted on the site of the proposed evaporation pond represent a valuable resource in terms of trees that are either native to Jordan or occur within the Region. Elsewhere on the site there were few examples of native tress other than the *Tamarix arabica*, which was observed at one location.

Table 10-1 Flora Species On-Site – IUCN Conservation Status

Flora - Species Name	IUCN Conservation Status
Plantago ovata	Not assessed
Tamarix arabica	Not assessed
Eruca sativa	Not assessed
Centurea pseudosinaic	Not assessed
Cardus pycnocephalus	Not assessed
Senecio glaucus	Not assessed
Phragmites australis	Least Concern
Genera: *Geranium spp, Anthemis* spp, *Crepis* spp, *Erodium, Rumex* spp, *Chenopdium* spp, *Eucalyptus* spp, *Olea* sp, *Neurada* spp, *Pulicaria* spp, Sisymbrium, *Calendula*	

The site has limited undisturbed habitats suitable for small mammals or reptiles. In addition, the site is largely severed from external habitat due to the boundary wall at the existing HTPS. However, one species of lizard was recorded during a site visit in 2012, was an Agamadae (*Agamadae pallidus*) on the dry exposed slopes beneath the existing switchgear station.

Repeated site visits have not observed any other reptiles or small mammals.

10.5 Sensitive Receptors

The table below outlines the identified receptors in relation to biodiversity as well as the determined sensitivity of those receptors.

Table 10-2 Ecology – Receptor Sensitivity

Receptor	Sensitivity	Justification
Flora (onsite)	Low	The site is a brownfield, and the majority of the area is regularly disturbed by the temporary waste management activities such as land clearing. The ecology of the site is limited to few hardy plant species and opportunist and highly adaptable fauna. The proposed area for the evaporation pond has been planted with a variety of conifer species
Fauna (onsite)	Low	

10.6 Significance of Impacts

10.6.1 Construction

The baseline survey showed that the site exhibits limited biodiversity, with the main vegetation and insect fauna most widespread in the evaporation pond area and the location for the storage tanks. The requirements for the design and layout of the plant will necessitate site clearance of topsails, although this should be retained in piles to maintain the seed resource on site. In addition, the conifer trees and saplings would be retained in situ (along the site boundary) or trans-located to a similar boundary location.

In addition to the existing site disturbances, the removal of soils for levelling and grading of the site may reduce the seed bank for future growth. It is possible that regrowth will occur to a certain extent where areas of ground are undeveloped and retaining topsoils on site should encourage this.

The equipment and machinery used on site will generate fairly high volumes of noise which could disturb fauna within the vicinity, though given the lack of fauna identified on site, this can be assessed to be a permanent impact of minor negative significance.

Table 10-3 Ecology – Magnitude of Construction Impacts

Impact	Magnitude	Justification
Direct Loss of habitat (onsite)	Negligible	The requirements for the design and layout of the plant will necessitate site clearance, which will disturb any remaining fauna and flora on the site. The baseline survey indicated that the site and surrounding areas exhibits little biodiversity and is not sensitive.
Loss of seed bank	Minor	Site clearing and earth moving will alter the diversity and density of seeds in the soils. Removal of the vegetation will also limit the re-deposition of new seeds, and soil compaction will prevent regrowth of any seeds remaining on site.
Noise impact on fauna	Negligible	The equipment and machinery used on site may generate high volumes of noise that could disturb fauna within the vicinity. However, the lack of macro-organisms identified on site, industrial and residential use of the adjacent lands, and the construction of the project, has limited the presence of fauna.

Table 10-4 Ecology – Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Direct Loss of habitat	Negligible	Flora (onsite)	Low	Negligible or Minor
		Fauna (onsite)	Low	Negligible or Minor
Loss of Seedbank	Minor	Flora (onsite)	Low	Negligible or Minor
Noise impact on fauna	Negligible	Fauna (onsite)	Low	Negligible or Minor

10.6.2 Operation

Due to the likely paving and hard standing construction over the majority of the proposed site, it is anticipated that impacts during the operational phase to any on site vegetation will be minimal. As such, the only activities that could negatively impact the ecology of the site would be through indirect measures, relating to poor management practices of any designated landscaped areas; or to the fauna species inhabiting/using these areas.

Specific provision for landscaping will be made at the project site. The extent to which landscaping will be included and specifically which species has not been detailed at this stage.

Inadequate storage and handling of hazardous materials, and inappropriate design and storage of wastes could result with contamination of soils and groundwater and attract pest species and spread disease. Pests may also be attracted to site by the accumulation of wastes (particularly domestic food wastes) if these are not stored and disposed of appropriately.

Where applied to the landscaped areas, the use of additives, such as non-organic herbicides, pesticides and fertilisers may potentially impact on the groundwater through run-off, may be toxic to birds and also impact on the local vegetation, thereby increasing the secondary poisoning of non-targeted species. This may result in a temporary impact of minor negative significance.

Table 10-5 Ecology – Magnitude of Operation Impacts

Impact	Magnitude	Justification
Provision of Landscaping	Minor Positive	Landscaping provision and management of these landscaped areas will provide an offset to habitat loses at the construction phase.
Pests from domestic waste	Minor	Pests may pose a very minor temporary reversible loss of biodiversity through the spread of disease and nuisance to native habitats in the site and immediate surroundings.
Landscaping additives	Minor	Inadequate management and selection of persistent non-biodegradable landscape chemicals may be toxic to birds and also impact on the local vegetation, thereby increasing the secondary poisoning of non-targeted species.
Wastewater Discharge	Minor	Poor Wastewater management may potentially impact on flora.

Table 10-6 Ecology – Significance of Operation Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Provision of Landscaping	Minor Positive	Flora (onsite)	Low	Minor
Pests from domestic waste	Minor	Fauna (onsite)	Low	Negligible to Minor
Landscaping additives	Minor	Flora (onsite)	Low	Negligible to Minor
Wastewater Discharge	Minor	Fauna (onsite)	Low	Negligible to Minor

10.7 Mitigation & Management Measures

10.7.1 Construction

Table 10-7 Terrestrial Ecology –Mitigation & Management Measures for Construction

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Direct Loss of habitat	In line with EBRD/IFC PR/PS 6 regarding biodiversity conservation, the loss of native vegetation should be offset through corresponding re-vegetation of the site. Any required offset for vegetation should use native or naturalised species. Alien species will not be introduced.	EPC Contractor	CESMP – Planning: During the completion of construction
	The laydown areas of the site will be minimised in size wherever possible, and preferably located in an area with little or no vegetation.	EPC Contractor	CESMP – site preparation
	Hazardous materials used during the construction stage will be adequately managed, in order to minimise the potential risk of spillage and therefore potential contamination of the habitats.	EPC Contractor	CESMP – Management and training throughout construction
Loss of Seedbank	To aid re-vegetation, the topsoil (containing the most nutrient rich soils) will be removed and stored safely and spread over the site once construction has been completed.	EPC Contractor	CESMP - Planning and removal of soils during initial earthworks
Noise impact on fauna	Construction noise mitigation as per the noise section to be applied	EPC & Sub-Contractors	CESMP - Throughout Construction

10.7.2 Operation

Although the terrestrial ecology on the site is not of high value, it remains important to consider ways to minimise the impact and potentially improve on the terrestrial environment of the Project Site and surrounding area during operations.

Table 10-8 Terrestrial Ecology –Mitigation & Management Measures for Operation

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Provision of Landscaping	In line with EBRD/IFC PR/PS 6 regarding biodiversity conservation, the loss of native vegetation should be offset through corresponding re-vegetation of the site. Any required offset for vegetation should use native or naturalised species. Alien species will not be introduced.	O&M to manage and maintain	OESMP – Throughout Operation
	Intentional replanting of vegetation and incidental recolonisation with native species from the seeds retained from the stockpiling of topsoil would enhance the biodiversity of the site as well as improve the visual aesthetics of the site. Areas used for laydown and storage will be scarified if compacted, in order to facilitate the recolonisation of native species;	O&M to manage and maintain	OESMP – Throughout Operation
Pests from domestic waste	Implement a pest control plan, including measures to deter pests (e.g. suitable containment of wastes, as per waste mitigation)	O&M	Throughout Operation
Landscaping Additives	Use of landscaping additives such as fertilisers and pesticides will be avoided where possible or otherwise minimised. Banned chemicals under the Stockholm Convention (POP's) will not be permitted on-site.	O&M	OEMP – Planning, design, monitoring
Wastewater Discharge	The project will ensure wastewater treatment to an appropriate level with frequent monitoring of water quality. All other wastewater shall be suitably contained or otherwise managed. This includes storm water which may become contamination by any hazardous surface residues.	O&M	OESMP – Planning, design, monitoring

10.8 Residual Impacts

10.8.1 Construction

Table 10-9 Ecology – Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact
Direct Loss of habitat	Negligible	Flora (onsite)	Low	Negligible or Minor	Yes	Negligible
		Fauna (onsite)	Low	Negligible or Minor	Yes	Negligible
Loss of seedbank	Minor	Flora (onsite)	Low	Negligible or Minor	Yes	Negligible
Noise impact on fauna	Negligible	Fauna (onsite)	Low	Negligible or Minor	Yes	Negligible

10.8.2 Operation

Table 10-10 Ecology – Residual Impacts – Operation Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact
Provision of Landscaping	Minor Positive	Flora (onsite	Low	Minor	Yes	Minor
Pests from domestic waste	Minor	Fauna (onsite	Low	Negligible to Minor	Yes	Negligible
Landscaping Additives	Minor	Flora (onsite)	Low	Negligible to Minor	Yes	Negligible
Wastewater Discharge	Minor	Fauna (onsite)	Low	Negligible to Minor	Yes	Negligible

11 SOCIAL AND ECONOMIC

11.1 Introduction

The scale and nature of the proposed project and the emphasis that both he MoE and lender requirements place upon social issues and community involvement highlights the importance of the Social and Economic Assessment process. It is fundamental to incorporate the viewpoints of relevant stakeholders into such a nationally important development and mitigation for the social or economic concerns of these stakeholders has therefore been incorporated within the design at an early stage.

The social and economic chapter of this ESIA is primarily concerned with the impacts upon local communities, their dynamics and the interaction between economics and the environment.

11.2 Methodology

The purpose of this chapter is to assess the predicted impacts of the projects construction and operational phase upon social and economic conditions. Of particular note are impacts to the existing workforce, which have been outlined in this chapter, as well as the many positive impacts relating to employment, additional cleaner power generation, indirect education and service uses locally.

Existing data and statistics for the local area and Jordan have been referenced from reputable sources, as has knowledge gained via various interactions with local people, existing HTPS staff and from the scoping consultation exercise. This baseline allows the impacts of construction and operation to be suitable assessed against.

11.3 Applicable Legislation

The applicable environmental Legislation in relation to socio and economic issues which will be considered as part of the ESIA include the following:

Lender Requirements

<u>EBRD</u>

The application of EBRD's performance requirements to the ESIA will ensure that social and economic impacts are fully assessed with suitable provision for the management of identified potential impacts. The notable PR's that will apply to this project include:

- Performance Requirement 1: Assessment and Management of Environmental and Social Impacts and Issues;
- Performance Requirement 2: Labour and Working Conditions;
- Performance Requirement 4: Health and Safety;
- Performance Requirement 10: Information Disclosure and Stakeholder Engagement.

It is recognised that PR5 and PR7 are not triggered by this project as there is no direct land acquisition, involuntary resettlement or interaction with any indigenous people.

<u>IFC</u>

The following applicable IFC Performance Standards aim to identify and ensure that social and economic impacts of a project are addressed in the relevant areas, in particular:

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;
- Performance Standard 2: Labour and Working Conditions;
- Performance Standard 4: Community Health, Safety and Security;

IFC Performance Standards 5 on Land Acquisition and involuntary Resettlement and IFC PS 7 in relation to Indigenous People is not triggered by this project.

11.4 Baseline

Jordan

The table below provides a summary of population information in Jordan.

Table 11-1 Jordan Population Data Summary

Criteria	Data (2015 - Estimates)
Population	8,117,564 **note:** estimate reflects revised assumptions about the net migration rate due to the increased flow of Syrian refugees (July 2015 est.)
Age Structure	0-14 years: 35.42%: 15-64 years: 60.67%; 65 years and over: 3.91%
Median Age Total:	22 years (Male: 21.7 years; Female: 22.4 years)
Sex Ratio (Male/ Female):	At birth: 1.06; Under 15yrs: 1.05, 15-64 yrs.: 1, 65+yrs: 0.89 and Total population 1.02
Amman (Capital)	1.155 million (2015)

Source: CIA World Factbook, 2015

Jordan's economy is among the smallest in the Middle East, with insufficient supplies of water, oil, and other natural resources, underlying the government's heavy reliance on foreign assistance. Other economic challenges for the government include chronic high rates of poverty, unemployment, inflation, and a large budget deficit. In recent years, the global economic slowdown and regional turmoil have depressed Jordan's GDP growth, export sectors, construction and tourism. Another key challenge for Jordan has been the influx of Syrian refugees since 2011 (estimated at over 630,000). A summary of Jordan's economy is outlined in the table below.

Table 11-2 Jordan Economic Data Summary

Criteria	Data (2015 – Estimate)
GDP (Purchasing Power Parity):	US$82.99 billion
GDP (Real Growth Rate):	2.9%
GDP per Capita:	US$12,400
Labour Force:	2.02 million
Unemployment Rate:	13%

Source: CIA World Factbook

Zarqa

Once the site of a small Arab fortress, Zarqa marked the defence line east of Al Sadaqah and west of Ma'an. In the 1920's Zarqa was a small Circassian village, but it expanded rapidly in size after 1948. In 1924 the headquarters of the Arab League were established in Zarqa and in 1962 an oil refinery was built to the north of the city. The Hashemite University (1992) is located in Zarqa.

Nowadays, Zarqa is Jordan's industrial centre with the existing oil refinery, Hussein TPS, Steelworks and large wastewater treatment facility to the north of the city (Al Samra WWTP). The Petrochemical refinery is the only facility of its kind in Jordan and the original Hussein TPS was the first thermal power plant in the country. It is understood that the population of Zarqa flourished since the development of the industrial facilities in these areas for local populations to gain employment.

The Hussein TPS Power Generation Project is located north of Zarqa city, in the Zarqa Governorate of Jordan. The Zarqa Governorate is the third largest governorate in Jordan by population, with the most heavily populated areas of the region coinciding with the Zarqa River Basin in western areas.

'Zarqa is classified as a 'poverty pocket.' Since 1997, poverty in Zarqa has increased, as opposed to all other governorates of Jordan. Poverty rates in the target neighbourhoods range from 29 to 52.2 percent. The severity of poverty in Zarqa is twice as high compared to the national average.

Young people growing up in this environment miss the opportunity to acquire requisite life and job skills—critical for their protection, development and the rebuilding of their communities… The informal sector in Zarqa is vibrant with hundreds of small and medium-sized enterprises.

Jordanian women are primarily involved in the resale trade. They sell recycled clothing, home appliances, phones, pre-paid cell phone cards, cosmetics, and linens. Many make frequent overnight trips to the duty-free zone in Aqaba to stock up on products that they later sell at a higher price.'[2]

Zarqa: Demographic Indicators *(Source: knoema.com)*

- Capital: Zarqa
- Languages: Arabic
- Governor: Hamid Alsheyyab
- Population (persons): 951,800 (2012)
- Area in sq.km: 4,761 (2012)
- Population Density (persons per sq.km):199.9 (2012)
- Number of Schools:630 (2009)
- Number of Students: 246,423 (2009)
- Birth Rate (Per 1000 population):25.9 (2009)
- Death Rate (Per 1000 population):2.9 (2009)
- Infant Mortality Rate (Deaths per 1000 live births):15 (2009)
- Beds in Hospitals:963 (2009)
- Unemployment Rate:11.6 (2008)

[2] *(Source: Enhancing the Economic Resilience of Displaced Iraqis and Poor Jordanians, ECONOMIC ASSESSMENT: OPPORTUNITIES AND CONSTRAINTS FOR VULNERABLE WOMEN AND YOUTH IN ZARQA, JORDAN (March 2014))*

- Number of Road Accidents: 10,819 (2009)
- Average Household Size:5.4 (2008)

Existing Hussein TPS

The project is a timely replacement for the existing HTPS HFO plant that ceased operations in December 2015. The existing HTPS was the first thermal power plant in Jordan, located at its inception in an undeveloped area north of Zarqa, adjacent to the petrochemical refinery (which still remains the only petrochemical refinery in Jordan). The local area grew due to these facilities in the area, and people started to build residences and locate businesses in the area. This ultimately lead to the expansion and development of the Hashmiyeh residences immediately north of the pant and refinery.

As the original thermal power station in Jordan and until December 2015, one of CEGCO's longest standing facilities, the wider HTPS site has developed into more than just a power generation facility. The landholding at the HTPS is much larger than the existing power plant itself, and nowadays it comprises space for several CEGCO support services that serve the operational and maintenance of the CEGCO assets. These include the transportation department, central stores, warehouses, laboratories, NEPCO training centre (on CEGCO land) and some CEGCO worker accommodation (for Hussein TPS employees).

There are a significant number of people that are employed at the HTPS site by CEGCO and NEPCO, and despite the closure of the existing HTPS plant in December 2015, they remain active at the site. CEGCO have indicated that there were 250 staff specifically employed by the existing HTPS HFO plant. For those staff who were involved directly in the operation of the existing HTPS HFO plant, many of these have been retained by CEGCO at the site to oversee the proposed project, and the management of the land. Those employees who were not retained at the HTPS site, have been provided with job opportunities at other CEGCO facilities. It is understood that none of the existing HTPS workforce has been made redundant.

It is understood that approximately 80% of staff at the existing HTPS staff from the Zarqa/Hashmiyeh area.

Syrian Refugee Crisis

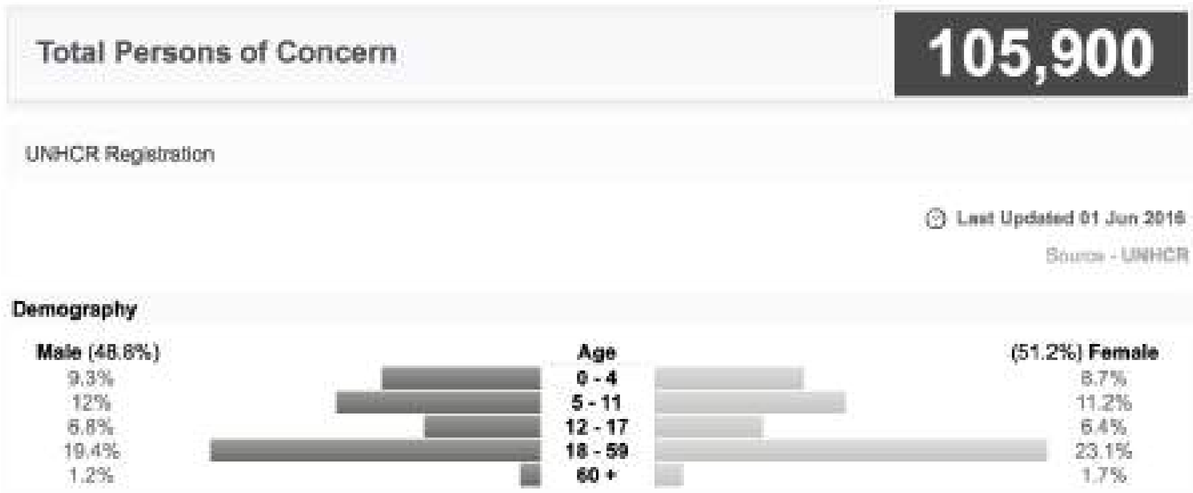
According to www.syrianrefugees.eu, '*As of August 2014, the United Nations had registered 619,000 refugees in Jordan, with over 80,000 registered in the refugee camp Za'atri.*

Approximately 80 percent of Syrian refugees in Jordan live in urban areas in the north of Jordan, while the remaining 20 percent live in the Za'atari, Marjeeb al-Fahood, Cyber City and Al-Azraq camps.

Northern Jordan has been dramatically altered by the Syrian civil war. Since the uprising began in March 2011 right across the border in the city of Deraa, Jordanians have experienced the conflict via the thousands that have crossed into their country through the towns of Jabir and Ramtha.'

In regard to refugee camps in Zarqa governorate, these are located away from the project itself, however the UNHCR estimates that approximately 105,900 people are under refugee staus in the Governorate. This includes the Al-Azraq camp (51,089 people), Emirati Jordanian Camp (6,644 people) and approximately 48,167 refugees in Zarqa city.

Figure 11-1 Refugee Camps and Locations in Zarqa Governorate



Source: UNHCR.org

CEGCO Social Initiatives

It is recognised that CEGCO play an interactive role with the local community within Hashmiyeh, Zarqa and throughout Jordan generally. Such initiatives have and continue to include the provision of free medical examinations, winter clothing for children, computers to schools and construction of a theatre facility at a school. CEGCO plans to continue its support for the local community to ensure that its good relationship is maintained.

Workers Organisations

There are several available worker organisaitons in Jordan. This includes the Jordan Solidarity Center, which '*supports initiatives to protect the rights of all workers in Jordan, through worksite mobilization and organization, and through national advocacy campaigns*'.

According to the Jordan Solidarity Centre, '*Jordan's economic development has failed to halt eroding living conditions for most Jordanian workers. The cost of living continues to rise, with no commensurate rise in wages. The gap between the very wealthy and the poor is increasingly visible, both inside and outside the capital. Many of Jordan's trade unionists have a long history* *of struggling for worker rights, and despite restrictions on freedom of association, workers continue to form unions. In April 2013, Jordanian workers established the Federation of Independent Trade Unions of Jordan (FITU).*

The Solidarity Center encourages and supports Jordanian unions in their efforts to change the nation's labor law to allow for greater union freedom. Public-sector workers are forbidden to form unions and civil servants do not have collective bargaining rights. Jordanian unions are expected to obtain permission from the government before a strike takes place.'

11.5 Receptors

Derived from available baseline information, the following table identifies receptors specific to potential impacts associated with Social and Economic Issues.

Table 11-3 Socio-economic – Sensitivity of Receptors

Receptor	Sensitivity	Justification
Employment	**Medium**	Jordan's unemployment rate is relatively high, but not excessive, putting it in the mid-range of countries worldwide.
Welfare of Local Population	**Medium**	Any change to infrastructure, population or regional inputs are also likely to have knock on effects for the welfare of the local population.
Community services	**Medium**	Existing available community services are likely to be intended for the current local population only, with little additional capacity.
Local / Regional Economy	**Medium**	The proposed project is likely to influence regional businesses. Not only local contractors and those directly involved in the construction, but also for local commercial operations such as accommodation, food retailers etc.

11.6 Significance of Impacts

11.6.1 Construction

The construction of the proposed project will generate a number of jobs for construction workers and skilled labourers. Positive impacts will therefore occur as a result of increased local employment, dissemination of skills to the local workforce and purchase of local good and services to stimulate the local economy.

Population Influx

The construction phase of the project is anticipated to require up to 1,500 labourers and other project staff at the peak of construction activities. It Is expected that a number of workers will be sourced locally, however it is likely that a number of staff from areas external to the local communes, districts, and province may be required; particularly for specialist and skilled positions. The majority of SEPCO III's EPC staff will be expatriates from China (amounting to approximately 200 staff). The EPC staff will be housed at an existing accommodation area 3k north of the project site at the Al-Samra area. The source of sub-contractor staff is largely unknown but it is anticipated that the majority will be local Jordanian, with perhaps some specialist companies requiring expertise from overseas workers. The accommodation for sub-contractor staff has not been finalised, as the sub-contractor contracts are not in place.

The requirement for staff and labourers at the construction phase will therefore result in an amount of population influx to the local project area. Estimations in regard to the influx populations of workers are difficult to make due to several unknown factors at present, including the availability of appropriate labour locally, as well as the requirements of sub-contractor companies employed for the various aspects of the work on-site.

The influx of workers therefore will lead to a temporary rise in the local population during the construction phase. From experience of several other EPC accommodation area in the region, the Chinese expatriates typically remain in a close knit community, either at the site or at the accommodation area. It is not expected that the Chinese staff will be very visible within the local areas. Despite this, it is expected that local Jordanian and other Arabic labour staff maybe more prominent and interactive locally.

Secondary impacts as a result of local population increase have the potential to disrupt the community dynamics and the provision of services (positive and negative impacts) described in this impacts section, as well as factors such as crime, littering and other undesirable behaviours.

Employment Opportunities

Due to the requirement for labour during the construction phase, it is expected that a number of employment opportunities may become available to local populations via the sub-contractor companies. The number of potential jobs available is not yet known.

SEPCO III (the EPC Contractor) has indicate that they will provide opportunities to local populations where applicable and where suitably qualified staff are available. SECPO II have indicated that this will be reflected in their project HR Policy, with an associated procedure to be outlined.

The majority of positions available at the construction phase will likely arise from sub-contractors. SEPCO III have indicated that most of the sub-contractor workers will live locally, as the preference will be to employ local sub-contractors (where available). SEPCO III will endeavour to include a preference for local employment in their Sub-Contractor contracts.

It is noted that SEPCO III have had recent experience of a similar project in this area of Jordan (Al Samra PP), and it is understood that many construction project staff lived or were recruited locally for sub-contractors, including administration staff for SEPCO III.

Education of Locals

The project aims to engage with local communities at the construction phase in order to provide updates regarding construction and to respond to any grievances. It is expected that informal information provision to local populations during these times will enhance understanding of the project processes at the construction phase. It is expected that local communities will be well informed of the project generally and as such will receive an amount of education in regard to it.

<u>Demand on local services</u>

Initially it is expected that local services may come under pressure with influx of populations, in terms of being able to cater for increased service demand. However, the principle of supply and demand is anticipated to generate a higher service output to cater for the additional requirements of the influx population. This is very likely for private sector services, such as restaurants, and trading etc. The increase in local services may include the expansion of existing services or the generation of new businesses within the local area. Such impacts are expected to be positive overall during the construction phase and are likely to result in stimulation of the local economy.

<u>Demand on Utilities</u>

Demand for local utilities will undoubtedly increase with the influx of project workers and the requirements for utilities to cater for the needs of the projects construction.

The potential impacts relating to the increased demand for local utilities may include shortage of electricity; leading to instability of the power network, littering and waste dissemination, increased wastewater releases to the environment, reduced coverage of telecommunications networks and internet.

Table 11-4 Socio-economic - Magnitude of Construction Impacts

Impact	Magnitude	Justification
Population Influx	**Moderate Negative**	Temporary population influx associated with peak construction requirements may occur.
Employment Opportunities	**Moderate Positive**	Significant temporary job creation will be available for skilled and unskilled positions. Benefits to other local businesses with potential new employment opportunities due to business expansions and new sectors that may arise.
Training and Dissemination of Skills	**Minor Positive**	Training for workers in regard to vocational skills and health, safety and environment knowledge.
Education of Locals	**Negligible Positive**	Locals to be well aquatinted and understanding enhanced regarding the project, its construction and its technology.
Demand on Local Services	**Moderate Positive**	Local services may be under pressure initially, however the construction phase is expected to result in greater provision and diversity of local services generally, due to potential population influx and new required business for construction.
Demand on Utilities	**Moderate Negative**	Demand on utilities will likely increase during construction and could lead to interruptions in supply.

Table 11-5 Socio- Significance of Construction Socioeconomic Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Population Influx	Moderate Negative	Community Services	Medium	**Moderate**
Employment Opportunities	Moderate Positive	Welfare of Local Population	Medium	**Moderate**
		Local / Regional Economy	Medium	**Moderate**
Training and Dissemination of Skills	Minor Positive	Welfare of Local Population	Medium	**Minor**
		Local / Regional Economy	Medium	**Minor**
Education of Locals	Negligible Positive	Welfare of Local Population	Medium	**Negligible to Minor**
Demand on Local Services	Moderate Positive	Welfare of Local Population	Medium	**Moderate**
Demand on Utilities	Moderate Negative	Welfare of Local Population	Medium	**Moderate**

11.6.2 Operation

The completion of the proposed Hussein TPS Power Generation project will result in the secure provision and increased capacity of electrical energy to the population of Jordan. This will include a cleaner generation process and subsequently fewer environmental impacts relating to local air quality, noise, use of resources and wastewater compared to the original Hussein TPS plant.

Besides improved electrical infrastructure and enhanced security of power supply in Jordan, the most significant local benefits will include the potential employment opportunities related to the operation of the facility.

Employment Opportunities

The operational phase of the project will require an amount of staff in order to effectively manage the day-to-day operations and maintenance of the power plant. There will be a demand for both skilled and unskilled labour, as well as specialist positions for technical staff. The projects manpower requirements will be as follows.

Table 11-6 Project Manpower Requirements

Manpower	Staff No.
Plant Manager	1
Operation Manager	1
Maintenance Manager	1
Performance Manager	1
Finance Manager	1
Operation Engineers	4
Maintenance Engineers mech' ,elc' ,control & inst'	3
Operation Staff (supervisor level) 19	
Control Room Operators	9
St' local	4
Chem' operation and balance of Plant	4
chem lab and injection	2
Maintenance Staff(supervisor level) 13	
Super' :mech' ,el' ,in'	3
mech tech	5
elct tech	2
i&c tech	3
Admin and P.R	1
Labor	2
HSE Staff	1
Secretary & Doc Controller	1
Accountant	1
Storekeeper	1
IT Support Engineer	1
Planing and prucurment manager	1
Driver	1
Chemist (section head level)	1
Total	**55**
Security Officers	4
house keeping	2

These will relate to the following opportunities:

- Jobs related to the project company (already established from existing CEGCO HTPS staff, unlikely to require additional).
- Jobs related to Operation and Maintenance of the plant.
- Jobs related Security and Services.
- Jobs on temporary basis upon needs.

CEGCO have signed an Implementation Agreement (signed on 21st December 2015) with the Ministry of Energy and Minerals, which ensure that 250 members of staff will be retained as part of the operational phase, or at the other CEGCO operations at the HTPS site (e.g. CEGCO warehouses, transportation, laboratories etc). This is therefore commensurate to the number of staff previously employed at the existing HTPS HFO plant and other CEGCO operations at the HTPS site.

The operational phase may also generate positive impacts for employment within other local industries and services as a knock on effect of additional employment locally.

It is confirmed that the ACWA Power overarching HR Policy will be the basis for all HR policies to be implemented for the project. This ensures compliance to all ILO conventions and will ensure compliance to local Jordanian regulations.

<u>Training and Dissemination of Skills</u>

Staff and labourers employed at the plant will benefit from the provision of training and dissemination of skills specific to their roles. This may include specialist training or training n the job, as well as the implementation of international best practices into daily working methods (e.g. occupational health and safety and environmental considerations).

<u>Education of Locals</u>

The project aims to engage with local communities at the operational phase in order to provide updates and to respond to any grievances. CEGCO also plan to continue their longstanding support within local communities via their many interactions and provision of support. It is expected that the placement of the new power plant will result in an informal education and information provision to local populations regarding the power plant and power sector. Particularly in regard to the interactions that CEGCO have with the local schools.

<u>Demand on local services</u>

It is possible that the operation of the project will result in the establishment of new business and potentially other industry in the local area due to the additional provision and reliability of power supply. This will may therefore likely have a positive impact upon services, including availability and increased diversity. Such services may include services directly linked to the power plant, supporting services for the local communities and other professional service options.

<u>Demand on Utilities</u>

The provision of utilities due to the operational phase will likely result in benefits locally, particularly due to the stability of power supply as a result of the power plant. In general, the proposed plant will improve the provision upon utilities locally as there will be less demand on groundwater resources, and fewer operational wastes than from the existing Hussein TPS. In general, there will be little demand upon utilities as the plants facilities will serve itself (i.e. on-site wastewater treatment plants).

Use of groundwater from the on-site wells as the primary raw water supply will reduce water diversion from potable sources, for users and other consumers in Jordan.

Natural gas and potable water supply are being provided for under specific fuel and water supply agreements from national service providers in Jordan. The provision of these services has been guaranteed and it is expected that these agreements have taken into consideration any additional requirements for water and natural gas that will be required because of the proposed plant, and will hence not result in deficits in supply elsewhere.

Table 11-7 Socio-Economic Significance of Operational Impacts

Impact	Magnitude	Justification
Employment Opportunities	**Minor Positive**	A small amount of permanent job creation will be available for skilled and unskilled positions, with a preference to local populations in recruitment policy. Benefits to other local businesses with potential new employment opportunities due to business expansions and new sectors that may arise.
Dissemination of skills	**Minor Positive**	Dissemination of know-how among the operation and maintenance work force including vocational skills associated with health, safety and environment knowledge.
Purchase goods and materials from the local / regional economy	**Minor Positive**	The project will generate demand for basic goods and services by the workforce and materials required for operation and maintenance, to be sourced in the first instance (where available) from the local/regional area.
Education of Locals	**Negligible Positive**	Locals to be well aquatinted and understanding enhanced regarding the project, and power generation. Particularly schools through ongoing support from CEGCO.
Demand on Local Services	**Minor Positive**	A long term positive impact is expected upon local services as a result to the project, with greater availability and diversity for such services, particularly due to expected new business from increased power availability locally.

Table 11-8 Socio- Significance of Operational Socioeconomic Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Employment Opportunities	Minor Positive	Employment	Medium	**Minor**
		Community Services	Medium	**Minor**
Purchase goods and materials from the local / regional economy	Minor Positive	Local / Regional Economy	Medium	**Minor**
Dissemination of Skills	Minor Positive	Education	Low	**Negligible to Minor**
Education of Locals	Negligible Positive	Education	Low	**Negligible to Minor**
Demand on Local Services	Minor Positive	Community Services	Medium	**Minor**

11.7 Mitigation & Management Measures

11.7.1 Construction

Table 11-9 Socio-Economic – Mitigation & Management Measures during the Construction Phase

Impact / Source	Mitigation Measure
Population Influx	Population influx will be minimised where possible by employment of local sub-contractors and populations at the construction phase. The projects recruitment policy will ensure a preference for local workers where suitable applicants and local companies are available.
	First Aid facilities and clinic room will be available to construction personnel on-site. This will reduce demand upon existing local services in regard to the additional population during construction.
Employment Opportunities	The EPC and Sub-Contractors HR Policy will be prepared to ensure consistency in line with local labour laws and international ILO and UN conventions. The EPC Contractor is to ensure that this is applied as an overarching policy for all sub-contractor company HR policy as part of their contractual arrangements.
Training and Dissemination of Skills	All project workers will receive induction training at the project, as well as vocational specific training for on-site construction works.
	All workers will receive training in regard to health and safety, as well as environmental awareness.
	Tool-Box talks will be conducted before work on each day to ensure workers are reminded of key topics.
Education of locals	CEGCO will continue their interactions and support within the community, particularly in regards to health check ups and support for schools. All aspects will provide the opportunity for informal education and dissemination of information.
	An information board for project related information will be erected at the project main entrance.
	Appropriate dialogue signage and notification will communicate any key construction related events to the local communities of Hashmiyeh (as applicable).
Demand on Utilities	Use of diesel generators on-site for electrical generation.
	Water will be sourced tankered supply, or bottled supply (for drinking).
	Site sanitary wastewater will be collected in septic tanks and removed by a licensed contractor for treatment off-site (i.e. locally at Al Samra WWTP)
	Licensed waste contractors will be engaged to remove all waste from the site for re-use, recycling, recovery or disposal off-site.

11.7.2 Operation

Table 11-10 Socio-Economic – Mitigation & Management Measures during the Operational Phase

Impact / Source	Mitigation Measure
Employment Opportunities	The projects recruitment policy will ensure a preference for local populations where appropriately skilled workers are available locally (or if unskilled positions are available).
	The HR Policy will be prepared to ensure consistency with the ACWA Power corporate policy which will ensure compliance with local labour laws and international ILO and UN conventions.
	It is recommended that key supply chains are monitored periodically during operations to ensure that material, goods and service providers do not employ forced or child labour, whilst ensuring the suppliers have a suitable occupational health and safety record.
Training and Dissemination of Skills	All plant personnel will receive induction training at the project, as well as vocational specific training for their duties.
	All workers will receive training in regard to health and safety, as well as environmental awareness. Training will be updated on a yearly basis as a minimum.
	Workers will be encouraged to develop their careers and may be provided with opportunities to attend training courses and other career development processes.
Education of locals	Appropriate dialogue signage and notification (e.g. by external notice boards) will communicate key operational related events.
Demand on Utilities & Services	The power plant will provide a highly significant local source of power that will provide enhanced stability to the local area in terms of electrical supply.
	As the project will not discharge process wastewater streams, the plant will re-use a significant portion of its treated wastewater, to reduce water consumption.
	Use of groundwater from the on-site wells will reduce water diversion from potable sources.
	Service and process water will be provided from the on-site reverse osmosis plant. Drinking water will be supplied via the water pipeline connection to the plant.
	Process wastewater streams will be treated at the wastewater treatment plants on-site, or evaporated.
	Licensed waste contractors will be engaged to remove all waste from the site for re-use, recycling, recovery or disposal off-site.

It is recognised that in addition to the above Mitigation & management measures, the project will also implement a Stakeholder Engagement Plan (SEP) separate to this ESIA that will incorporate robust methods for dialogue with the local communities and stakeholders. The SEP will include a grievance mechanism accessible to communities and any vulnerable groups.

11.8 Residual Impacts

11.8.1 Construction

Table 11-11 Socio-Economic – Residual Impacts – Construction Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact Significance
Population Influx	Moderate Negative	Community Services	Medium	Moderate	Yes	**Minor**
Employment Opportunities	Moderate Positive	Welfare of Local Population	Medium	Moderate	Yes	**Moderate**
		Local / Regional Economy	Medium	Moderate	Yes	**Moderate**
Training and Dissemination of Skills	Minor Positive	Welfare of Local Population	Medium	Minor	Yes	**Minor to Moderate**
		Local / Regional Economy	Medium	Minor	Yes	**Minor to Moderate**
Education of Locals	Negligible Positive	Welfare of Local Population	Medium	Negligible to Minor	Yes	**Minor**
Demand on Local Services	Moderate Positive	Welfare of Local Population	Medium	Moderate	Yes	**Moderate**

11.8.2 Operation

Table 11-12 Socio-Economic – Residual Impacts – Operational Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact Significance
Employment Opportunities	Minor Positive	Employment	Medium	Minor	Yes	**Minor to Moderate**
		Community Services	Medium	Minor	Yes	**Minor to Moderate**
Purchase goods and materials from the local / regional economy	Minor Positive	Local / Regional Economy	Medium	Minor	Yes	**Minor to Moderate**
Dissemination of Skills	Minor Positive	Education	Low	Negligible to Minor	Yes	**Minor**
Education of Locals	Negligible Positive	Education	Low	Negligible to Minor	Yes	**Minor**
Demand on Local Services	Minor Positive	Community Services	Medium	Minor	Yes	**Minor**

12 TRAFFIC AND TRANSPORT

12.1 Introduction

This chapter of the ESIA focuses on the transportation related impacts associated with the construction and operation of the proposed CCGT Project. The baseline transportation infrastructure within the region and particularly within the immediate vicinity of the project is described. Consequently, the impacts from the increased traffic generated by the construction and operation phases of the project have been considered. Where necessary and possible, opportunities to pursue measures to minimise and / or mitigate any impacts have been developed and put forward.

12.2 Methodology

The baseline analysis of this chapter is principally desk based, drawing from the technical proposal for the project, and on-site observations from the various the site visits completed to date. Further to the establishment of baseline conditions, the impact of the development on the surrounding transport infrastructure is evaluated.

As the development will have differing impacts throughout the lifecycle of the project, we have structured our analysis to reflect the key development stages of construction and operation. The analysis in this chapter deals solely with primary transport impacts, namely demands placed on transportation infrastructure by the development. Issues relating to secondary impacts arising from the transportation needs of the development, such as noise, are dealt with separately in the relevant chapters of this report.

The impacts upon transportation from the new access point to the project site and the installation of the WAJ water pipeline associated facility have also been assessed in this chapter.

12.3 Environmental Legislation

Jordanian Requirements

The applicable law in relation to vehicles and traffic in Jordan is the Traffic Law (Law No. 49 of 2008), which was revised in its 2008 version with an emphasis to reduce road traffic related incidents, injuries and fatalities within Jordan. Additionally, the following transportation related laws should be considered:

- Regulations for the Registration and Licensing of Vehicles No. 104 for 2008;
- Regulation for Maximum Dimensions, Weights and Total Engine Power for Vehicles No. 42 of 2002; and
- Instructions for Allowable Speed Limits for 2002.

European (EBRD) Requirements

The EBRD PR 4 on Health and Safety establishes management requirements with regards to traffic and road safety risks to workers and potentially affected communities. Relevant EU road and traffic safety management standards must therefore be taken into consideration.

International (IFC) Requirements

The assessment will be undertaken with due consideration of the recommendations set out within the IFC/World Bank General EHS Guidelines (2007) Section 3.4 Traffic Safety, within Section 3: Community Health and Safety.

12.4 Baseline

Direct access to the existing Hussein TPS is made via the service exit from Highway 25 to the west of the site. Links to Amman are available from this road and adjoining highways to the south, which run through and also bypass Zarqa. A new more direct highway from the airport to Zarqa is currently under construction which will likely reduce travelling time to the Hussein TPS from the airport considerably.

The key local roads around the project site are indicated below on the satellite image. Highway 25 runs to the west of the project and the key local road which will provide future access to the new project entrance runs to the north.

Figure 12-1 Local Roads at and around the Project Site

Satellite Image Source: Google Earth

Observations of the local roads during the site visits have identified a general poor condition of the roads, with uneven surfacing, potholes, unmarked speed humps, as well as many unsigned exits and junctions. The vehicle flows on the roads appeared to be busy, but not congested during observation periods. Vehicles in the local area included multiple fuel trucks which are associated with the adjacent petrochemical refinery.

Plate 12-1 Highway 25 in Foreground

The poor road conditions and lack of sufficient road markings and signage is anticipated to increase the potential for accidents locally. The transport of fuels locally also increases the potential magnitude of this risk.

Roads within the existing Hussein TPS are paved and are generally of a better quality than those on surrounding public areas. A strict speed limit of 20Km/h is enforced across the Hussein TPS area.

Plate 12-2 Road within Existing HTPS

12.5 Sensitive Receptors

Table 12-1 Traffic and Transport – Receptor Sensitivity

Receptor	Sensitivity	Justification
Highways	High	The main highway linking Amman to the north eastern governorates, well used by commercial and private vehicles. Old, poor maintenance, poor signage and poor traffic management negatively affect the driving conditions.
Local roads	High	The majority of local roads are old and poorly maintained. Adequate signage is lacking and poor traffic management is exacerbating the driving conditions.

12.6 Significance of Impacts

12.6.1 Construction

Two aspects of transport during construction can potentially generate impacts: The transport of the workforce and the transport of equipment and materials to the site.

The major components for the construction of the plant are equipment that cannot be assembled in-situ. Therefore, it has to be transported to the site in its built form. Such equipment and materials are likely to be transported by specialised vehicles that may be oversize or may haul containers. It is expected that a significant portion of the materials will arrive by road, but that an amount of equipment may also require shipping, prior to final delivery by road. Where materials and equipment are shipped, they will go via Aqaba port, and will then require road hauling to the site via the national highway network. The exact route the construction vehicles will take to reach the site is not known, however all vehicles will eventually need to use Highway 25 and the local access road to the immediate north of the project site in order to enter via the site access point.

The quantity of construction related vehicles will vary dramatically during the construction phase depending on the intensity of construction. It is estimated that up to 100 HGV will enter and depart the site per day during peak periods, along with minibuses to shuttle workers and private cars for certain staff and specialist contractors.

It is expected that all vehicles coming to the project site will use the national highway network. Therefore, construction activities are likely to lead to an increase in vehicle numbers and traffic on the highways and potentially on the future proposed new highway; where equipment and workers come via air transportation from Queen Alia International Airport. However, due to the existing high vehicle and HGV flows on the highway networks, particularly close to the site, the increase in such vehicles is not likely to be perceptible.

Any dangerous goods shall be transported following the current international standards and codes for transport of special merchandise, applying for the relevant permits with the Jordanian authorities and assessing the safety and environmental risks.

A new access point to the Hussein TPS is being constructed specifically for the proposed project, to enable a dedicated access to the project once it is fenced off from the existing HTPS plant. Due to the new access, all construction vehicles will need to travel approximately

500m from the highway along a local road to the new entrance. The existing flows on this local road are much lower in comparison to the highway. As the existing local road links the highway to the local industrial/commercial area (immediately north of the power block area) it does currently have a small flow of vehicles, including HGV's. However, due to the expected intensity of construction activities, the increase in construction vehicles may be noticeable, however it is not expected to result in congestion due to the existing low vehicle flows and lack of junction and signals around the new project site access.

During the construction phase, the water pipeline to provide potable water supply to the project will be installed by the Water Authority of Jordan (WAJ). Although the pipeline route is not finalised, it is understood that the routing will come from an existing water main and spur to the site along the existing road network locally. The length of the spur from the main water pipeline is not expected to be particularly long but will require excavation works on local routes in order to reach the project site. Such excavation works are expected to be undertaken in the less frequented and less trafficked commercial areas to the north of the proposed power block area (it is understood that the main water pipeline runs through this area). During such activities there may be an amount of daytime traffic disruption to the local routes whilst the pipeline is installed sub-surface. The specific nature of such impacts will not be known until WAJ implement their construction plan, however it is expected that this may relate to lane closures and the use of traffic management (e.g. temporary traffic lights) to maintain a flow of vehicles in both directions along the local roads. Such traffic management may result slightly increased journey times along local routes, however, the likely staged nature of such works will reduce the impacts to a great extent.

Table 12-2 Traffic and Transport – Magnitude of Construction Impacts

Impact	Magnitude	Justification
Increased vehicles on highways	Minor	Minor direct but temporary impacts to volume and traffic flow.
Increased vehicles on local roads	Moderate	A likely noticeable but temporary increase of vehicles on the local road to the new site access.
Delays on Local roads due to water pipeline installation	Minor	Traffic management for the installation of the water pipeline may result slightly increased journey times along local routes.

Table 12-3 Traffic and Transport – Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Increased congestion highway	Minor	National Highway	High	Minor to Moderate
Increased congestion and local roads	Moderate	Local roads	High	Moderate to Major
Delays on Local roads due to water pipeline installation	Minor	Local roads	High	Minor to Moderate

12.6.2 Operation

Project related vehicles movements will revert back to a similar flows experienced during the operation of the original Hussein TPS, which closed in December 2015. Since December 2015 vehicle flows have not varied significantly as there are still various works on going to manage on-site facilities and other CEGCO departments based at the existing HTPS landholding.

The key change to traffic, is that project vehicles will enter the site via the new entrance to the north of the back up storage tank area.

Essentially, the relatively small workforce and the small amounts of supplies that are expected to be required in the operational phase of the plant are expected to represent an impact of negligible negative significance.

Table 12-4 Traffic and Transport – Magnitude of Operation Impacts

Impact	Magnitude	Justification
Increased vehicles on highways	Neutral	Few and infrequent equipment and supplies will be transported over long distances
Increased vehicles on local roads	Neutral	Small permanent work force, working in shifts, will result with little increase in traffic on the local roads.

Table 12-5 Traffic and Transport – Significance of Operation Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Increased vehicles on highways	Neutral	National Highway	High	Neutral
Increased vehicles on local roads	Neutral	Local roads	High	Neutral

12.7 Mitigation & Management Measures

12.7.1 Construction

Table 12-6 Traffic – Selected Mitigation & Management Measures for Construction

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Increased vehicles on Highways and Local Roads	A transport plan will be developed to indicate designated access routes, site entrance points, waiting and parking areas etc. The plan will outline how construction traffic will be managed to limit impacts upon local communities, on-site personnel, and other road users. The traffic management plan will be developed to ensure that road safety concerns are addressed. The plan should detail what routes will be taken for any specialist deliveries (i.e. oversize vehicles). The plan needs to identify specific requirements such as any diversions required for road types, bridge capacities, weight restrictions, overhead line (if an issue) etc., as well as any required traffic management for local traffic.	Contractor	CESMP – planning and managem ent
	EPC staff and Labourers will be transported by buses to reduce vehicle movements and trips. Car pooling will be encouraged for all other construction staff to reduce the number of vehicles on highways and local routes.	Contractor	CESMP – planning and managem ent
	Key trips to the site will be scheduled outside of peak traffic flow hours.	Contractor	CESMP – planning and managem ent
	Staggering key deliveries or periods of high vehicle movements to the site will ensure that additional vehicle presence on local and site roads is minimised, whilst reducing waiting times for drivers and over demand on receiving staff at the site.	Contractor	CESMP – planning and managem ent
	Designated routes will be made clear to the drivers and signs for the directions and speed limit will be placed all along the roads.	Contractor	CESMP – planning and managem ent
Delays on Local roads due to water pipeline installation	It is expected that the contractors for the WAJ pipeline installation will implement traffic management to ensure road safety and to regulate flows of vehicles during lane closures.	WAJ Contractor	-

12.7.2 Operation

Table 12-7 Traffic – Selected Mitigation & Management Measures for Operation

Impact/ Source	Mitigation Measure	Responsibility	Schedule
Increased vehicles on local roads and highways	Wherever possible waste removal will be scheduled outside of peak periods	O&M	OEMP – Planning and Management
	Develop a traffic management plan which identifies preferred access routes and times for HGVs within the project.	O&M	OESMP – Planning and Management

12.8 Residual Impacts

12.8.1 Construction

Table 12-8 Traffic and Transport – Residual Impacts – Construction Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact
Increased vehicles on highways	Minor	National Highway	High	Minor to Moderate	Yes	Minor
Increased vehicles on local roads	Moderate	Local roads	High	Moderate to Major	Yes	Moderate
Delays on Local roads due to water pipeline installation	Minor	Local roads	High	Minor to Moderate	Yes (Expected)	Minor

12.8.2 Operation

Table 12-9 Traffic and Transport – Residual Impacts – Operation Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact
Increased vehicles on highways	Neutral	National Highway	High	Neutral	Yes	Neutral
Increased vehicles on local roads	Neutral	Local roads	High	Neutral	Yes	Neutral

13 CULTURAL HERITAGE AND ARCHAEOLOGY

13.1 Introduction

This chapter considers the potential cultural heritage and archaeology impacts which could potentially occur during the construction phase of the proposed CCGT Project.

The cultural heritage and archaeological assessment takes into account that archaeological and cultural resources are finite and therefore consideration for their preservation will always be addressed. In addition, cultural and historical sites are an important value for the tourism activities in Jordan and Zarqa Governorate.

For the purpose of this assessment, these resources may include, but not be limited to:

- Archaeological remains, buried and/or above ground;
- Historical structures and sites e.g. tombs or forts; and
- Any other structure of archaeological and/or cultural/historical significance.

Where appropriate, Mitigation & management measures to minimise or prevent potential risks to cultural heritage and archaeology have been provided.

This chapter provides an overview of existing information and guidelines for handling artefacts or sites of cultural and archaeological significance, which will be used in the event that such artefacts are discovered during the construction phase.

13.2 Methodology

<u>Desk-Based Study</u>

The purpose for conducting the desk-based assessment is to identify any relevant historic sites or the location of any artefacts on the site or the surrounding study area (including the presence or absence, character, extent, date, integrity, state of preservation and relative quality of the potential archaeological resource). The desk-based study consisted of an internet search on the MEGA-Jordan website, (the official website of the Jordanian Department of Antiquities), the collation of existing written, graphic, photographic and electronic information in order to identify the likely character, extent, quality and worth of the known or potential archaeological resource at the site in a local, regional, national and international context.

<u>Site Walkover</u>

In order to complement the information gathered during the desk-based study, a site visit was undertaken to identify the presence of any above ground archaeological structures, deposits and /or antiquities. The results and findings are discussed below.

13.3 Applicable Legislation

<u>Jordanian Requirements</u>

The Antiquities Law No. 21 of 1988 and its amendment No. 23 for 2004 is the main law concerning cultural heritage in Jordan and outlines the management measures to protect and conserve the archaeological richness of Jordan. The relevant requirements within the Law include the following:

- The excavation within a distance less than 1 km from an archaeological location is banned (Article 3);
- A project location must be free from any archaeological materials, before any excavations, in order to avoid any penalty defined by this law.

<u>European (EBRD) Requirements</u>

The EBRD PR 8 for Cultural Heritage outlines requirements for the protection, management and sustainable use of tangible and intangible cultural heritage. The requirements mainly focus on the assessment process, the management of impacts (including a chance finds procedure) and the consultation with affected communities and other stakeholders.

<u>International (IFC) Requirements</u>

In accordance with the Equator Principles' requirements for projects located in non-OECD countries (as defined by the World Bank Development Indicators Database), the assessment will refer to applicable IFC Performance Standards on Social and Environmental Sustainability, specifically with due consideration of IFC Performance Standard 8 on Cultural Heritage.

13.4 Baseline

Jordan has a wide range of archaeological sites of significance, the most notable sites being Petra (UNESCO World Heritage Site), the ancient city of Jerash, the Roman Theatre and other remains in Amman, the Byzantine site of Um er-Rasas (UNESCO World Heritage Site) and Wadi Rum (UNESCO World Heritage Site) amongst others.

Zarqa Governorate has a long heritage including the occupation by different civilisations dating back to the bronze age. Sites of historical relevance are briefly described below.

Qasr Al-Hallabat

The complex is originally a Roman fortress constructed under Emperor Caracalla to protect its inhabitants from Bedouin tribes. The site dates to the second and third century AD, although there is trace evidence of Nabatean presence at the site. It was one fort of many on the Roman highway, Via Nova Traiana, a route that connected Damascus to Aqaba by way of Petra and Amman. However, by the eighth century, the Umayyad caliph Hisham ordered the demolition of the Roman structures in order to redevelop this military site and its neighbouring territory to become one of the grandest of all Umayyad desert complexes.

Hammam As-Sarakh

The bath is located approximately two kilometres east of al Hallabat. The main site is known as Hammam as-Sarakh and consists of a rectangular audience hall, and a bath.

Qusayr Amra (UNESCO World Heritage)

Umayyad Palace, featuring the throne room, rooms, and bathrooms, it was built by -Waleed bin Abdul Malik, containing beautiful murals that adorn the ceiling and the walls of the palace rooms and bathrooms.

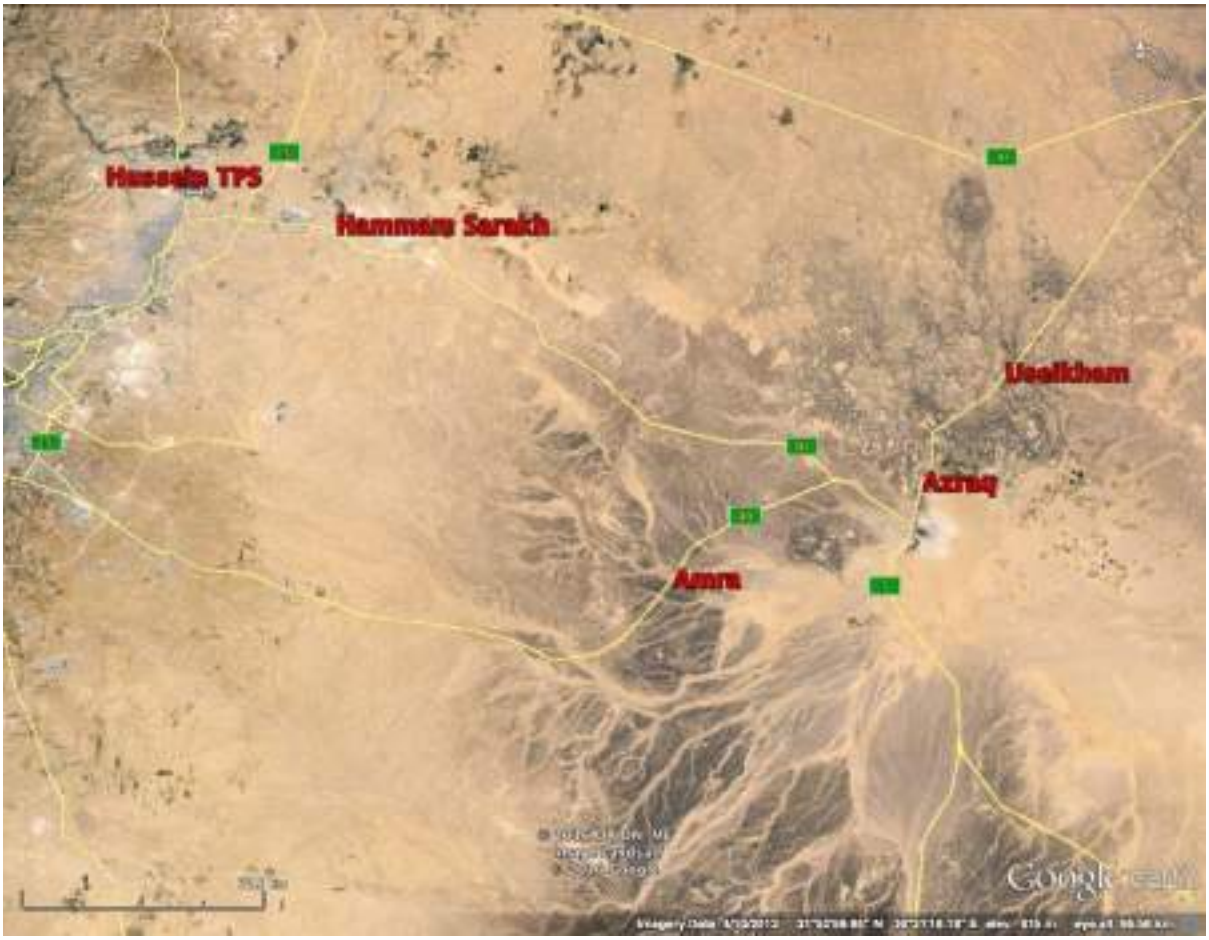
Useikhem Palace

Located about 20 km northeast of Azraq town, the Roman castle belonging to the limes arabicus is situated on a cone-shaped orographic mount built from limestonenite overlaid with basalt stratifications. The hill on top of which rises the castle, is called Jebal Aseikhim. The hill top may have been used first by the Nabataeans in the 1st Century AD, as an Observation post to monitor traffic in and out of Wadi Sirhan.

Azraq Castle

Azraq Castle is one of the historic desert castles. It is located in the village of North Azraq. The castle is solidly constructed out of black basalt, it dates back to the Greece period, and was used as one of the armies' camps of the Arab Revolt, then inhabited by Druze after their migration from Jabal al-Arab after the Syrian revolution.

Figure 13-1 Listed archaeological sites in Zarqa Governorate



Satellite Image Source: Google Earth

Qasr Al-Hallabat and Hammam As-Sarakh are the two closest sites to the proposed power station, and are over 20km east of the project site.

Whilst undertaking the preliminary site visits, no general signs or visual evidence of cultural/archaeological features have been identified (based on walkovers over the past 4 years and knowledge of site personnel). Therefore, given the lack of any materials or structures that could be used to substantiate the claim of a cultural or archaeological site, it is unlikely that the proposed project plot contains any resources of cultural or archaeological value.

Despite this, the MEGA-Jordan website does identify a feature within the wider HTPS landholding, but approximately 300m from the project site. The feature is not identifiable on the website (MEGA Number: 18266), with no reference to its presence on the database or what it is.

Figure 13-2 Archaeological Database Screenshot – megajordan.org

Source: megajordan.org

Finally, according to the consultations undertaken for the ESIA, no indication was provided suggesting that the proposed project is located within or adjacent to any areas of archaeological or cultural significance.

13.4.1 Associated Facilities

In regard to the potential routing of the projects associated facilities, it is recognised from site walkovers and review of available baseline information (e.g. MEGA Jordan) that there are no known or visible features of cultural or archaeological significance along the routes provided.

13.5 Sensitive Receptors

The table below outlines the identified receptors in relation to cultural heritage and archaeology as well as the determined sensitivity of those receptors.

Table 13-1 Culture and Archaeology - Receptors sensitivity

Receptor	Sensitivity	Justification
Potentially unidentified archaeological sites	Medium	There is no evidence of any archaeological sites onsite. However if discovered, any such features could potentially be of regional or national importance

13.6 Significance of Impacts

13.6.1 Construction

For the reasons outlined in the baseline, it is considered unlikely that potential impacts of cultural or archaeological value will occur during the construction phase. This relates to the lack of any known or visible cultural or archaeological receptors in the site working area.

No archaeological or cultural receptors have been identified from the visits to the routing of the associated facilities. Impacts along the associated facility gas pipeline route may occur, but are considered likely, due to the placement of the pipeline in the managed wadi channel that also has an existing sewerage line adjacent. Impacts relating to the placement of water pipeline are also not expected as this will be laid under existing road infrastructure,

In the event that earthworks during the construction phase uncover unidentified sources of archaeological or cultural heritage, this will result in an impact of major negative significance prior to the implementation of Mitigation & management measures.

Table 13-2 Culture and Archaeology – Magnitude of Construction Impacts

Impact	Magnitude	Justification
Destruction of unknown archaeological remains onsite & at associated facilities	Moderate	Construction activities could cause the destruction of archaeological remains onsite, resulting in permanent loses of the archaeological features.

Table 13-3 Culture and Archaeology – Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Destruction of unknown archaeological remains onsite & at associated facilities	Moderate	Potentially unidentified archaeological sites	Medium	Moderate

13.6.2 Operation

It is not considered that any significant impacts upon archaeological or cultural resources will occur during the operational phase, as this phase of the project will not include further earthworks.

Should further excavation on the site be required, the Mitigation & management measures mentioned previously for the construction phase will be followed, including the chance finds procedure, which should be detailed in the O&M Company's OESMP.

13.7 Mitigation

13.7.1 Construction

The EPC contractor will be required to prepare a CESMP before commencing construction works, which will consider the potential for unearthing historical sites or artefacts.

The EPC contractor is expected to implement appropriate measures for chance find procedures which are standard requirements by the DoA as required by the "Antiquities Law No. 21 for 1988 and its amendments No. 23 for 2004". Those mainly require that construction activities be halted and the area fenced, while the contractor Site Manager immediately notifying the DoA. No additional work will be allowed before the Department assesses the found potential archaeological site and grants a clearance to resume the work. Construction activities can continue at other parts of the site if no potential archaeological remains were found. If found, same procedures above apply

In addition, the EPC will also be required to follow and consider the Standards and Guidelines for an Archaeological Watching Brief, Institute of Field Archaeologists, Revised Version, 2008. The Archaeological Watching Brief is a formal programme of observations and investigations that are carried out for non-archaeological projects. It can be undertaken in any site where possibilities to find any archaeological deposits exist.

Training and awareness programmes will be provided to ensure that construction staff and labourers are aware of the procedures relating to the Archaeological Watching Brief will any artefacts or anthropogenic finds be uncovered.

13.7.2 Operation

Although objects of archaeological value are not expected to be discovered during the operational phase of the project, the chance finds procedure outlined for the construction phase (as above) shall be followed and included to the site-specific OESMP.

13.8 Residual Impacts

13.8.1 Construction

Given that no evidence of sites of historical or archaeological value has been observed in the area, the risk of uncovering any archaeological resources is considered very low. Equally, the implementation of the above mitigation procedures will help minimise any impact that may occur to an acceptable level.

Table 13-4 Culture and Archaeology – Residual Impacts – Construction Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact Significance
Destruction of unknown archaeological remains onsite & at associated facilities	Moderate	Potentially unidentified archaeological sites	Medium	Moderate to Major	Yes	Negligible

14 LANDSCAPE AND VISUAL

14.1 Introduction

Impacts upon the landscape typically occur in situations where the visual horizon is disturbed by a development. Such impacts may include the anthropogenic intrusion of the landscape by buildings/structures where no intrusion previously existed; or the change in the landscape character of an area, which could arise from new/out of place development or from changes in the land use.

Visual impacts may occur when the line of sight to and/or from a receptor (e.g. residential areas, area of natural beauty) is intersected or blocked.

Visual and landscape impacts are relevant to this project, given the scale of the major components of the power station.

14.2 Applicable Legislation

Specific legislation or standards in regard to landscape and visual impacts does not exist, however the assessment of the baseline and impacts relating to such impacts has been undertaken with reference to the guidelines set out by the UK Landscape Institutes 'Guidelines for Landscape and Visual Impact Assessment, 3rd Edition' (2013).

14.3 Baseline

The area of the proposed project site is located within the existing HTPS landholding in the industrialised area to the north of the city of Zarqa. Due to the other industries in the area, the proposed site is situated in a landscape consisting of large industrial superstructure buildings, chimney stacks, storage tanks, machinery, vehicles and visible air pollution (e.g. vapour plumes, particulates and gases from the petrochemical refinery). The immediate landscape can be described as a mix of industrial, commercial and residential areas, within low rising hills characterised by exposed crests, gentle slopes and small wadi valleys. Sporadic vegetation is present in the form of shrubs, which are found in higher abundances in the wadi valleys.

The proposed project will be located at the lowest point of the existing HTPS landholding and is at one of the lowest points in the surrounding area. At this location, several nearby properties overlook the project area from the gentle slopes to the north. The view of the site from the south is obstructed by other slopes and the NEPCO training facility, while the view to the west is currently obstructed by the elevated existing HTPS turbines, boilers and HFO tanks, which are built on fill material.

Specific designations in regard to landscape character of areas of landscape beauty have not initially been identified in the local project area.

This chapter presents a number of photos that have been taken on and surrounding the proposed PROJECT, to provide an indication of the landscape and visual characteristics.

Plate 14-1 View Across Proposed ACC Area and Power Block Area to North East

Plate 14-2 View across proposed GT/HRSG/ST Area to the East

Plate 14-3 View over GT/HRSG/ST Area to the West

Plate 14-4 View across proposed fuel and water storage tank area towards north west

Plate 14-5 View over proposed evaporation pond area to the west

Plate 14-6 View from community to north to the Existing Hussein TPS and Refinery

Plate 14-7 View to north over the existing Hussein TPS from CEGCO Accommodation

14.4 Sensitive Receptors

The relevant landscape and visual receptors to the proposed PROJECT site are located immediately surrounding and to the north of the proposed project site. The area to the south is generally blocked by the local topography and also by the existing HTPS structures.

The table below outlines the identified receptors in relation to landscape and visual impacts as well as the determined sensitivity of those receptors.

Table 14-1 Landscape and Visual – Receptor Sensitivity

Receptor	Sensitivity	Justification
NEPCO Training Centre	Low	This facility is located immediately overlooking the site to the south and is industrial in nature and appearance. The workers are only present during the day.
Residential Neighbourhood	High	Residents are mostly located to the northwest of the project site and hills mostly block their view of the station (Hashmiyeh).

14.5 Significance of Impacts

14.5.1 Construction

One of the first stages of construction activities will result in the levelling and preparation of the site, before the commencement of construction. The proliferation of such activities throughout the construction period and across the site will add to the existing industrial appearance of the site. Therefore, the wider landscape character will not be significantly affected by the addition of these industrial plant and activities, given that the area is largely industrial. Additionally, it should be noted that the proposed project will be built entirely within the existing HTPS landholding which is a significantly larger and more obtrusive facility.

The movement of heavy construction vehicles and earthworks on loose surfaces may result in dust generation with a potential resulting dust haze disturbing the visual envelopes of local receptors.

Although not expected, at certain stages during the construction phase, some night-time works may take place which will likely require floodlighting. If not mitigated, this could have a minor negative impact on local road users and residents, given that existing security lighting is already in place.

Temporary impacts relating to the construction phase will mostly affect the residential areas to the north. Movement of vehicles, dust, laydown areas, and the various construction activities and processes will be directly visible. However, the existing solid perimeter wall will help to minimise the visual impact.

Table 14-2 Landscape and Visual – Magnitude of Construction Impacts

Impact	Magnitude	Justification
New features in the landscape	Minor	New features in the landscape will minimally impact the landscape character, and they will not adversely affect the integrity of it in respect to the surrounding area which is already industrial.
New features impacting views	Minor	New features will partially impact views from receptors, however they will not result in significant changes of the existing key views.
Light Pollution	Minor	Construction floodlights will increase the illumination in the area, although the background lighting is already high.

Table 14-3 Landscape and Visual – Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
New features in the landscape	Minor	NEPCO Training Centre	Low	Negligible or Minor
		Residential Neighbourhood	High	Minor
New features impacting views	Minor	NEPCO Training Centre	Low	Negligible or Minor
		Residential Neighbourhood	High	Minor
Light Pollution	Minor	NEPCO Training Centre	Low	Negligible or Minor
		Residential Neighbourhood	High	Minor

14.5.2 Operation

The proposed power plant will ultimately not result in a significant change to the existing industrialised and commercial landscape in North Zarqa. The existence of the original HTPS for over 40 years as well as the local petrochemical refinery and steelworks has gradually changed the local landscape to an industrial and commercial character.

Over time humans have frequented the local areas and established residences and commercial activities surrounding these industries to benefit from their activities and to provide supporting services (e.g. via business and workforce). It is expected that besides the new power plant facility, the local landscape may result in further development of such supporting services due to an increase in power production, as well as a more stable power supply. Such changes in landscape as a secondary reaction to the power plant will likely occur over a number of years and be very gradual.

The addition of new structures, power generating equipment, and stack structures, may impact the views onto the site from overlooking receptors. However, Impacts are expected to be minor given that current views onto this site are of an industrial nature and the extent of views is limited due to the hill slopes and NEPCO training centre to the immediate south of the proposed site.

Vies of the site from the north will encounter a wall of significant height for the noise barrier. The noise barrier is expected to be 10m in height and therefore may restrict views of the power plant power block facilities. It is understood that the upper section of the noise barrier will be transparent to reduce impacts upon the visual receptors.

Table 14-4 Landscape and Visual– Magnitude of Operation Impacts

Impact	Magnitude	Justification
Influence on Landscape Character Use	Negligible	The proposed facility will be within the existing Hussein power station boundary and will not result with a cumulative impact on the landscape character.
Impact upon Visual Amenity of Receptors	Negligible	The site is most visible to the residents from the north and from the main access road, but will be blocked to an extent by the noise barrier around the power block area. However, the new plant will blend into the existing buildings and stacks.
Night Time Lights	Minor	The additional lighting of the project, will have a minor cumulative impact on the sensitive receptors.

Table 14-5 Landscape and Visual – Significance of Operation Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Influence on Landscape Character Use	Negligible	NEPCO Training Centre	Low	Negligible
		Residential Neighbourhood	Medium	Negligible or Minor
Impact upon Visual Amenity of Receptors	Negligible	NEPCO Training Centre	Low	Negligible
		Residential Neighbourhood	Medium	Negligible or Minor
Night Time Lights	Minor	Residential Neighbourhood	Medium	Negligible or Minor

14.6 Mitigation & Management Measures

14.6.1 Construction

Table 14-6 Landscape and Visual – Selected Mitigation & Management Measures for Construction

Impact	Mitigation Measure
New features in the landscape	Where appropriate, construction laydowns and working areas on and off the site shall be screened to reduce the visual intrusion to existing off site receptors. When not in use, cranes and other construction plant hall be lowered, so they are at their minimum height and do not protrude unnecessarily within the visual envelope of local receptors.
New features impacting views	Mitigation & Management Measures relating to the generation of dust (as detailed in the air quality mitigation section) shall be implemented to ensure that visual impacts are not caused through construction activities.
Light Pollution	Any flood lights required during night time will be directed onto the working areas, with a maximum position angle of 30° from vertical, and back spill shields, therefore minimising any unwanted light spill and impacts at night.

14.6.2 Operation

Table 14-7 Landscape and Visual – Selected Mitigation & Management Measures for Operation

Impact	Mitigation Measure
Influence on Landscape	Although the project is located within a developing industrial Zone, efforts shall be made to soften the landscape character impacts, this will include the planting of endemic vegetation in appropriate areas such as the project boundaries, to soften the landscape impacts. The noise barrier at the project site will have a transparent upper section to limit the impacts upon local visual receptors
Impact of Lights	Lighting provision shall not be excessive or unnecessary. Minimise lighting intensity (lumens below 4050). Light fittings shall be directional as deemed appropriate for their use and intended areas of illumination. Lighting column and lighting head design should be chosen to limit back spill and any unwanted light spill to other site areas or, those areas off the site. Minimise illumination of building facades for aesthetic purposes. Lighting should not cause reflected glare from site buildings.

14.7 Residual Impacts

14.7.1 Construction

Table 14-8 Landscape and Visual – Residual Impacts – Construction Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact
Topographical impacts to landscape	Negligible	NEPCO Training Centre	Low	Negligible	No	Negligible
		Residential Neighbourhood	Medium	Negligible or Minor		
New features in the landscape	Minor	NEPCO Training Centre	Low	Negligible or Minor	Yes	Negligible
		Residential Neighbourhood	Medium	Minor	Yes	Negligible
New features impacting views	Minor	NEPCO Training Centre	Low	Negligible or Minor	Yes	Negligible
		Residential Neighbourhood	Medium	Minor	Yes	Negligible
Light Pollution	Minor	NEPCO Training Centre	Low	Negligible or Minor	Yes	Negligible
		Residential Neighbourhood	Medium	Minor	Yes	Negligible

14.7.2 Operation

Table 14-9 Landscape and Visual– Residual Impacts – Operation Phase

Impact	Magnitude	Receptor	Sensitivity	Impact Significance	Mitigation	Residual Impact
Influence on Landscape Character Use	Negligible	NEPCO Training Centre	Low	Negligible	No	Negligible
		Residential Neighbourhood	Medium	Negligible or Minor		
Impact upon Visual Amenity of Receptors	Negligible	NEPCO Training Centre	Low	Negligible	Yes	Negligible
		Residential Neighbourhood	Medium	Negligible or Minor		Negligible
Night Time Lights	Minor	Residential Neighbourhood	Medium	Negligible or Minor	Yes	Negligible

15 COMMUNITY HEALTH, SAFETY & SECURITY

15.1 Introduction

Project related activities can result in the increase of risks associated to the local communities who live and work in the areas of impacts surrounding projects. In particular, certain projects may have specific impacts upon vulnerable groups, which need to be assessed.

15.2 Methodology

This chapter has been specifically included to outline and assess the impacts relating to the safety and security of the local community who live and work in the surrounding area and may be subject to project related impacts.

The majority of secondary impacts relating to the local community in terms of air quality, noise, wastewater, waste etc., have been addressed in specific chapters elsewhere in this ESIA. This chapter therefore concentrates more specifically on the potential emergency impacts that could relate to the project and the security of the project to avoid instances of trespass, or other misdemeanours.

The methodology aims to cover the lender requirements for community safety and security (as below) as well as the general Jordanian requirements.

Specifically, the 'Emergency Preparedness and Response Plan' for the project will ensure many risks relating to the projects construction and operation are covered in regard to community safety and security, whilst outlining what response will be taken for certain situations. The 'Emergency Preparedness and Response Plan' will be prepared by the EPC Contractor and O&M Company for the constriction and operational phases of the project respectively.

15.3 Applicable Legislation

The applicable environmental Legislation in relation to socio and economic issues which will be considered as part of the ESIA include the following:

Jordanian Requirements

- Public Health Law No. 47 for 2008
- Environmental Protection Law No. 52 of 2006

Lender Requirements

<u>EBRD</u>

The application of EBRD's performance requirements to the ESIA will ensure that social and economic impacts are fully assessed with suitable provision for the management of identified potential impacts. The notable PR's that will apply to this project include:

- Performance Requirement 4: Health and Safety;
- Performance Requirement 10: Information Disclosure and Stakeholder Engagement.

The construction phase may present an unwanted opportunity for local communities to access the site, in terms of trespassing, with associated risks to those working at the site and those who are trespassing. Under such circumstances there is potential for incidents to occur particularly as the construction site is a high risk areas and should only be accessed by trained personnel who are wearing adequate personal protective equipment.

IFC

The following applicable IFC Performance Standards aim to identify and ensure that social and economic impacts of a project are addressed in the relevant areas, in particular:

- Performance Standard 4: Community Health, Safety and Security;

IFC's EHS Guidelines for Thermal Power Plants also address industry-specific impacts on the social and economic aspects of the site and surrounding context, specifically:

- Occupational Health and Safety; and
- Community Health and Safety.

15.4 Significance of Impacts

15.4.1 Construction

All construction projects have potential risks relating to public safety that could arise, particularly in regard to the use of high powered equipment, heavy construction plant, excavations, transportation amongst others, including fire and pollution releases.

Public risks during construction have the potential to result in isolated incidents, which could be of a devastating magnitude to a person or group of people in the wrong place at the wrong time. Unlike the operational phase, there is less opportunity of widespread risks that could potentially affect the wider communities and environment as a single event (e.g. large scale oil spills, spontaneous combustion of fuels, dust, explosions etc.).

Risks to public safety will be appropriately addressed and prepared in the construction phase 'Emergency Preparedness and Response Plan' and training.

The construction phase may present an unwanted opportunity for local communities to access the site, in terms of trespassing, with associated risks to those working at the site and those who are trespassing. Under such circumstances there is potential for incidents to occur particularly as the construction site is a high risk areas and should only be accessed by trained personnel who are wearing adequate personal protective equipment.

Please Note: Due to public safety being a risk rather then a potentially defined impact, its significance is not assessed further in this ESIA. Risks to public safety will be managed through effective emergency and disaster planning and the communication of these plans with the local communities via relevant communication channels and dialogue, as per the project specific Stakeholder Engagement Plan.

Exposure to Disease

For construction, workers will likely be mixed between local populations (predominantly for subcontractor staff) and expatriates (EPC staff). Workers will be in close proximity to nearby communities both at the site and at their camp location (e.g. <200m from residences at both locations). Due to the close proximity of works with external communities and the dense nature of the project site and accommodation, there is potential for disease to spread internally and externally.

Security Personnel

The project constitutes a facility of national importance and will employ security personnel through the construction period.

SEPCO III have prepared a security risk assessment, which is presented in Appendix T.

Specifically, SEPCO III have confirmed that security arrangements be guided by UN Code of conducts for law enforcement officials and UN basic principles on the use of Force and Firearms by law enforcement officials.

Besides the above, security personnel will receive internal training in regard to grievances, reporting such grievances and dialogue with any members of the local community.

15.4.2 Operational

The project will carry various risks that could result in impacts to public safety where such impacts are transferred or received outside of the project site. Such impacts may relate to fire, VOC fumes, explosions, spills of back up fuels, un-warranted releases of wastewater, exposure to hazardous as well as, environmental impacts (e.g. excessive noise, air emissions, dust etc.) and security concerns of trespassers.

The extent of such impacts may range outside of the projects boundaries and required the involvement of outside agencies to help manage and abate such impacts (e.g. Civil Defence, police and Army).

Public risks during operation have the potential to result in incidents, which could have a significant impact upon neighbouring communities and populations. Risks to public safety will be appropriately addressed and prepared for in the operational phase 'Emergency Preparedness and Disaster Plan' and training.

The project site may present an unwanted opportunity for local communities to access the site, in terms of trespassing, with associated risks to those working at the site, equipment and those who are trespassing. Under such circumstances there is potential for incidents to occur particularly due to the heavy nature of such equipment and the lack of knowledge such people may have regarding the dangers of power plant site. Power plants are high risk areas and should only be accessed by trained personnel who are wearing adequate personal protective equipment.

Please Note: Due to public safety being a risk rather then a potentially defined impact, its significance is not assessed further in this ESIA. Risks to public safety will be managed through effective emergency and disaster planning and the communication of these plans with the local communities via relevant communication channels and dialogue.

During operation CEGCO will employ internal security personnel to protect and patrol the exterior of the plant and gatehouses from any threats.

15.5 Mitigation

15.5.1 Construction

Table 15-1 Community Safety and Security – Selected Mitigation Measures for Construction

Impact	Mitigation
Emergency Situations	Risks to public safety will be appropriately addressed and prepared for in the operational phase 'Emergency Preparedness and Response Plan' and training. The plan will include the appropriate procedure to respond to any such incidents, as well as site specific contact details and details of external agencies who may be required.
	All high risk areas including fuel storage areas will be secured with internal fencing and will be patrolled by security throughout the day. Appropriate mechanisms for emergency control (e.g. firefighting equipment) will be placed at suitable positions around the site.
Exposure to Disease	The Health and Safety teams on site will provide advice during training/inductions on exposure to disease. During construction SEPCO III plan to protect against the spread of internal and external diseases by taking the following measures: • Site personnel will only be cleared for work after with a medical fitness certificate from an authorized medical centre. • SEPCO III project staff will include a Doctor, Nurse and First aiders. The medical staff shall ensure a monitoring and health surveillance program. • Any reportable disease shall be diagnosed by the authorized occupation health centre doctor. Diagnosis includes identifying any new symptoms, or any significant worsening of existing symptoms. • Any external and internal spreading diseases shall be diagnosed and taken the precautions as per the instructions from the national/ local medical authority.
Security	SEPCO III will employ a security company who will provide 24*7 armed security control across the site and at dedicated security staff at gatehouses. SEPCO III will prepare a Security Plan consistent with the Security Risk Assessment, for review by ACWA Power and the lenders.
	SEPCO III have confirmed that security arrangements be guided by UN Code of conducts for law enforcement officials and UN basic principles on the use of Force and Firearms by law enforcement officials. Security personnel will follow a strict code of conduct and will be trained in weapons handling, human rights and receipt of grievances.
	The project will be fenced prior to construction including internal fencing to segregate the project areas from the existing HTPS HFO plant.
	All vehicles entering the site will require pre-approved clearance and will need to registered to enter the site. Project security will record all instances of incoming vehicles.
	CCTV will be installed at key locations around the site and at gatehouses. Appropriate lighting will be provided at gatehouses for security personnel to ensure that unauthorised access cannot be gained.

	Project personnel will only be provided access to the construction site with valid ID cards and permits to work in line with HSE requirements of the site. People trying to gain unauthorised access to the site without appropriate permits and PPE will not be permitted, or will be ejected.

15.5.2 Operation

Table 15-2 Community Safety and Security – Selected Mitigation & Management Measures for Operation

Impact	Mitigation
Emergency Situations	Risks to public safety will be appropriately addressed and prepared for in the operational phase 'Emergency Preparedness and Response Plan' and training. The plan will include the appropriate procedure to respond to any such incidents, as well as site specific contact details and details of external agencies who may be required.
	The plant will have a purpose built primed firefighting infrastructure to respond to instances of fire.
	The plant will have various mitigation controls to protect against spillage of hazardous liquids and materials, including fuels (as detailed elsewhere in this ESIA).
Security	The project will employ its own security staff who will provide 24*7 armed security control across the plant and at dedicated security staff at the gatehouse.
	Security personnel will follow a strict code of conduct and will be trained in weapons handling, human rights and receipt of grievances. Security arrangements be guided by UN Code of conducts for law enforcement officials and UN basic principles on the use of Force and Firearms by law enforcement officials.
	The project will be fenced with a high grade security fence with razor wire, security cameras, lookout points, and internal lighting. The fencing will include fencing to segregate the project areas from the existing HTPS HFO plant.
	All vehicles entering the site will require pre-approved clearance and will need to registered to enter the site. Project security will record all instances of incoming vehicles.
	CCTV will be installed at key locations around the project, boundaries and gatehouses. Appropriate lighting will be provided at gatehouses for security personnel to ensure that unauthorised access cannot be gained.
	Project personnel will only be provided access to the plant with valid ID cards and permits to work in line with HSE requirements of the site. People trying to gain unauthorised access to the site without appropriate permits and PPE will not be permitted, or will be ejected.

16 LABOUR AND WORKING CONDITIONS

16.1 Introduction

Any construction project will introduce health and safety risks associated with the use of plant, machinery and construction processes. Risks can be severe depending on the type of activities required, materials used and site condition.

For projects in isolated locations or where the local population/skill sets require influx of people from other regions/countries. In such a scenario, a project will need to consider requirements associated with accommodation, welfare, sanitary provision, health care, hygiene, food potable water etc.

16.2 Standards and Guidelines

Jordanian Standards

Labour Law (No. 8, 1996); The labour law defines aspects relating to worker rights and are relevant for those people who will be working at the project during construction and operation. A key component of this law in relation to this project is that the project must comply with article (78) related to occupational health and safety, where the proponent must provide essential precautions and arrangements to protect the workers from the risk of hazards and supply them with Personal Protective Equipment (PPE).

EBRD

The notable PR's that will apply to this project include:

- Performance Requirement 2: Labour and Working Conditions;
- Performance Requirement 10: Information Disclosure and Stakeholder Engagement.

In line with EBRD requirements '*Projects are required to comply, at a minimum, with (i) national labour, social security and occupational health and safety laws, and (ii) the fundamental principles and standards embodied in the ILO conventions* (EBRD, Performance Requirement 2, 2014).'

IFC

The following applicable IFC Performance Standards aim to identify and ensure that social and economic impacts of a project are addressed in the relevant areas, in particular:

- Performance Standard 2: Labour and Working Conditions;

IFC's EHS Guidelines for Thermal Power Plants also address industry-specific impacts on the social and economic aspects of the site and surrounding context, specifically:

- Occupational Health and Safety; and
- Community Health and Safety.

In line with IFC requirements, IFC Performance Standard 2 (Labor and Working Condition's) will be complied with, which includes overall alignment to the following conventions:

- ILO Convention 87 on Freedom of Association and Protection of the Right to Organize;
- ILO Convention 98 on the Right to Organize and Collective Bargaining;
- ILO Convention 29 on Forced Labor;
- ILO Convention 105 on the Abolition of Forced Labor;

- ILO Convention 138 on Minimum Age (of Employment);
- ILO Convention 182 on the Worst Forms of Child Labor;
- ILO Convention 100 on Equal Remuneration;
- ILO Convention 111 on Discrimination (Employment and Occupation);
- UN Convention on the Rights of the Child, Article 32.1; and
- UN Convention on the Protection of the Rights of all Migrant Workers and Members of their Families.

16.3 Potential Impacts

16.3.1 Construction

HR Policy, Freedom of Association and Collective Bargaining

The overarching ACWA Power HR Policy will provide the basis upon which the projects HR Policy will be developed (to be adopted by SEPCO III's in their construction HR policy). SEPCO III HR Policy will ensure alignment with Jordanian labour law and will ensure consistency with international ILO and UN conventions:

- ILO Convention 87 on Freedom of Association and Protection of the Right to Organize
- ILO Convention 98 on the Right to Organize and Collective Bargaining
- ILO Convention 29 on Forced Labor
- ILO Convention 105 on the Abolition of Forced Labor
- ILO Convention 138 on Minimum Age (of Employment) ILO Convention 182 on the Worst Forms of Child Labor
- ILO Convention 100 on Equal Remuneration
- ILO Convention 111 on Discrimination (Employment and Occupation)
- UN Convention on the Rights of the Child, Article 32.1
- UN Convention on the Protection of the Rights of all Migrant Workers and Members of their Families

Note: In line with the above, the ACWA Power HR Policy the minimum age of working is 18 years. Freedom of Association (FoA)and collective bargaining is included to the ACWA Power annual sustainability reports and our "Our Commitments" policy under "making certain of human rights, the safety and welfare of workers, fair employment and equal opportunity practices across our operations", where Human Rights is intended to cover FoA and Collective Bargaining.

Occupational Health and Safety

The EPC Contractor will manage Occupational Health and Safety on site via a dedicated Health, Safety and Environment (HSE) Team. Sub-contractor companies will have dedicated HSE Managers who will be responsible for implementing the sites HSE plan in their working areas. SEPCO III's HSE Plan will be subject to approval by ACWA Power and ACWA Power Zarqa. ACWA Power and the ACWA Power Zarqa will periodically audit the project in line with the necessary HSE requirements.

Common activities undertaken during construction such as the movement of heavy machinery, excavation, handling of chemicals works undertaken at height etc. can all introduce significant risk to the health and safety for the associated work force. In particular, risks are more likely to be apparent for those who are not familiar with the type of works undertaken and/or the associated hazards.

The type of hazards attributable to a construction site will vary significantly dependant on the construction methods employed and the degree of control implemented by the EPC and affiliated sub-contractor. It is therefore of the utmost importance that the EPC and affiliated sub-contractors demonstrate consideration of health and safety risks as part of their chosen construction methods and that these risks are appropriately mitigated.

Please Note: Due to occupational health and safety being a risk rather then a potentially defined impact, its significance is not assessed further in this ESIA. Health and safety risks to the site force will be managed through effective risk assessment, development of appropriate methods statements, emergency and disaster planning and the communication of specific health and safety requirements relative to specific work/access requirements.

Working Conditions

Labour exploitation on construction site unfortunately has become a reality in some parts of the world. Inequalities in income, education and opportunities has led to opportunistic immoral practices with labourers and site staff suffering as a consequence.

To ensure the wellbeing of the staff associated with the project, the EPC and associated subcontractors will need to plan for necessary provisions relative to the requirement of the of the required workforce.

Please Note: As worker conditions are a defined aspect of site planning rather then a potentially environmental impact, its significance is not assessed further in this ESIA. Risks associated with worker welfare during construction will be managed through effective project planning, and the enforcement of fair and just treatment throughout the construction phase.

16.3.2 Operational

Occupational Health and Safety

The risks associated with the operational phase of the project are anticipated to be significantly less than during the construction phase due to reduced site activity and requirements for heavy plant and machinery.

There will however be a significant amount of high powered equipment on site, including high voltage electrical connection, and open water (evaporation pond), all of which pose a significant risk to worker health and safety. Maintenance and inspection will also require the use of site vehicles and activities that pose risks to human health and safety.

The Severity and likelihood of risks during the operational phase will be dependant on the frequency and requirements for planned and unplanned maintenance. The operation and maintenance team will need to ensure that a robust plan is in place to appropriately manage these risks.

Please Note: Due to occupational health and safety being a risk rather then a potentially defined impact, its significance is not assessed further in this ESIA. Health and safety risks to the site force will be managed through effective risk assessment, development of appropriate methods statements, emergency and disaster planning and the communication of specific health and safety requirements relative to specific work/access requirements.

Worker Conditions

No long term accommodation requirements are anticipated for the project and where appropriate, staff may be offered suitable CEGCO accommodation nearby. However, as with construction, operational activities will need to plan for and enforce just and fair treatment of operation and maintenance staff (including any engaged sub-contractors). Allowance will also need to be made for site staff welfare facilities.

Please Note: As worker conditions are a defined aspect of site planning rather then a potentially environmental impact, its significance is not assessed further in this ESIA. Risks associated with worker welfare will be managed through effective project planning, and the enforcement of fair and just treatment throughout the operation of the facility.

16.4 Mitigation & Management Measures

16.4.1 Construction

Table 16-1 Worker Conditions & OH&S – Selected Mitigation & Management Measures for Construction

Impact	Mitigation
Human Resources Policies and Procedures	Human resource policies and procedures for ACWA Power Zarqa will be prepared on the basis of the ACWA Power Corporate HR Policy template for Project Companies. The EPC Contractor and sub-contractor companies will be required to reflect the ACWA Power Corporate requirements in their own HR Policies. In general, the HR Policies will be adapted appropriate to the size of the workforce required for the project. Policies and procedures must be prepared to demonstrate consistency with the requirements of national legislation and EBRD Performance Requirement 2 and IFC Performance Standard 2, particularly in regard to the full implementation of all ILO standards.
Child Labour	The Project Company and EPC contractor will comply with all relevant national laws and provisions related to the employment of minors. In any event, the client will not employ children.
Forced Labour	The Project Company and EPC contractor will not employ forced labour, which consists of any work or service not voluntarily performed that is exacted from an individual under threat of force or penalty. This covers any kind of involuntary or compulsory labour, such as indentured labour, bonded labour or similar labour-contracting arrangements.
Non-discrimination and equal opportunity	The Project Company and EPC contractor will comply with EU requirements on non-discrimination related to employment. In particular, the EPC contractor will: • Not make employment decisions on the basis of personal characteristics, such as gender, race, nationality, ethnic origin, religion or belief, disability, age or sexual orientation, unrelated to inherent job requirements; • base the employment relationship on the principle of equal opportunity and fair treatment, and will not discriminate with respect to all aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, promotion, termination of employment or retirement, and discipline. *Please note that special measures of protection or assistance to remedy past discrimination or promote local employment opportunities or selection for a particular job based on the inherent*

Impact	Mitigation
	requirements of the job, which are in accordance with national law, will not be deemed discrimination.
Working Relationships	The Project Company and EPC contractor will document and communicate to all workers their working conditions and terms of employment including their entitlement to wages, hours of work, overtime arrangements and overtime compensation, and any benefits (such as leave for illness, maternity/paternity, or holiday).
Working Conditions and terms of employment	The Project Company and EPC contractor will provide a plan detailing how working conditions and terms of employment are compliant with national labour, social security and occupational health and safety laws. Employment relationship shall be on the principle of equal opportunity and fair treatment, and will not discriminate with respect to any aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, promotion, termination of employment or retirement, and discipline. Special measures of protection or assistance to remedy past discrimination or promote local employment opportunities or selection for a particular job based on the inherent requirements of the job, which are in accordance with national law, will not be deemed discrimination.
Workers organisations	The Project Company and EPC contractor will enable means for workers to express their grievances and protect their rights regarding working conditions and terms of employment. The Project Company and EPC contractor will not discourage workers from forming or joining workers' organisations of their choosing or from bargaining collectively, and will not discriminate or retaliate against workers who participate, or seek to participate, in such organisations or bargain collectively.
Wages, benefits and conditions of work	Wages, benefits and conditions of work offered should, overall, be comparable to those offered by equivalent employers in the relevant region of that country/region and sector concerned.
Occupational Health and Safety (OHS)	The Project Company and EPC contractor will provide the workers with a safe and healthy work environment, taking into account inherent risks and specific classes of hazards associated with the project. The Project Company and EPC contractor shall implement and maintain an OHS management system taking into account specific risks associated with the project, legal requirements and duty of care. The Project Company and EPC contractor shall be responsible for ensuring that all affiliated sub-contractors comply with the OHS management system. The OHS management system shall be in-line with recognised international best practice and as a minimum, this plan shall include: • Means of identifying and minimising, so far as reasonably practicable, the causes of potential hazards to workers. • Provision of preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances. • Provision of appropriate equipment to minimise risks, and requiring and enforcing its use. • Training of workers, and provision of appropriate incentives for them to use and comply with health and safety procedures and protective equipment.

Impact	Mitigation
	• Documentation and reporting of occupational accidents, diseases and incidents. • Emergency prevention, preparedness and response arrangements.
Worker Accommodation	Accommodation shall be appropriate for its location and be clean, safe and, at a minimum, meet the basic needs of workers. In particular, the provision of accommodation shall meet national legislation and EBRD/IFC guidelines and other international good practice in relation, but not restricted, to the following: • the practice for charging for accommodation. • the provision of minimum amounts of space for each worker. • provision of sanitary, laundry and cooking facilities and potable water. • the location of accommodation in relation to the workplace. • any health, fire safety or other hazards or disturbances and local facilities. • the provision of first aid and medical facilities. • heating and ventilation. Workers freedom of movement to and from the employer-provided accommodation shall not be unduly restricted.
Retrenchment	If the EPC contractor anticipates collective dismissals associated with the proposed project, the EPC contractor shall develop a plan to mitigate the adverse impacts of retrenchment, in line with national law and good industry practice and based on the principles of non-discrimination and consultation. Without prejudice to more stringent provisions in national law, such consultation will involve reasonable notice of employment changes to the workers' representatives and, where appropriate, relevant public authorities so that the retrenchment plan may be examined jointly in order to mitigate adverse effects of job losses on the workers concerned. The outcome of the consultations will be reflected in the final retrenchment plan.
Grievance Mechanism	The EPC contractor will provide a grievance mechanism for workers to raise reasonable workplace concerns. The client will inform the workers of the grievance mechanism at the time of hiring, and make it easily accessible to them. The mechanism should involve an appropriate level of management and address concerns promptly, using an understandable and transparent process that provides feedback to those concerned, without any retribution. The mechanism should not impede access to other judicial or administrative remedies that might be available under law or through existing arbitration procedures, or substitute for grievance mechanisms provided through collective agreements.
Supply chain	The EPC contractor shall devise a supply management system to ensure the Mitigation & management measures identified above can be demonstrated by associated sub-contractors. Potential adverse impacts associated with supply chains will be considered where low labour cost is a material factor in the competitiveness of the item supplied. In such circumstances, the EPC contractor will take reasonable steps to inquire about the use of child

Impact	Mitigation
	labour and forced labour in its supply chain in relation to goods and materials which are central to the core functions of the project.

16.4.2 Operation

Table 16-2 Worker Conditions & OH&S – Selected Mitigation & Management Measures for Operation

Impact	Mitigation
Human Resources Policies and Procedures	Human resource policies and procedures will be adapted appropriate to the size of the workforce required for operation and maintenance requirements. Policies and procedures must be prepared to demonstrate consistency with the requirements of national legislation and EBRD Performance Requirement 2.
Child Labour	The O&M Company will comply with all relevant national laws provisions related to the employment of minors. In any event, the client will not employ children.
Forced Labour	The O&M Company will not employ forced labour, which consists of any work or service not voluntarily performed that is exacted from an individual under threat of force or penalty. This covers any kind of involuntary or compulsory labour, such as indentured labour, bonded labour or similar labour-contracting arrangements.
Non-discrimination and equal opportunity	The O&M Company will comply with EU requirements on non-discrimination related to employment. In particular, the The O&M Company will: • Not make employment decisions on the basis of personal characteristics, such as gender, race, nationality, ethnic origin, religion or belief, disability, age or sexual orientation, unrelated to inherent job requirements; • base the employment relationship on the principle of equal opportunity and fair treatment, and will not discriminate with respect to all aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, promotion, termination of employment or retirement, and discipline. *Please note that special measures of protection or assistance to remedy past discrimination or promote local employment opportunities or selection for a particular job based on the inherent requirements of the job, which are in accordance with national law, will not be deemed discrimination.*
Working Relationships	The O&M Company will document and communicate to all workers their working conditions and terms of employment including their entitlement to wages, hours of work, overtime arrangements and overtime compensation, and any benefits (such as leave for illness, maternity/paternity, or holiday).

Impact	Mitigation
Working Conditions and terms of employment	The O&M Company will provide a plan detailing how working conditions and terms of employment are compliant with national labour, social security and occupational health and safety laws. Employment relationship shall be on the principle of equal opportunity and fair treatment, and will not discriminate with respect to any aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, promotion, termination of employment or retirement, and discipline. Special measures of protection or assistance to remedy past discrimination or promote local employment opportunities or selection for a particular job based on the inherent requirements of the job, which are in accordance with national law, will not be deemed discrimination.
Workers organisations	The O&M Company will enable means for workers to express their grievances and protect their rights regarding working conditions and terms of employment. The O&M Company will not discourage workers from forming or joining workers' organisations of their choosing or from bargaining collectively, and will not discriminate or retaliate against workers who participate, or seek to participate, in such organisations or bargain collectively.
Wages, benefits and conditions of work	Wages, benefits and conditions of work offered should, overall, be comparable to those offered by equivalent employers in the relevant region of that country/region and sector concerned.
Occupational Health and Safety (OHS)	The O&M Company will provide the workers with a safe and healthy work environment, taking into account inherent risks and specific classes of hazards associated with the project. The O&M Company shall implement and maintain an OHS management system taking into account specific risks associated with the project, legal requirements and duty of care. The O&M Company shall be responsible for ensuring that all affiliated sub-contractors comply with the OHS management system. The OHS management system shall be in-line with recognised international best practice and as a minimum, this plan shall include: • Means of identifying and minimising, so far as reasonably practicable, the causes of potential hazards to workers. • Provision of preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances. • Provision of appropriate equipment to minimise risks, and requiring and enforcing its use. • Training of workers, and provision of appropriate incentives for them to use and comply with health and safety procedures and protective equipment. • Documentation and reporting of occupational accidents, diseases and incidents. • Emergency prevention, preparedness and response arrangements.

Impact	Mitigation
Worker Accommodation	Where accommodation is provided for workers, the accommodation shall be appropriate for its location and be clean, safe and, at a minimum, meet the basic needs of workers. In particular, the provision of accommodation shall meet national legislation and international good practice in relation, but not restricted, to the following: • the provision of minimum amounts of space for each worker. • provision of sanitary, laundry and cooking facilities and potable water. • the location of accommodation in relation to the workplace. • any health, fire safety or other hazards or disturbances and local facilities. • the provision of first aid and medical facilities. • heating and ventilation. Workers freedom of movement to and from the employer-provided accommodation shall not be unduly restricted.
Retrenchment	If the O&M Company contractor anticipates collective dismissals associated with the proposed project, the O&M Company contractor shall develop a plan to mitigate the adverse impacts of retrenchment, in line with national law and good industry practice and based on the principles of non-discrimination and consultation. Without prejudice to more stringent provisions in national law, such consultation will involve reasonable notice of employment changes to the workers' representatives and, where appropriate, relevant public authorities so that the retrenchment plan may be examined jointly in order to mitigate adverse effects of job losses on the workers concerned. The outcome of the consultations will be reflected in the final retrenchment plan.
Grievance Mechanism	The O&M Company will provide a grievance mechanism for workers to raise reasonable workplace concerns. The client will inform the workers of the grievance mechanism at the time of hiring, and make it easily accessible to them. The mechanism should involve an appropriate level of management and address concerns promptly, using an understandable and transparent process that provides feedback to those concerned, without any retribution. The mechanism should not impede access to other judicial or administrative remedies that might be available under law or through existing arbitration procedures, or substitute for grievance mechanisms provided through collective agreements.
Supply chain	The O&M Company shall devise a supply management system to ensure the Mitigation & management measures identified above can be demonstrated by associated sub-contractors. Potential adverse impacts associated with supply chains will be considered where low labour cost is a material factor in the competitiveness of the item supplied. In such circumstances, the O&M Company will take reasonable steps to inquire about the use of child

Impact	Mitigation
	labour and forced labour in its supply chain in relation to goods and materials which are central to the core functions of the project.

17 CUMULATIVE IMPACT ASSESSMENT

Cumulative impacts result from the incremental impact of an action when combined to impacts (e.g. past, present, and reasonably foreseeable future actions) regardless of what agency or person undertakes such other actions.

In practice, the assessment of cumulative effects requires consideration of some concepts:

- Assessment of effects over a larger (i.e., "regional") area that may transboundary/cross-jurisdictional; (Including effects due to natural perturbations affecting environmental components and human actions).
- Assessment of effects during a longer period of time into the past and future;
- Assessment of effects on Valued Environmental Components due to interactions with other actions, and not just the effects of the single action under review;
- Evaluation of significance in consideration of other than just local, direct effects.

For the purpose of this ACWA Power Zarqa CCGT ESIA, the Cumulative Impacts Assessment (CIA) has been undertaken to establish whether there are barriers to future development within the projects area of influence. For instance: is there sufficient environmental carrying capacity available for future development; are there any factors that may restrict future development; and, are there any key factors of concern that may relate to the development/operation of other projects in tandem with the proposed ACWA Power Zarqa CCGT plant.

17.1 Assessment Methodology

This ESIA has assessed cumulative impacts of several environmental parameters in in the main sections of this ESIA. For instance, air quality and noise impacts have considered the measured baseline conditions in combination with the predicted process contributions. As a result, this has provided an assessment of cumulative impacts, as a result of the project itself.

This specific cumulative impact assessment chapter therefore considers the cumulative impacts relating to potential future development and works in the projects area of influence. In this instance the projects predicted impacts have been assessed in combination with other potential future developments to determine the potential longer term impacts upon related environmental parameters.

17.1.1 Local Projects

Typically, the assessment of cumulative impacts would be based upon solid documented development plans/strategies and announced projects. In the case of this cumulative impacts assessment, there is little available information regarding future development plans in Zarqa and particularly future development plans of NEPCO in regard to additional power generation projects.

Of particular note is the future of the land at the existing HTPS plant, which will be available following demolition of the decommissioned units. At this point in time neither CEGCO or NEPCO have plans for this land. CEGCO have verbally informed 5 Capitals that the land may be used for other CEGCO operations. Further to this, NEPCO have verbally informed ACWA Power and the project lenders that there are no further plans for power generation projects in

Zarqa, the next plan for a fossil fuelled power plant is for the City of Irbid in 2027 (75km from the proposed project site).

This section has been prepared in order to complement the existing and detailed project cumulative impact assessment provided in the remainder of this ESIA. As such any additional cumulative impacts have been developed using the IFC, 2013. Good Practicee Handbook: Cumulative Impact Assessment and Management.

The known and confirmed projects in the local area of project influence are detailed in the table below.

Table 17-1 Known and Documented Future and Ongoing Projects in the Projects Area of Influence

Project Name	Description	Distance to Project	Expected Start-Up Date	Source
Al Samra PP Conversion of 4th Phase to Combined Cycle	The Samra Power Plant, owned by the Samra Electric Power Company (SEPCO) includes 4 phases with all units fully operational (Phase 4 operational since 2013), for a total of 1031MW. Phases 1, 2 and 3 are combined cycle plants and the 4th phase is simple cycle. A proposed project announced in January 2016 is for the conversion of the 4th phase to combined cycle. This is currently under project design.	3km North	Before end of 2017	http://www.sepco.com.jo/en/index.php?option=com_content&view=article&id=60&Itemid=67
De-commissioning of HTPS HFO Plant	It is understood that the decommissioning of the existing HTPS will be undertaken as a separate project unrelated to the proposed 485MW project. In line with the initial decommissioning plan provided by CEGCO, the existing structure, including all mechanical units and fuel containers, related services and infrastructure will be decommissioned gradually between December 2016 until March 2019.	Adjacent	March 2019	CEGCO

17.1.2 Valued Environmental & Social Components (VEC's)

The VEC's considered in this cumulative Impact Assessment are related to those environmental and social parameters discussed in this ESIA (e.g. noise, soil , landscape etc.). Only those parameters envisaged to have significant cumulative impacts in addition to the proposed ACWA Power Zarqa CCGT plant have been included for the Cumulative Impacts Assessment; as per the impacts from those projects outlined in the table above. Where the projects are not considered to relate to significant impacts, these have not been included.

The VEC's relating to the the projects above are as follows:

Table 17-2 Valued Environmental & Social Components (VEC's)

Project Name	Valued Environmental & Social Components (VEC's)	
	Included to CIA	Not Included to CIA
Al Samra PP Conversion of 4th Phase to Combined Cycle	**Air Quality** – Potential changes to dispersion characteristics due to combined cycle operation. **Groundwater** – Project may take groundwater for process water supply.	**Noise** – Project approximately 3 km distance to ACWA Power Zarqa CCGT and is not perceptible in the local area. **Soil, Geology** – Impacts limited to project site and immediate area. Cumulative impacts not expected. **Solid & Hazardous Waste** – The project will unlikely generate significant quantities of waste at construction or operation. **Biodiversity** – Impacts limited to project site and immediate area. Cumulative impacts not expected. **Social & Economic** – The project will not likely require a large labour force during construction, due to the existing arrangement of the Simple Cycle plant. It is not envisaged that the project will require additional operational staff to those already engaged at the 4 stages of the power plant. **Traffic & Transportation** – The project is 3km away from the ACWA Power Zarqq Project and uses different local road networks for access which branch from the main highways in Jordan. **Cultural Heritage & Archaeology** – Impacts limited to project site and immediate area. Cumulative impacts not expected. **Landscape and Visual Impacts** – Due to the topography of the intervening land, the Samra and ACWA Power Zarqa projects are not in the same view shed.. Impacts due to landscape character at eh Samra plant will be minimal given that the PP has 7 existing combined cycle units.
De-commissioning of HTPS HFO Plant	**Air Quality** – Potential impacts due to demolition (Dust, VOC's from fuel tanks etc.). **Noise** – Cumulative noise impacts to similar receptors locally. **Waste** – The demolition of the existing HTPS HFO plant will generate significant quantities of waste.	**Soil, Geology, Groundwater** – Impacts limited to project site and immediate area. Cumulative impacts not expected. Impacts to groundwater are not expected. **Biodiversity** – There is a lack of biodiversity at the HTPS HFO plant area and it is therefore not expected to be significantly impacted **Social & Economic** – The project is temporary and will therefore not have a significant impacst upon the local socio-economic factors. The

<table>
<tr><th rowspan="2">Project Name</th><th colspan="2">Valued Environmental & Social Components (VEC's)</th></tr>
<tr><th>Included to CIA</th><th>Not Included to CIA</th></tr>
<tr><td></td><td>Traffic & Transportation – Additional traffic to local road network from removals of waste off site and demolition equipment.

Landscape & Visual – Decommissioning/demolition of the HTPS HFO plant will change the immediate landscape of the area and change the visual envelope for receptors.</td><td>project will also be staged over several years and will not specifically requirea large workforce.

Cultural Heritage & Archaeology – Impacts limited to project site and immediate area. Cumulative impacts not expected.</td></tr>
</table>

17.2 Potential Impacts

The potential cumulative impacts to the VEC's listed above have been set out below in relation to of the aforementioned projects.

17.2.1 Air Quality

HTPS HFO Plant Decommissioning/Demolition

The existing HTPS HFO plant ceased to operate in December 2015. In line with the initial decommissioning plan provided by CEGCO, the existing structure, including all mechanical units and fuel containers, related services and infrastructure will be decommissioned gradually between December 2016 until March 2019. This period of decommissioning will coincide with both the construction and operational phases of the proposed CCGT project. The decommissioning of the existing HTPS HFO plant will be undertaken as a separate project to the development of the proposed project.

The key air quality impacts relating to the decommissioning of the existing HTPS plant will include:

- Particulate matter dispersion – as structures are dismantled
- Gaseous and particulate emissions from equipment and vehicles
- VOC emissions from exposed fuel tanks and piping infrastructure.

Where the existing structure of the HTPS HFO plant is dismantled dust emissions may be generated, particularly where large scale demolishing practices of superstructures and masonry is undertaken. Such activities are likely to coincide with both the construction and operation of the proposed CCGT project. The impacts will however be largely reduced as the primary materials associated with the existing plant are metals (not concrete, brick or other powdery constituents). It is expected that metals will not result in the significant generation of dust unless they interact with open dusty surfaces. The existence of dusty surfaces are few due to the largely sealed nature of the existing HTPS site. Such dust generating impacts may have a cumulative effect where the demolition works coincide with construction of the proposed CCGT plant, where there are dust emission from earthworks. Such dust related impacts are expected to be limited to the working areas, due to the implementation of mitigation measures and localised settlement of dust.

In general, the combustion of fuels from demolition plant and machinery are not expected to pose a significant impact upon the air shed. As identified in the baseline assessment there is a large carrying capacity for pollutants relating to hydrocarbon combustion; even when combined to the projects own construction related impacts, or where firing for operation.

The construction phase of the proposed project will coincide with the removal of the existing HTPS fuel tanks and fuel infrastructure, which has the potential for the release of VOC's from residual fuels oils. Such VOC emissions may pose a minor localised impact within the HTPS landholding and project area, which could result in cumulative effects when combined with VOC emissions from the adjacent petrochemical refinery. The impacts of VOC's are not expected to pose a cumulative impact with the construction of the proposed CCGT project due to the lack of LDO fuel on-site at this time.

Al Samra Power Plant 4th Phase Combined Cycle Conversion

It is documented on the Samra Electric Power Company website that a project to establish combined cycle operation on it 4th phase simple cycle gas turbine is in progress with engineer designers. It is recognised that the implementation of this project will not result in the combustion of additional fuel and hence will not release additional pollutants to the air shed.

A potential emissions characteristic that may vary due to the implementation of combined cycle operation at the Al Samra plant may be the dispersion range of pollutants due to the lower temperature of the resulting flue gas. As such, the implementation of combined cycle operation at the Al Samra 4th Phase may result in closer dispersion of pollutants and would likely reduce dispersion of these pollutants to wider areas, including the area of influence of the proposed ACWA Power Zarqa CCGT project. The predicted dispersion impacts of the ACWA power Zarqa CCGT plant are limited to about 1.5km from the project, before there are diminishing returns on the decrease in ambient concentrations vs. distance from point of emission. In this instance, it is considered that the potential Al Samra combined cycle project (on its 4th phase) would not result in a significant change to the local air shed in the area of influence of the proposed ACWA Power Zarqa project.

17.2.2 Noise

HTPS HFO Plant Decommissioning/Demolition

In regard to the decommissioning of the existing HTPS HFO plant, this will be undertaken both during construction and operation of the proposed plant. Decommissioning activities are expected to be undertaken only during weekday daytimes. As such there may be some cumulative impacts during both proposed project phases (construction and operation of the CCGT project).

Noise during the proposed decommissioning of the existing HTPS HFO plant will likely include:

- Noise from demolition;
- Equipment noise;
- Vehicle noise associated with scrap and waste removals.

Noise from decommissioning activities will largely resemble the same noises generated on a typical construction site. This Is related to the shifting of large materials and construction type equipment in use for these processes. As such the cumulative impact during of these decommissioning works during the construction phase will unlikely be perceptible in combination with the construction of the CCGT plant, but may result in a slightly increased noise level propagating from the general area. It is however likely that the high intensity of works at the project site will generally be louder and more sustained compared to the decommissioning works (expected to be sporadic in nature), and as such the additional impacts may not be perceptible.

During the operational phase of the proposed project, the types of noises relating to the power generating processes compared to the decommissioning in the existing HTPS HFO plant will be different. The power production processes tend to emit sustained noise levels of a similar nature, whereas demolition type activities will be more sporadic and variable in magnitude. The cumulative impacts of decommissioning may be perceptible during times of large demolitions, or movement of heavy materials (only expected during the daytime).

17.2.3 Groundwater

Al Samra Power Plant 4th Phase Combined Cycle Conversion

The source of process water for the Samra Power complex is not confirmed, however it is expected to originate from groundwater.

As the proposed conversion of the 4th Phase will require the use of water to generate steam, an amount of water will need to be supplied to the Samra plant. If the water is abstracted from groundwater, this will result in additional abstractions locally. The hydrogeological study of this ESIA has noted the observance of groundwater depletion locally in the area of the previous HTPS, but a much higher groundwater level in the area of the Samra wastewater treatment plant close to the Samra PP project. Given the higher groundwater levels in the Samra area, this is not expected to pose an issue for the ACWA Zarqa Porject or the Samra PP project.

17.2.4 Waste

HTPS HFO Plant Decommissioning/Demolition

The existing HTPS HFO Plant is initially scheduled to be decommissioned during both the construction and operational phases of the proposed project. Due to the nature of the decommissioning works (separate to the proposed project), there will be a large amount of waste generation at a similar time to waste being generated, particularly during construction.

It is noted the indicative decommissioning timeline presented in Chapter 3, that many components will be sold as they are, or as scrap materials. As such, there is unlikely to be a large amount of waste that is sent directly off the site to landfill's. Due to the majority of materials at the existing HTPS plant being metals, it is expected that a significant amount will be sold for scrap, which is likely to result in a significant re-use or recycling of the metal. This will undoubtedly lead to a positive impact to scrap businesses locally but also in regard to the management of such waste, and avoidance of waste to landfill. Other wastes such as concrete can be crushed and re-used for aggregate.

There will be an amount of material that cannot be re-used or recycled and this will require disposal at landfill. Such wastes are largely unknown at this stage, but the quantity is not expected to be exceptionally high, and it is expected that it will be generated over a wide period of time, which will unlikely add increased pressure upon waste management facilities/service providers locally, even at the same time as construction and operation of the proposed plant.

17.2.5 Traffic & Transportation

HTPS HFO Plant Decommissioning/Demolition

The demolition of the HTPS HFO plant will result in the generation of additional vehicular flows locally due to the removals of waste and use of construction plant on the site.

The majority of waste is expected to exit the site and be transferred directly by scrap metal vendors or taken to waste management facilities. In either situation, this will result in additional vehicular flows to the local road network. The amount of vehicles arriving and departing from the decommissioning site is not however anticipated to be of a large volume and may only be 5-10 per hour at most. This will not result in a perceptible increase of vehicles locally.

It is recognised that there will be separate dedicated access points to the proposed project and the decommissioning site. These access points will be from different roads and will therefore not result in cumulative impacts between the projects in terms of and queuing to entering the sites.

17.2.6 Landscape and Visual

HTPS HFO Plant Decommissioning/Demolition

As can be seen from the baseline photos, the existing HTPS HFO plant is in a very visible position locally, particularly to residential receptors in the Hashiymeh area of Zarqa. The industrial landscape is in part characterised by the tall metal superstructure, stacks and fuel tanks of the HTPS HFO plant, but also provides negative visual impacts to the local community.

The decommissioning of the existing HTPS HFO plant will therefore likely result in a positive impact to local receptors, as well as removing a key contributor to the local industrial landscape. The land use following the removal of the HTPS HFO plant is not yet known and CEGCO have made no plans for this land at present. However, due to the implementation of the proposed project (a more compact and modern facility aesthetically) the cumulative impacts is likely to be reduced generally. This is also due to the positioning of the proposed project at a lower topographical level than the existing HTPS HFO plant.

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