

Ouarzazate Solar Power Complex,
Phase 1
Morocco

Specific Environmental and Social
Impact Assessment

VOLUME 1



Prepared for:
ACWA Power
December 2012

Document Control (Ref 1005/001/015)

| | Draft | Issue 1 | Final |
|--------------------|--|-----------------------------------|-----------------------------------|
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| Date | November 7 th 2012 | December 12 th 2012 | December 21 st 2012 |
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GLOSSARY

| | |
|-----------------|--|
| ACWA Power | Arabian Company for Water and Power |
| AGCE | Autorite Gouvernemental Charge de L'environnement |
| ALARP | As Low As Reasonably Practicable |
| AP | Action Plan |
| As | Arsenic |
| AAQS | Ambient Air Quality Standards |
| BAT | Best Available Techniques |
| BMP | Best Management Practice |
| BOO | Build, Own and Operate |
| BOP | Balance of Plant |
| BS | British Standards |
| BTEX | Benzene, Toluene, Ethylbenzene, and Xylenes |
| CBD | Convention on Biological Diveristy |
| CCR | Central Control Room |
| Cd | Cadmium |
| CDSI | The Central Department of Statistics and Information |
| CESMP | Construction Environmental Management Plan |
| CEMS | Continuous Emission Monitoring System |
| CIA | The Central Intelligence Agency |
| CN | Cyanide |
| CNEIE | Committee National de EIE |
| CO | Carbon Monoxide |
| CO ₂ | Carbon Dioxide |

| | |
|-------|--|
| Cr | Chromium |
| CREIE | Committee Regional de EIE |
| Cu | Copper |
| DA | Degraded Airshed |
| dB(A) | A-weighted decibels |
| dB© | C-weighted decibels |
| DCMS | Distributed Control and Monitoring System |
| EHS | Environmental, Health and Safety |
| ESMP | Environmental Management Plan |
| EMS | Environmental Management System |
| EPs | Equator Principles |
| EPC | Engineering, Procurement and Construction |
| EPFIs | The Equator Principle Financial Institutions |
| ESF | Electrical Special Facilities |
| FCF | Fuel Connection Facilities |
| FESIA | Framework Environmental and Social Impact Assessment |
| GDP | Gross Domestic Product |
| GHG | Greenhouse Gas |
| GIS | Geographic Information System |
| ha | Hectares |
| HCE | Heat Collector Element |
| HDI | Human Development Index |
| Hg | Mercury |
| HTF | Heat Transfer Fluid |
| IFC | International Finance Corporation |

| | |
|-------------------|---|
| Laeq | A-weighted Equivalent Continuous Sound Level |
| Lamax | A-weighted Maximum Sound Level |
| Lcpeak | C-frequency weighted Peak Sound Pressure |
| LEL | Lowest Explosive Limit |
| LP | Low Pressure |
| MASEN | Moroccan Agency for Solar Energy |
| MEMEE | Moroccan Ministry of Energy, Mines, Water and Environment |
| Mm ³ | Million cubic meter |
| MSDS | Material Safety Data Sheet |
| MTA | Ministere de Tutelle de l'Activite |
| Ni | Nickel |
| NO _x | Nitrogen Oxide |
| NO ₂ | Nitrogen Dioxide |
| O ₂ | Oxygen |
| OECD | The Organisation for Economic Co-operation and Development |
| OESMP | Operational Environmental Management Plan |
| O&M | Operation and Maintenance |
| PAH | Polycyclic Aromatic Hydrocarbons |
| Pb | Lead |
| PCOD | Project Commercial Operation Date |
| PM ₁₀ | Particulate matter with an aerodynamic diameter of less than 10 micrometers. |
| PM _{2.5} | Particulate matter with an aerodynamic diameter of less than 2.5 micrometers. |
| PPA | Power Purchase Agreement |
| PPE | Personal Protective Equipment |

| | |
|-----------------|--|
| RfP | Request for Proposal |
| SCA | Solar Collector Assembly |
| SCE | Solar Collector Element |
| Se | Selenium |
| SESIA | Specific Environmental and Social Impact Assessment |
| SF | Solar Field |
| SGS | Steam Generation System |
| SO ₂ | Sulphur Dioxide |
| SPC | Solar Power Complex |
| TES | Thermal Energy Storage |
| TSS | Thermal Storage System |
| TOR | Terms of Reference |
| TPH | Total Petroleum Hydrocarbons |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| VOC | Volatile Organic Compounds |
| WB | World Bank |
| WI | Work Instructions |
| WHO | World Health Organisation |
| WSC | Water-Steam Cycle |
| WTO | World Trade Organization |
| WWTP | Wastewater Treatment Plant |
| Zn | Zinc |
| 5 Capitals | 5 Capitals Environment and Management Consultancy |

1 INTRODUCTION

1.1 General Background

The Moroccan Agency for Solar Energy (MASEN) is planning to construct a 500MW solar power complex in Ouarzazate, to meet the national renewable energy policy objectives. The consortium, lead by ACWA Power has been awarded the first phase of the project, which will produce 160MW using parabolic solar power concentration technology.

'5 Capitals Environmental and Management Consulting' (5 Capitals) has been commissioned by ACWA Power to undertake the Specific Environmental and Social Impact Assessment (SESIA) for the proposed Ouarzazate Solar Power Complex Ouarzazate (SPC), Phase 1, in Morocco.

The project is situated on a greenfield of the Ait Ogrour Toundout rural community, and falls within the administration of the Ghassate Commune. The proposed project sits adjacent to the national highway connecting Ouarzazate and Errachidia, and is approximately 10Km north east of the city of Ouarzazate and 5Km north of National Road N10. The specific plot for Phase 1 of the SPC has a total area of 450ha, and the electricity generated will be supplied to the Ouarzazate 225/60 KV station located near the complex.

It is understood that construction is expected to last about 28months from Notice to Proceed, followed by 1 year of optimization and demonstrating performance guarantees to reach Final Commercial Operation.

1.2 Report Structure

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

Volume 1- Non-Technical Summary and Main text

Volume 2- Technical Appendices

Volume 3- Environmental and Social Management Plan

Volume 1 comprises the Non-Technical Summary and main text of the report with the issues identified that the Ouarzazate SPC may impact upon (following the framework assessment) each following a similar general structure:

- Introduction and Project Background;

- Legal Framework, Standards and Guidelines;
- Methodology;
- Baseline Information;
- SESIA Assessment Method;
- Assessment of Effects/Impacts, Mitigation Measures, and Residual Effects During Construction Phase;
- Assessment of Effects/Impacts, Mitigation Measures, and Residual Effects During Operational Phase; and
- Assessment of Effects/Impacts, Mitigation Measures, and Residual Effects During De-Commissioning Phases, where relevant.

Volume 2 comprises all Technical Appendices (consultation meeting, baseline survey reports, monitoring reports and other Technical Studies).

Volume 3: provides the framework for the development of the Construction Environmental Social Management Plan (CESMP) by the main contractor and all sub-contractor; and the Operational Environmental and Social Management Plan (OESMP) to be developed by the project proponent and implemented by the Operation and Management (O&M) team.

2 PROJECT DESCRIPTION

2.1 Key Project Objectives

The Moroccan Agency for Solar Energy (MASEN) has proposed to construct this solar power complex in Ouarzazate to meet several national policy objectives, namely law No. 13-09 regarding renewable energy. The proposed project would meet the following key objectives of this law:

- to reduce the oil-dependency of the Kingdom of Morocco;
- to diversify the sources and resources of energy production;
- to use an indigenous natural resource; and
- to reduce CO₂ emissions to the atmosphere.

2.2 Location of the Project Site

The location of the proposed Ouarzazate SPC project is within the commune of Ghassate, on the Tamzaghten Izerki site, as shown in the figure below. The proposed plant will be located 10km northeast of the City of Ouarzazate and approximately 6km north of Mansour Eddahbi Dam.

The subsequent table provides the boundary coordinates of the site, and the Figure 2-3 provides the layout of the proposed project.

Figure 2-1 Ouarzazate Phase 1 SPC location

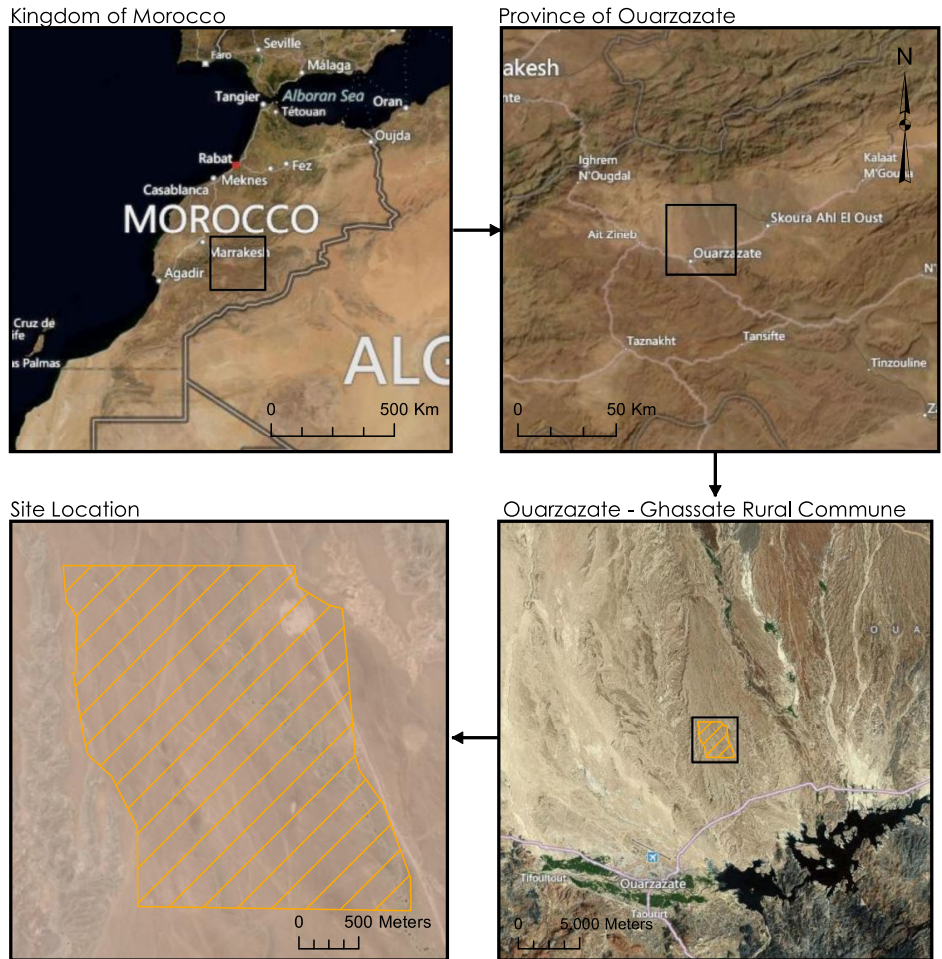


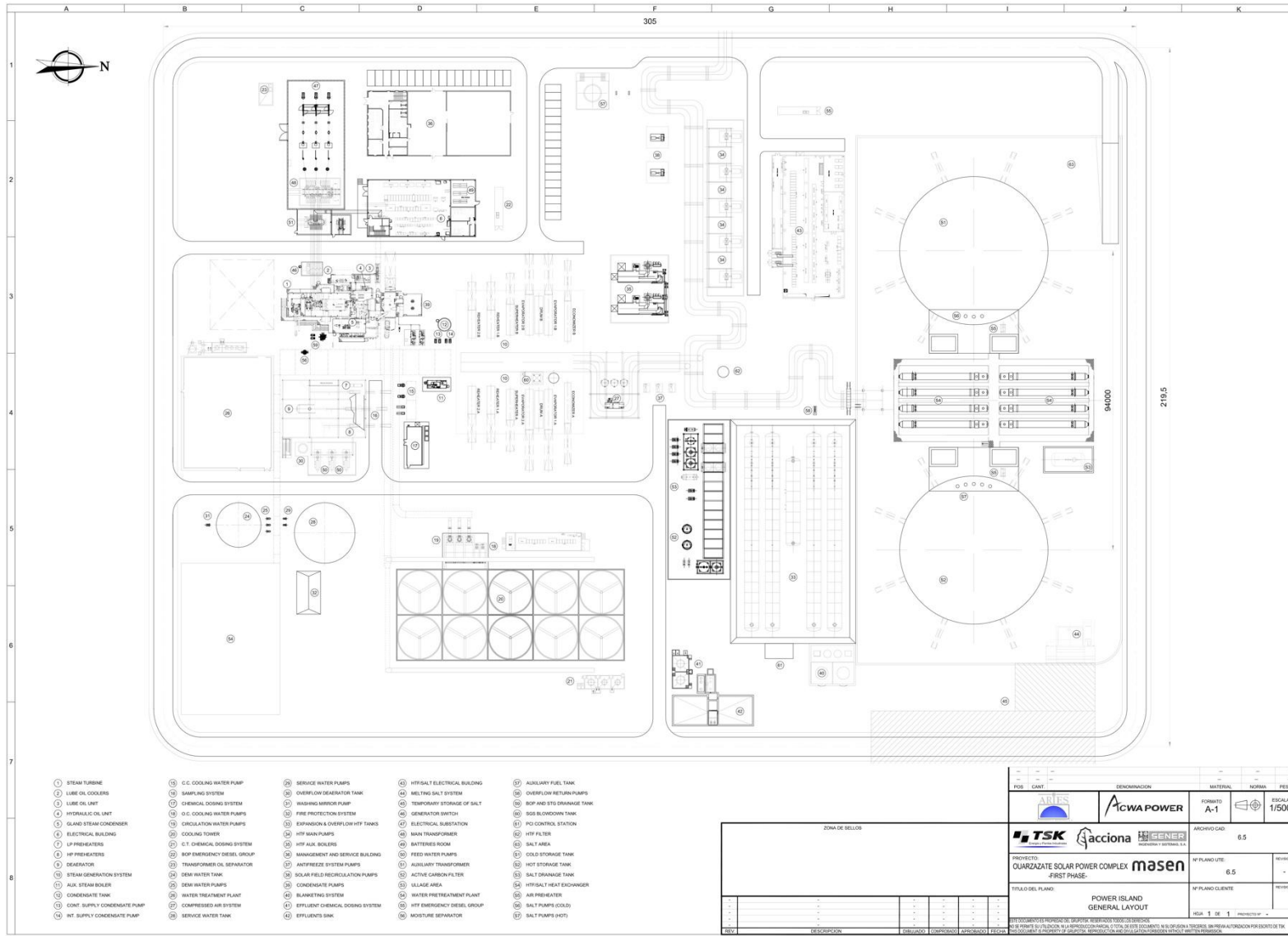
Table 2-1 Centre Co-ordinates of the Project

| Latitude | Longitude |
|---------------|--------------|
| 31° 0'37.53"N | 6°51'52.28"W |

Figure 2-2 Project Layout – General



Figure 2-3 Project Layout – Power Island



Phase 1 Ouarzate Solar Power Complex - SESIA

December 2012/January 2013

2.3 Site Condition and Land Use

The proposed project is located on a sparsely vegetated and flat rocky plateau, which is crossed north to south by wadis. The wadis support a relatively higher biodiversity than the remaining areas of the site, as the vegetation is denser on the edges of the wadis. To the west and east of the proposed project site are deep canyons and lateral wadis.

An access road to the site is being built on the eastern boundary of the proposed site. This access road will connect with the village of Tasselmant. The plateau extends to the north of the project site, where the next phases of the solar complex will be located.

There are no permanent settlements on the site, but nomads with their herds cross the plateau, even though it is not a highly valuable location for grazing.

The environmental characteristics of the study area that are relevant for the study of environmental impacts and the study area are provided in Chapters 6 to 16.

Plate 2-1 Sparsely vegetated plateau



Plate 2-2 Wadi running through the site



Plate 2-3 Canyon to the west of the site



2.4 Key Sensitive Receptors

The main anthropogenic sensitive receptors are the city of Ouarzazate, the villages and arable lands to the east and northeast of the project site, namely Tasselmant, Tiflité, Igherm Amellal, Tidgheste, Taferghouste, and the nomadic pastoralists that cross the site with their herds.

From an ecological perspective, the stability of the canyons situated to the east and the south of the site might be affected by the project drainage and be subject to increased erosion rates or increase flood risks. Equally, the dam of Mansour Eddahbi would be susceptible to any increased siltation or pollution resulting from significant changes in the drainage regime of the site. For this reason, the dam and canyons are considered a sensitive receptor and included in the study area.

Figure 2-4 maps the locations of the identified social and environmental sensitive receptors.

Plate 2-4 Village of Tasselmant, north-east of the site



Plate 2-5 City of Ouarzazate, seen from the entrance to the site

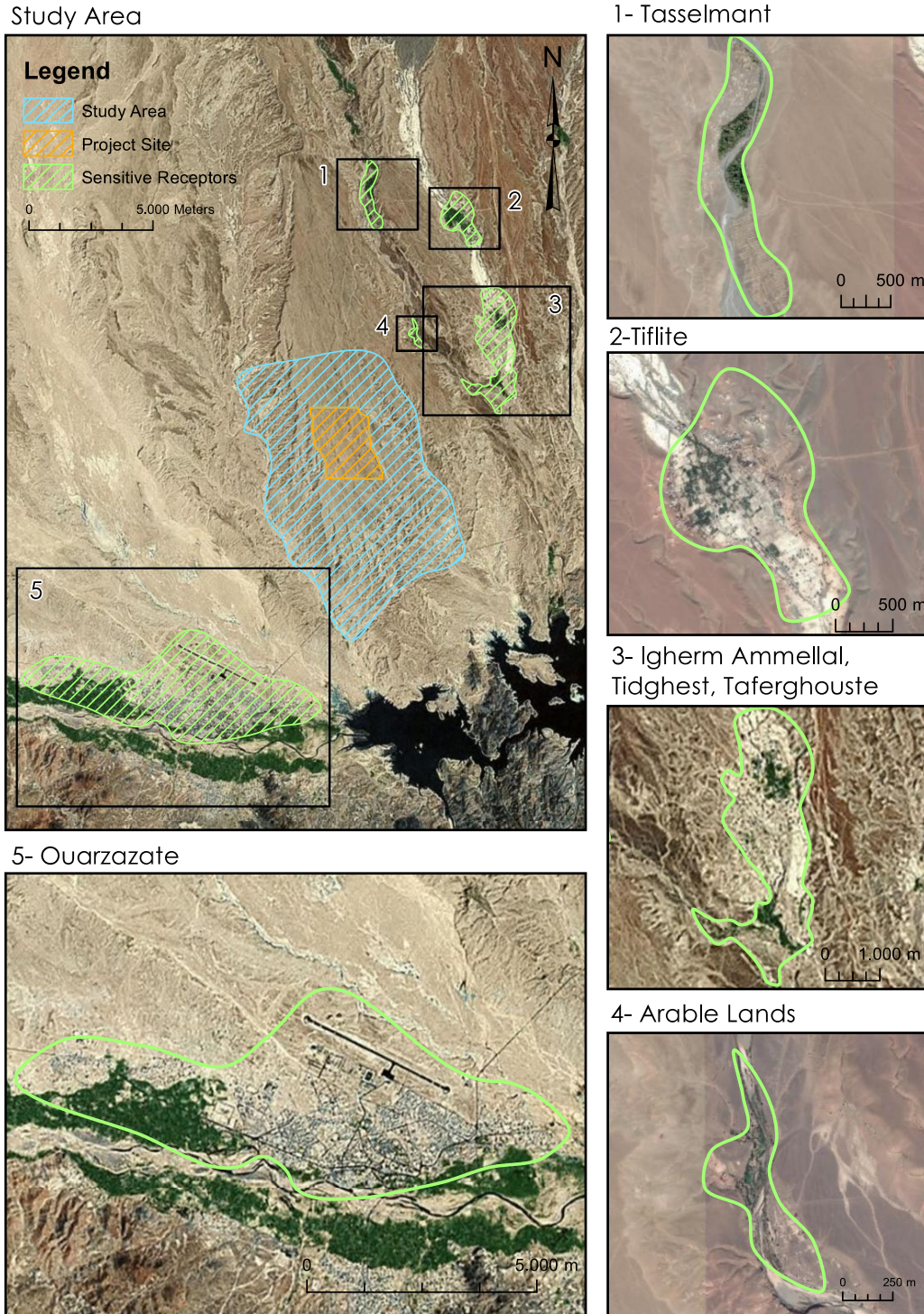


Plate 2-6 Nomadic pastoralists crossing the site



Figure 2-4 Potential Sensitive Receptors

Ouarzazate Solar Complex Phase 1
Anthropogenic sensitive receptors



2.5 Project Alternatives

Under Moroccan and international guidelines for environmental impact assessments, the evaluation of various project design and activity alternatives will be 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 solar power production technologies
- Alternative project location and layouts

2.5.1 'No Project'

The "No Project" option is not a viable alternative, as the objective of the renewable energy law is to diversify the sources and production measures of power for the Kingdom of Morocco. The development of Phase 1 Ouarzazate SPC will be the catalyst that will eventually provide 25% of 2000MW national production projected by 2020.

Phase 1 of the proposed solar power complex will not only pave the way to meet the 2020 renewable power projections, but will also provide opportunities to develop technological and engineering expertise in the field of solar production.

Finally, the national objective for producing renewable energy at a significant scale will be to elevate the country's profile to the international level as a producer of renewable power.

2.5.2 Alternative solar power production technologies

The Framework Environmental and Social Impact Assessment (FESIA) that was carried out in January 2011, identified and assessed four technologies for solar power production in relation to ecological and social settings of the proposed site. The alternative technologies considered included: Photovoltaic without tracking devices, photovoltaic with tracking devices, solar power tower with solar farm, and parabolic trough solar field.

The concentrated solar power field with tower would result in a significant visual impact as the 100-150m tall tower would be visible from the city of Ouarzazate. With regards to the photovoltaic option, this technology would not allow for storage of power, nor

generation of power during low solar irradiance and night time, therefore additional conventional methods for generating power would be required to meet demand.

Consequently, the parabolic solar power field was identified as the preferred choice, as power could still be generated during lower solar irradiance, and the visual impact was minimal and localised.

2.5.3 Alternative project location and layout

Based on design and operational engineering considerations, in particular to reduce erosion risks on the boundaries of the site, three general site layouts were considered. The two alternative layouts shown below, were developed due to the erosion risks in the northeast and in the west boundaries. The outline of the original plant layout is shown in the dark blue line. The essential differences between the three sites can be seen in the corners of along the Eastern boundary of the proposed project site.

From an environmental and social perspective, these three alternatives do not entail a significant difference in relation to their environmental and social impacts. The project specifications are largely unaffected, therefore the assumptions and assessment of the SESIA will not be affected by any variations.

The preferred alternative is depicted in Figure 2-2.

Figure 2-5: Alternative 1 Layout

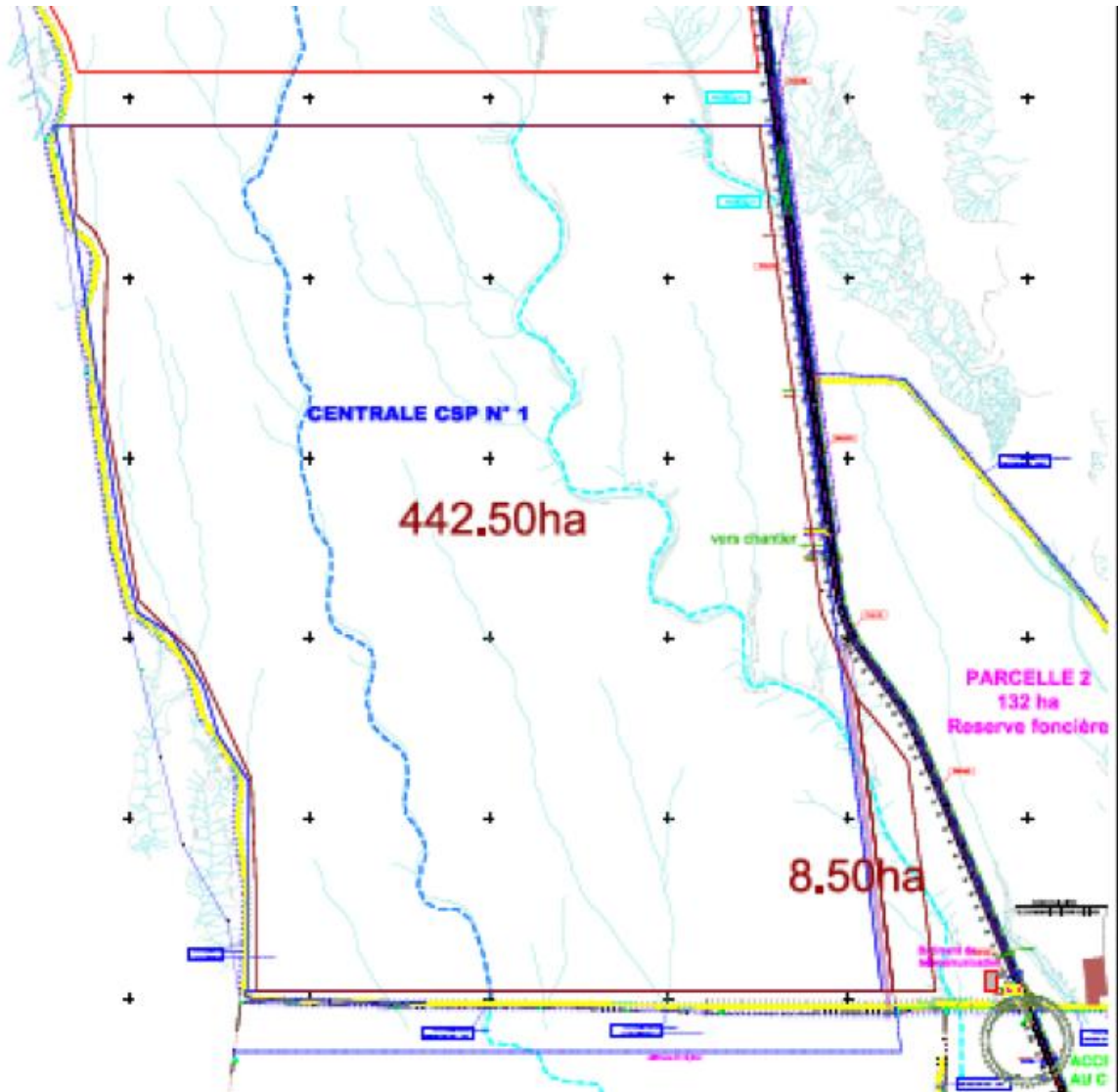
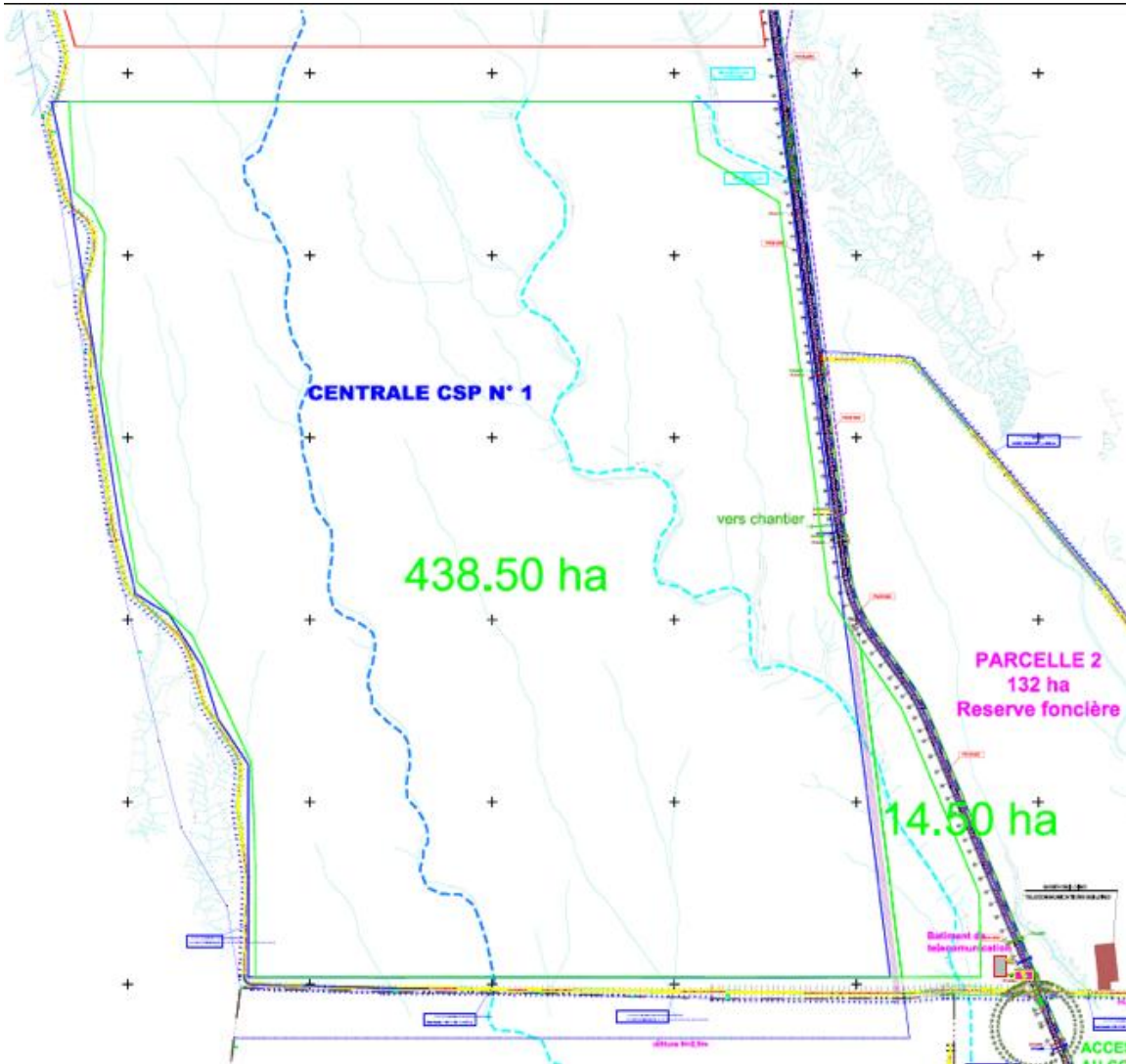


Figure 2-6: Alternative 2 Layout



2.6 Project Design

A Thermoelectric Solar Power Plant is an electricity generation system based on a low temperature Rankine cycle. The first phase of the Solar Power Complex will use a solar field of approximately 1,308,000 m² of parabolic-trough collectors to generate thermal energy, and will consist of a thermal energy storage system based on molten salts and a steam cycle of 160 MW to generate electricity.

Using the field of parabolic-trough collectors the solar radiation is concentrated on a Heat Collector Element (HCE), located at the focus of the parabola, which is filled with Heat Transfer Fluid (HTF). This HTF is heated to 393°C as it circulates through the receivers and returns to a series of heat exchangers, the Steam Generation System (SGS) in the power island, where the HTF is used to generate high-pressure superheated steam (380 °C and 105 bar). This steam is then used by a high-pressure steam turbine to generate electricity.

At the outlet of the high- pressure turbine, the steam is reheated in the SGS and the hot reheated steam is fed to the low-pressure turbine. The low-pressure turbine outlet steam is condensed transferring the residual heat to a mechanical draft wet cooling tower. The condensed water is pumped through a system of preheaters and a de-aerator and returned to the SGS.

Once the HTF has passed through the heat exchangers, the cooled HTF is returned to the solar field and the cycle is repeated.

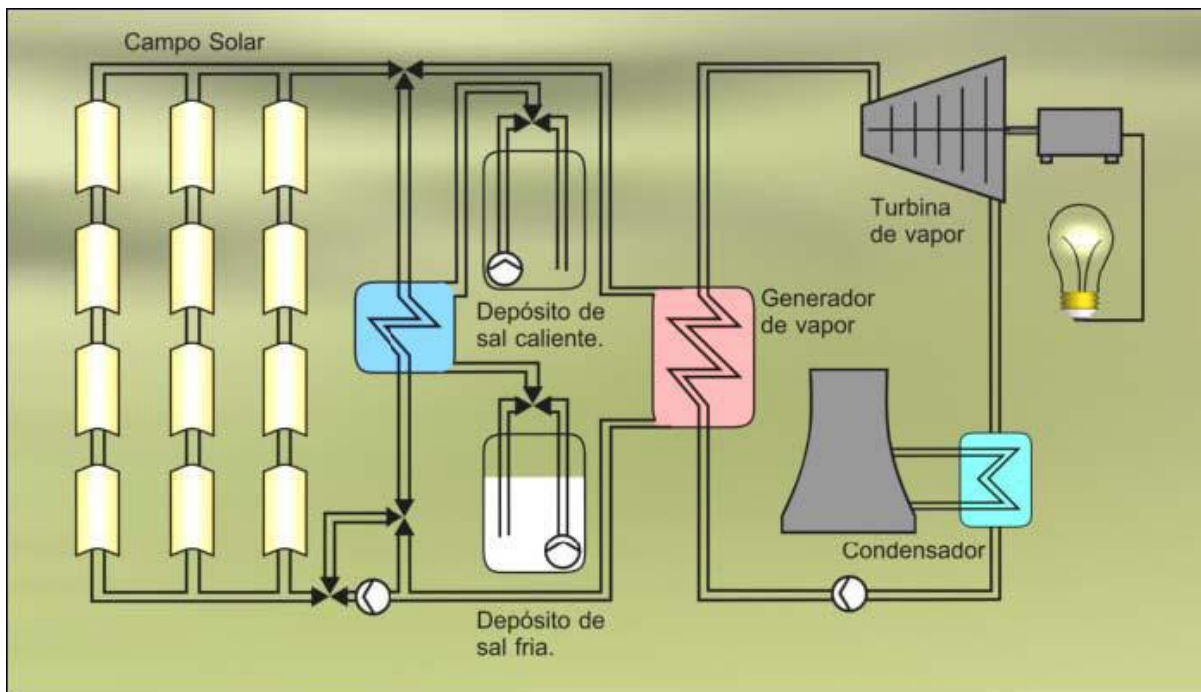
During the summer months the plant can be expected to operate on solar energy for 10 to 12hrs a day. During Peak Hours (high electricity demand with conditions of low or no solar radiation) an energy storage system consisting of two molten salt tanks will be used to generate steam for the turbines. The energy storage capacity of the molten tanks will be equivalent to 3 hours of operation under full load of the steam turbine.

Therefore, the plant will be designed to generate electricity whilst also loading the Thermal Storage System (TSS). The heat contained in the HTF will be transferred to the Molten Salts Fluid tank through the HTF/Salts Heat exchanger. The molten salts fluid will be pumped from the Cold Tank to the Hot Tank through this Heat Exchanger and the thermal energy will be stored in the Hot Tank. With this energy it is possible to produce electricity after sunset.

After sunset, the operation of the solar field is shut down and the download from the thermal storage begins. The thermal load of the hot salts is transferred to the HTF in the HTF/Salts heat exchanger and into the SGS to maintain the electricity production in the turbine- generator.

Finally, in order to prevent the molten salts and thermal oil from freezing during non-operation periods, auxiliary boilers will be installed to maintain the minimal temperature needed for both liquids. The auxiliary boilers, in addition to their operation for non-freezing functions, may also be used to produce steam in the SGS in order to support the synchronization of the turbine.

Figure 2-7 Basic Plant Process Sketch



As the figure above was provided by the EPC in Spanish, a translation of the terms used is provided below:

Campo solar – Solar field;

Condensador – Condensator;

Deposito de sal caliente – Hot salts tank;

Deposito de sal fria – Cold salts tank;

Generador de vapour – Vapour generator;

Turbina de vapour – vapour turbine.

2.6.1 Plant Operation Modes

Based on the time of day and solar radiation capacity, the plant will be designed to operate in the following standard modes.

MODE 1 - THERMAL OIL HEATING SYSTEM

Thermal Oil is heated up with the energy from the Solar Field. This mode is only accessed from Mode 7 (Safe Plant Shut-down).

MODE 2 – HEAT TRANSFER FROM THE SOLAR FIELD TO THE STEAM GENERATION SYSTEM

When there is enough solar irradiation to operate the Steam Turbine but no excess energy to send to Thermal Storage or when Thermal Storage is completely charged.

The HTF Main Pumps will pump the HTF from the Expansion Vessel through the Solar Field, to the Steam Generation Trains, and back to the Expansion Vessels.

The Solar Field will capture the maximum available energy or the energy required for the desired electrical generation at the Steam Generation Train (SGT), whichever is lower. HTF flow will be adjusted to this demand, and Solar Field will defocus partially if the available energy exceeds the demand. Hot HTF temperature will be maintained at the target hot HTF temperature (typically 390-395°C).

MODE 3 – HEAT TRANSFER FROM THE SOLAR FIELD TO THE STEAM GENERATION SYSTEM AND SALTS THERMAL STORAGE SYSTEM

When the solar irradiation is enough to keep the Steam Turbine at the desired load and to send excess energy to Thermal Storage.

The HTF Main Pumps will pump the HTF from the Expansion Vessel through the Solar Field, to the Steam Generation Trains or the HTF/Salt Heat exchangers (in a parallel way), and back to the Expansion Vessel.

The Cold Salt Tank Pumps will pump the salt from the Cold Tank, through the HTF/Salt Heat exchangers, to the Hot Tank.

The Solar Field will capture the maximum available energy or the addition of the SGT and Thermal Storage demands, whichever is lower. HTF flow will be adjusted to this demand, and Solar Field will defocus partially if the available energy exceeds the demands.

MODE 4 – HEAT TRANSFER FROM THE SOLAR FIELD TO THE SALTS THERMAL STORAGE SYSTEM

When there is low solar irradiation and it is preferable to store energy from the Solar Field in the Thermal Storage system for later use (at a higher load and optimum efficiency) instead of producing electricity in the Steam Turbine at lower loads and low efficiency, or when the Steam Turbine is not available.

The HTF Main Pumps pump the HTF from the expansion vessel, through the solar field, to the HTF/Salt heat exchangers (by-passing the Steam Generation Trains), and back to the Expansion Vessel.

The Cold Salt Tank Pumps will pump the salt from the Cold Tank, through the HTF/Salt heat exchangers, to the Hot Tank.

The Solar Field will capture the maximum available energy or Thermal Storage demand, whichever is higher. HTF flow will be adjusted to this demand, and Solar Field will defocus partially if the available energy exceeds the demand. Hot HTF temperature will be maintained at the target hot HTF temperature.

MODE 5 – HEAT TRANSFER FROM THE SOLAR FIELD AND SALTS THERMAL STORAGE SYSTEM TO STEAM GENERATION SYSTEM

When the energy coming from Solar Field is not enough to keep the Steam Turbine at the desired load and there is energy available at Thermal Storage.

The HTF Main Pumps pump the HTF from the Expansion Vessel to the Solar Field and the HTF/Salt Heat exchangers, in parallel, and then to Steam Generation Trains and back to Expansion Vessel.

The Hot Salt Tank pumps will pump the salt from the Hot Tank, through the HTF/Salt Heat exchangers, to the Cold tank.

The Solar Field will capture the maximum available energy, and Thermal Storage will supply the additional energy demanded by the SGT. One control valve at the Solar Field inlet and one control valve in the HTF side of the Thermal Storage will work together as a split-range to distribute HTF flows between Solar Field and Thermal Storage as necessary.

MODE 6 – SALTS THERMAL STORAGE SYSTEM TRANSFER TO THE STEAM GENERATION SYSTEM

When there is no available energy from the Solar Field but there is available energy from Thermal Storage.

The HTF Main Pumps pump HTF from the Expansion Vessel to the HTF/Salt Heat exchangers and from here to the Steam Generation Trains, and back to the Expansion Vessel.

The Hot Salt Tank Pumps will pump the salt from the Hot Tank, through the HTF/Salt Heat exchangers, to the Cold Tank.

The Solar Field Recirculation Pump will be put into operation in order to avoid freezing in the Heat Collecting Elements of the Solar Field Loops.

The HTF flow will be adjusted to meet the thermal power demand of the SGT. Hot salt flow will be adjusted to attain target hot HTF temperature for this mode.

MODE 7 - PLANT SHUT-DOWN

This is a transit mode which can appear for a short or long Plant halt, when there is no solar resource, TES is exhausted, under certain alarms or adverse ambient conditions, even in cases of planned outages.

The Thermal Oil circulation through HTF system may be stopped. The HTF heating pumps and the HTF heaters must be stopped and the lines to SGS and TES must be closed.

During a short shutdown period, it is recommended that pressure be maintained in the steam system, in order to facilitate start-up. Therefore, the auxiliary steam boiler for turbine sealing must be operated.

If Plant shutdown occurs, MODE 8 must be implemented in order to prevent an unsafe situation due a low temperature in the solar field.

MODE 8 - ANTIFREEZING

This mode will be selected after Plant shutdowns, when there is no solar irradiation and no Thermal Storage operation. This mode tries to avoid excessive HTF cooling.

One Freeze Protection Pump will pump the HTF from the Expansion Vessel, through the HTF heaters, to the Solar Field, and back to the Expansion Vessel, by-passing the Steam Generation Trains and the HTF/Salt heat exchangers.

Circulation is not continuous and is operated in short time intervals, in order to achieve a homogenous temperature distribution in the HTF. Without this circulation, HTF contained certain portions of the system could approach freezing temperature while the HTF in the rest of the system remains warm.

The HTF Heaters may be started or not, depending on the average HTF system temperature. The Operator will start them as needed to maintain HTF temperature level.

MODE 9 - PREHEATING OF SGS WITH HTF HEATERS

The piping design of the present plant allows the SF and the SGS to be warmed separately. The HTF that remains blocked inside the SGS after daily shutdowns is subject to cooling. Therefore, the plant will be equipped with the flexibility to isolate a separate circuit for SGS preheating. This is especially important in order to achieve the right temperature in the SGS before hot oil from the solar field is fed to the steam generation equipment. As a result, not only thermal shock is avoided and equipment is protected but also the plant start-up time is optimized.

Thermal oil from the HTF heaters is pumped through each steam generation train by means of a separate header that splits into two connections, one downstream each SGS inlet isolation valve. After preheating the SGS equipment the oil is sent back to the expansion vessel to finally feed the HTF anti-freezing pumps and close the circuit. This operation is expected to simultaneously take place whilst the solar field preheating is done through the main HTF circuit.

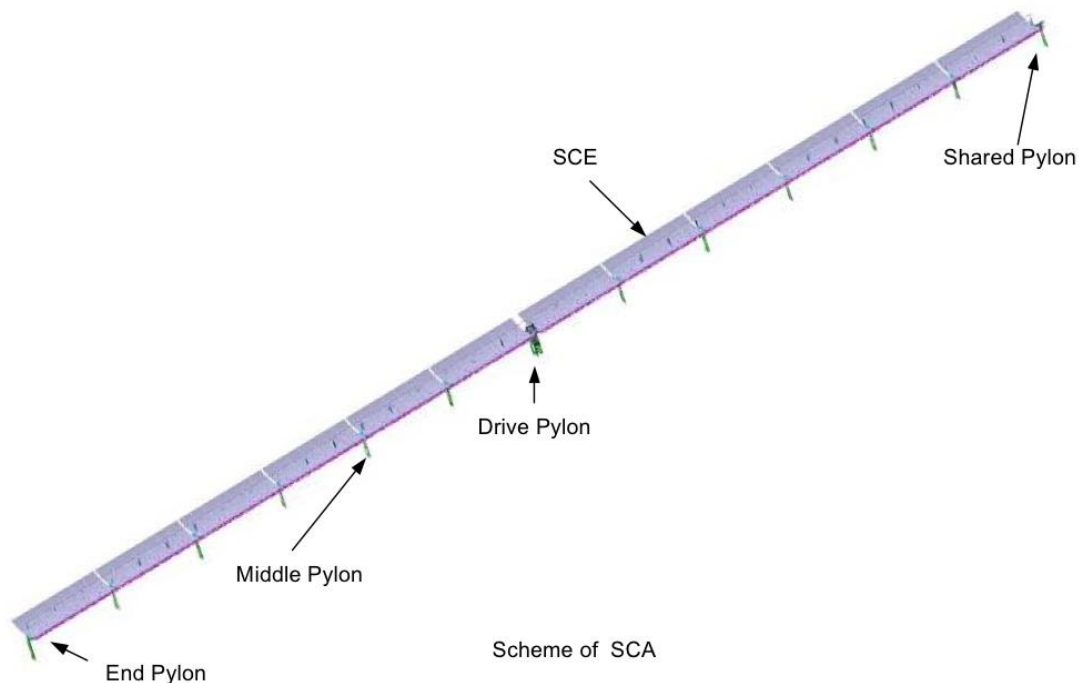
Once stabilization takes place and the generator is running at minimum output, the operator will start diverting oil from solar field into the SGS in order to increase power generation. Gradually, the oil from the HTF heaters is slowed down until it is stopped and only oil from solar field feeds the SGS equipment. The HTF Heaters will not support power generation.

This mode can be used for preparing the SGS for TES discharge.

2.6.2 Main Complex Facilities

Solar Field

The Solar Field will consist of 400 loops, with each loop comprising of four (4) connected Solar Collector Assembly (SCA) modules. Each of the SCA will contain up to twelve (12) Solar Collector Element (SCE) modules, which will collect the heat from the sun. The solar collectors will be capable of heating the HTF to a range of 297 °C to 393°C.



Heated Transfer Fluid (HTF) System

The HTF system is in charge of receiving and transferring the solar energy obtained in the solar field to the Steam Generation System (SGS) and the Thermal Storage System (TSS). This system is divided into various subsystems that carry out different tasks, as described below.

Solar Field - Main Headers

The solar field is made up of a network of pipes, the HTF Circuit, which consists of Heat Collector Elements (HCE) through which the HTF is circulated and heated by solar

radiation. The heated HTF is eventually carried to the Power Island to be fed into the SGS and TSS.

Main HTF Pumps

The HTF is pumped throughout the field and the Power Island by the main HTF pump.

HTF Expansion

During the thermosolar plant operation the HTF is subject to both thermal expansion and contraction. The expansion and overflow system buffers the volume changes of the HTF due to heating or cooling. The expansion tank is also used for top-up and temporary HTF storage during maintenance of the circuit.

The subsystem consists of one expansion tank and four overflow tanks.

A Nitrogen system inertises and pressurizes the expansion and overflow tanks and the main HTF circuit in order to ensure that the oil circuit is always kept above the oil's boiling pressure and the oil flows in liquid state.

HTF Heating

The HTF Heater subsystem is made up of two Thermal Oil Heaters, which guarantee that the oil's temperature will be maintained above 70° C to prevent deterioration from oxidation and potential freezing during long non-production periods. The Thermal Oil Heater capacity will be 72 MWt (36MW) in order to provide the necessary energy to produce the steam required to synchronize the turbine. These boilers will burn light diesel fuel, and will have a common exhaust stack. The flue gas stack will include sample points for the temperature analysis and control of the combustion smoke. Boiler emissions will include: SOx, NOX, PM10, CO2 and CO.

HTF Condensation and Purification (Ullage system)

The main function of the HTF condensation and purification system is to condense the HTF vapour that is vented from the expansion system and to purify the HTF in order to avoid the accumulation of oil's degradation products within the oil circuit.

The condensation process consists of two consecutive condensation tanks, which are used to separate the nitrogen from the vaporized HTF in the expansion tank vent. The HTF is recovered (i.e. condensed) by lowering the temperature using air-coolers. Liquids from the condensation tank are drained into a tank for safe disposal. The vent of the

condensation tank is equipped with an active carbon filter to avoid emissions of volatile compounds to the atmosphere.

During the life of the Plant, the HTF will degrade. Consequently a Purification System will separate the heavy degraded compound, 'low boilers', from the HTF. This is achieved by passing the HTF through a Flash Tank, which creates a purified gaseous phase and a liquid phase. The liquid will be rich in degraded compounds and subsequently eliminated from the system.

Steam Generation and Balance of Plant (BOP)

Steam Generation System

The Steam Generation System (SGS) of the power Plant will consist of a regenerative Rankine cycle (5+1 extractions) with two parts at two pressure levels with intermediate reheating. With a nominal load (160 MW), the characteristics of the steam in the turbine inlet are the following:

- High Pressure Intake Body (HP): approx. 105 bar (a), 380 °C
- Low Pressure Intake Body (LP): approx. 17.4 bar (a), 380 °C

The energy captured in the solar field will be used to produce steam, which will be sent to the turbines to produce electricity.

The feed water sent to the Steam Generation System is heated in the Economiser, converted into steam in the Evaporator and superheated in the Superheater, producing main steam at 380 °C that is sent to the high-pressure body of the steam turbine.

Subsequently, the cold reheat steam is sent to the Reheater of the SGS to obtain hot reheat steam, which is then sent to the low-pressure body of the steam turbine. Finally, the steam exiting the low-pressure outlet is conducted to the condenser, where the cycle is repeated.

Condensation System

The main function will be to extract and condense the steam from the Low Pressure Steam Turbine. Downstream, the condensate will be sent to the de-aerator through the LP Water Preheaters and will re-heat the condensate as it passes through. The cooling medium is circulating water, cooled by an evaporative cooling tower circuit.

Feed Water System

This circuit consists of degasification of the condensate in the de-aerator in order to prevent corrosion in the tubes of the SGS exchangers. Additionally, the system enables heating of the feed water through the high-pressure water pre-heaters.

Thermal Storage System (TSS)

The main function of the Thermal Storage System (TSS) is to store the thermal energy in order to extend the operation of the plant during Peak Hours by providing thermal energy when there is not enough solar energy available to run the plant at full load.

The main components of this system are the Storage Tanks, one for cold salts and the other for hot salts, the cold and hot salts pumps and the HTF/Salts Heat Exchangers.

The molten salt is a mixture of Sodium Nitrate and Potassium nitrate, commonly called *saltpeter*. Molten salt has a high heat transfer coefficient and high thermal storage capacity.

2.6.3 Interfaces

The following describes the interfaces with other systems or related equipment, which are necessary for the system operation.

Cooling Tower

The cooling system has been designed to relieve the heat loads produced by the main condenser, heat exchangers of the closed cooling circuit, and the cooling exchangers of the vacuum pump.

Auxiliary fuel system

The fuel system will not be used to complement the energy production during low or no radiation periods. Instead, the diesel fuel will be used in the following plant processes, either as the main source or for back up to ensure safe operation of the SPC:

- Support for starting up for the minimal turbine technical load (up to synchronization)
- Maintaining the minimal temperature of the HTF when there is no solar radiation
- HTF Boilers efficiency
- Thermal power for stand-by
- SGS nominal power

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.

The following chemicals may be used: alkaline solutions (sulphuric acid), deoxygenating agents, Tri-sodium Phosphate, corrosion inhibitors and anti-fouling agents (Sodium hypochlorite).

2.6.4 Auxiliary Systems

Auxiliary Cooling System

The purpose of this cooling system will be to facilitate the evacuation of non-useful heat that will be generated by the auxiliary equipment, such as: electric generator coolers, air compressors coolers, feedwater pumps, condensate pumps, thermal oil pumps, etc.

The system will consist of an open cooling circuit, which will take water from the cooling tower pond, in order to cool the auxiliary cooling system closed circuit plate exchangers and the condensate system vacuum pumps.

Water Treatment Plant

Wastewater generated by the various units at the solar plant will be treated by an on-site wastewater treatment facility. The treatment process will include:

- Pre-treatment Unit: disinfection with hypochlorite, coagulation-flocculation, flotation-clarification and sand filtration bed. The sludge will be thickened and dehydrated in a centrifuge for subsequent off-site disposal at the Ouarzazate municipal waste treatment facility.
- Demineralisation Unit: The treated water will then be sent to a polishing system, which will carry out chemical conditioning, microfiltration, a second step of reverse osmosis and finally electro deionization.

Pre-treated or filtered water will be used as: Tempering water, Service water, Drinking water, Reverse osmosis feed, and cooling tower direct make-up.

Demineralized water will be used for water-steam cycle make-up (water supply to the condenser and the degasser) and for mirror cleaning in the solar field.

The final remaining unused treated water will be sent to evaporation ponds, located in the southern quadrant of the proposed SPC.

Sampling System

Continuous analysis will be carried out by either automated systems or manually on a regular basis to verify optimum operations and ensure compliance with relevant regulations.

The following systems will be monitored: BOP water, auxiliary boiler, steam generation system, water treatment plant, and HTF system.

Other Auxiliary Systems

- Compressed Air System: Will supply instrument air and service air to different components of the SPC.
- Blanketing System: Will minimise risks due to flammable products, minimise emissions to the atmosphere and will prevent deterioration of certain sensitive equipment.
- Fire fighting System
- HVAC system
- Electrical Systems
- Plant Control Systems /Distributed Control System

2.7 Construction Phase

2.7.1 Construction Activities

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

A "cut and fill" plan will be generated to ensure that the site's platform follows the natural incline of the plateau. The platform will be distributed in 7 levels, where the

difference in maximum height between two adjacent levels will be 3.20m. Each level will have a descending slope of 0.2% from north to south, following the natural slope of the terrain. A transversal slope of 0.4% will be defined so that drainage runs to the east side of the site.

Figure 2-8 Longitudinal Profile of the Platform



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. Excavated soil will be reused where possible.

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 Morocco, 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.

2.7.2 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.

2.7.3 Construction Logistics

2.7.3.1 Programme

The construction is expected to last about 28 months from Notice to Proceed, followed by 1 year of optimization and demonstrating performance guarantees to reach Final Commercial Operation.

2.7.3.2 Workers and Facilities

Given the duration of the contract and the volume of construction, it is expected that all workers will live off-site. At the peak of construction it is anticipated that as many as 1,200 workers will be employed on site. The 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.

2.7.3.3 Water supply

Contractors will be responsible for the supply of water during construction. A water tank with sufficient capacity to meet construction water needs will be installed on site. Lorries will be used to fill the water tanks.

3 REQUIREMENTS FOR ENVIRONMENTAL ASSESSMENT

3.1 National Requirements

The law no. 12-03 for the year 2003 sets out the process for conducting an Environmental Impact Assessment (Etude d'Impact sur l'Environnement) within Morocco. Any project, which may have a significant impact on the environment, must have a comprehensive EIA carried out, before permission to operate (or license to begin construction) can be given.

The Environment Department is the government authority entrusted to enforce the environmental regulations for the EIA and is contained within the Ministry of Energy, Mines, Water and Environment (MEMEE). Decree No. 2-04-563 outlines the roles and responsibilities of the national and regional committees, which will be entrusted, with the review and approval of the SESIA.

The National Committee (CNEIE) will review projects, which are over 200 million Dirhams in investment, and the Regional Committee (CREIE) will review projects that are under 200million Dirhams in investment.

3.2 International Requirements: World Bank, AfDB, EIB, KFW and AFD

3.2.1 The World Bank Environmental Safeguard Policies

The World Bank (WB) has 10-major Social and Environmental Safeguards that are applicable in development projects. The World Bank considers these policies to be the cornerstone of its support to sustainable poverty reduction. The objective of these policies is to prevent and mitigate undue harm to people and their environment in the development process. These policies provide guidelines for bank and borrowers in the identification, preparation, and implementation of programmes and projects. The policies that have been triggered by this project are:

- Environmental Assessment; and
- Involuntary Resettlement.

Although the land acquisition process was a voluntary process, the WB has determined that this operation triggered the Involuntary Resettlement Policy. Therefore, a Land Acquisition Plan (LAP) to describe the land acquisition process and monitor use of the

proceeds to the benefit of the local population was prepared. The LAP includes, in particular, the following documents: a) copy of the land price committee determination of the price of the land, b) copy of the written agreement by the community of the Ait Oukroun Toundout on the sale and conditions of the transfer of the land, c) copy of the authorization of the Supervisory Board about the transaction and d) ONE/MASEN/Community tripartite agreement on land acquisition. The land acquisition was completed as per the process described in the LAP, July 2011.

3.2.2 The AfDB Environmental Safeguard Policies

The assessment of the Ouarzazate CSP has been conducted to take into account the AfDB's environmental safeguard policies as outlined in the Environmental and Social Assessment Procedures (ASAP) June 2001. As with all other bank environmental procedures these guidelines are intended to help identify the environmental and social issues that may arise from the construction and operation of a project, and subsequently develop the necessary mitigation and monitoring actions that will help to minimise and prevent the identified impacts.

Therefore, in addition to the ASAP, the AfDB also provides procedures for the development of the Environmental and Social Management Plan (ESMP), which has been provided in this SESIA.

Finally, the AfDB also provides a guideline for a Resettlement Action Plan (RAP), which has been addressed in the LAP, as mentioned previously, and has therefore been closed out.

3.2.3 The EIB, KfW, AFD Environmental Safeguard Requirements

The project is seeking a proportion of financing from international lenders. The specific requirements of each IFI cannot therefore, reasonably be incorporated into the SESIA, as the IFI's requirements can be contradictory, and would only result with confusion.

As an example of this the EIB's Environmental and Social Principle and Standards, 2009, states the following:

"In the case of co-financing, the Bank is prepared to accept a common approach based on the relevant requirements of one of its financial partners, for reasons of consistency and harmonization, and to avoid duplication. For instance, in projects outside the EU, working in cooperation with other international public and private

financial institutions, a common approach based on the Equator Principles or the safeguards of the World Bank may be followed”.

Since, the project is seeking financing from several international lenders, the WB/IFC standards and guidelines and the Equator Principles have been utilized in the assessment and are described below.

It should however be noted, that the project proponent is required to comply with all contractual agreements by all lending banks.

3.2.4 Background to 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) have reviewed the Equator Principles in 2012 (EP III) and these are currently in draft for consultation but are not applicable to this project as they have not been formally adopted.

The Equator Principles consist of 10 Principles and EPFIs will only provide loans to projects that conform to Principles 1-9 detailed below:

Table 3-1 Equator Principles II (2006)

| Equator Principle | Details |
|--------------------|---|
| Principle 1 | <p>Review and Categorisation</p> <p>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</p> |

| | |
|---------------------------|--|
| | <p>Corporation (IFC). These categories are:</p> <ul style="list-style-type: none"> • Category A- Projects with potential significant adverse social or environmental risks and/or impacts that are diverse, irreversible or unprecedented; • Category B – Projects with potential limited adverse social or environmental 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 or environmental risks and/or impacts. |
| <p>Principle 2</p> | <p>Social and Environmental Assessment</p> <p>For a project being assessed as either Category A or B, the borrower must complete and disclose a Social and Environmental Assessment (SEA), previously called an Environmental and Social Impact Assessment (ESIA). The SEA must comprise an assessment of social and environmental impacts including labour health and safety provision.</p> <p>The SEA report is required to address the relevant potential impacts and risks that may include some, or all, of the following:</p> <ul style="list-style-type: none"> a) Assessment of the baseline environmental and social conditions; b) Consideration of feasible environmentally and socially preferable alternatives; c) Requirements under host country laws and regulations, applicable international treaties and agreements; d) Protection of human rights and community health, safety and security (including risks, impacts and management of project's use of security personnel); e) Protection of cultural property and heritage; f) Protection and conservation of biodiversity, including endangered species and sensitive ecosystems in modified, natural and critical habitats, and identification of legally protected areas; |

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| | <p>g) Sustainable management and use of renewable natural resources (including sustainable resource management through appropriate independent certification systems);</p> <p>h) Use and management of dangerous substances;</p> <p>i) Major hazards assessments and management;</p> <p>j) Labour issues (including the four core labour standards) and occupational health and safety;</p> <p>k) Fire prevention and life safety;</p> <p>l) Socio-economic impacts;</p> <p>m) Land acquisition and involuntary resettlement;</p> <p>n) Impacts on affected communities, and disadvantaged or vulnerable groups;</p> <p>o) Impacts on indigenous peoples, and their unique cultural system and values;</p> <p>p) Cumulative impacts of existing projects, the proposed project and anticipated future projects;</p> <p>q) Consultation and participation of affected parties in the design, review and implementation of the project;</p> <p>r) Efficient production, delivery and use of energy; and</p> <p>s) Pollution prevention and waste minimization, pollution controls (liquid effluents and air emissions) and solid and chemical waste management.</p> <p><u>The SEA will also include:</u></p> <ul style="list-style-type: none"> • An assessment of compliance with applicable host country laws, regulations and permits; and • Proposed mitigation measures relevant and appropriate to the nature and scale of the proposed project. |
| <p>Principle 3</p> | <p>Applicable Social and Environmental Standards</p> |

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| | <p>For projects located in <i>OECD countries not designated as High-Income</i>, or in non-OECD countries, as is the case for the Morocco, the SEA will also refer to the IFC Performance Standards on Social and Environmental Sustainability and the relevant industry-specific Environmental, Health and Safety (EHS) Guidelines, which are described in the later section of this report.</p> <p>The IFC Performance Standards consist of the following aspects:</p> <ul style="list-style-type: none"> ▪ Performance Standard 1: <i>Assessment and Management of Environmental and Social Risks and Impacts;</i> ▪ Performance Standard 2: <i>Labour and Working Conditions;</i> ▪ Performance Standard 3: <i>Resource Efficiency and Pollution Prevention;</i> ▪ Performance Standard 4: <i>Community Health, Safety and Security;</i> ▪ Performance Standard 5: <i>Land Acquisition and Involuntary Resettlement;</i> ▪ Performance Standard 6: <i>Biodiversity Conservation and Sustainable Management of Living Natural Resources;</i> ▪ Performance Standard 7: <i>Indigenous Peoples;</i> and ▪ Performance Standard 8: <i>Cultural Heritage</i> |
| <p>Principle 4</p> | <p>Action Plan and Management System</p> <p>For Category A and B projects located in non-OECD countries or <i>OECD countries not designated as High-Income</i>, the borrower will prepare an Action Plan (AP), which addresses the relevant findings, and describes/prioritise the actions needed to implement corrective actions and mitigation and/or monitoring measures necessary to manage the impacts and risks identified in the assessment.</p> |
| <p>Principle 5</p> | <p>Consultation and Disclosure</p> <p>For all Categories A and, as appropriate, Category B projects located in or non-OECD countries or <i>OECD countries not designated as High-Income</i>, the borrower will consult with project-affected communities. A Public Consultation and Disclosure Plan (PCDP) may be required by EPFIs.</p> |

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| Principle 6 | Grievance Mechanism For all Category A and, as appropriate, Category B projects located in non-OECD countries or in <i>OECD countries not designated as High-Income</i> , the borrower will, scaled to the risks and adverse impacts of the project, establish a grievance mechanism as part of the management system in order to ensure that consultation, disclosure and community engagement continues throughout construction and operation of the project. |
| Principle 7 | Independent Review For all Category A and, as appropriate, Category B projects, an independent social or environmental expert not directly associated with the borrower will review the SEA, AP and consultation process documentation. |
| Principle 8 | Covenants For all Category A and B projects, the borrower will covenant in financing documentation incorporated and linked to comply with all relevant host country social and environmental laws, regulations and permits in all material respects and the AP (where applicable) during the construction and operations of the project, and to provide periodic reports at least annually, prepared by in-house staff or third party expert, in a format agreed by EPFIs as well as to decommission the facilities where applicable and appropriate. |
| Principle 9 | Independent Monitoring and Reporting For all Category A, and appropriate, for Category B projects, in order to ensure ongoing monitoring and reporting over the life of the loan EPFIs will require appointment of an independent environmental and/or social expert, or require the borrower retain qualified and experienced external experts to verify its monitoring information which would be shared with EPFIs. |
| Principle 10 | EPFIs Reporting |

Each EP Financial Institution adopting the Equator Principles commits to report publicly at least annually about its Equator Principles implementation processes and experience.

The revised principles detail projects that are classified as Category A or B projects are required to complete and disclose a Social and Environmental Assessment (SEA). This is defined as a process that 'determines the social and environmental impacts and risks (including labour, health and safety) of a proposed project in its area of influence' (EP, Statement of Principles, July 2006).

The anticipated environmental and social impacts identified and mitigated in this project are not unprecedented, can be readily mitigated and may be reversed in the future. However, the WB Regional Safeguard Adviser has categorised the Ouarzazate Power Plant Project as Category A. For this reason, the environmental and social assessment has been undertaken to meet Category A requirements.

3.2.5 IFC Sector Specific Guidelines

The World Bank Group / International Finance Corporation (IFC), Environmental, Health and Safety (EHS) General Guidelines of April 2007 superseded the World Bank Handbook issue of 1998. In addition, a number of sector specific guidelines have been revised or are undergoing peer review.

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: Resource Efficiency & Pollution Prevention, as well as certain aspects of Performance Standard 4: Community Health, Safety and Security.

When Moroccan Environmental regulations differ from the levels and measures presented in the EHS Guidelines, the Project will be expected to achieve whichever is more stringent.

3.3 SESIA Procedure

The international SEA requirements largely follow the same principles noted within the Moroccan environmental regulations with regards to the assessment methodology, although the Equator Principles, in comparison to the national standards, gives comparatively greater emphasis to the social assessment of projects.

The term FESIA (Framework Environmental and Social Impact Assessment) has been used in the Kingdom of Morocco to refer to the reports that compared strategic alternatives (what internationally is called Strategic Environmental Assessment). In the Ouarzazate SPC the FESIA compared the impacts of different solar technologies and established the baseline for the site. The term "Specific Environmental and Social Impact Assessment" (SESIA) has been used to describe project specific assessments. Given the relative similarity content between SEAs and SESIAs and in the interest of consistency, 'SESIA' is the term that will be referred to throughout the rest of this report.

4 LEGAL FRAMEWORK, STANDARDS AND GUIDELINES

The SESIA study will adopt and comply with the following environmental standards to ensure that the proposals meet the relevant national and international requirements:

- National environmental legislation, regulations and standards; and
- World Bank / IFC standards.

4.1 National

The main Moroccan legislation with regards to the environment consist of the following, which the proposed plant will be required to comply with:

- Law No 12-03 concerning the environmental impact study process.

Promulgated by Dahir No. 1-03-06 of 10 Rabii I 1424 (12 May 2003), lists the projects subject, the procedure of implementation and methodology of impact studies.

This Act establishes the creation of a national committee and regional committees entrusted with the review of the environmental impact studies.

- Law No 11-03 concerning the protection and improvement of the environment.

This law sets the general framework for the protection of the environment in Morocco, by identifying:

- Principles of environmental protection related to human settlements and the protection of nature and natural resources;
- Principle for establishing discharge standards and the definition of nuisances;
- Management tools and protection of the environment that are described within the impact studies, plans and standards.
- Standards of environmental quality and financial and tax incentives. The law also establishes a national fund for the protection and enhancement of the environment;
- Procedural rules defining the responsibilities and obligations in the event of damage.

- Law No 13-03 concerning air pollution and decree No 2-09-286 of 23 Rajeb 1431.

Chapter II of the Act, Article 2 states that the Act applies to any person or entity, public or private, who owns or possesses or uses or operates buildings or mining, industrial, commercial, agricultural or crafts. It also applies to motor vehicles or equipment or combustion or waste incineration or heating or cooling.

Chapter III of the Act, Article 4 states that "it is forbidden to release, issue or refuse to allow the release, emission or discharge of pollutants in the air such as toxic gas or corrosive fumes, vapors, heat, dust, odors beyond the quality or concentration allowed by the standards laid down by regulation."

This article also states that "in the absence of standards laid down by regulation, operators of installations referred to in Article 2 are required to apply the most advanced technologies available to prevent or reduce emissions."

Through Decree No. 2-09-286 of 20 Di Hijja 1430 (8 December 2009), this law sets standards for air quality and air monitoring.

- Law 10-95 concerning water management and decree No. 2-04-553 and 2-97-787 regarding wastewater management and water quality standards, respectively.

Decree 553 paves the way for the effective implementation of reporting procedures for existing discharges and subsequent payment of fees. The implementation of the Decree induces the need to:

Request authorization to discharge from the concerned water authority;

Meet the discharge limits set by domestic Order No. 1607-06 (25 July 2006).

Decree 787 aims to define quality classes to normalize and standardize the assessment of water quality. It also defines orders via quality standards which water must meet depending on the treated water use, including:

- Potable water;
- Irrigation;
- Wastewater for irrigation and aquaculture.

- Law No 28-00 concerning Waste Disposal and Management.

This Act aims to prevent and protect human health, fauna, flora, water, air, soil, ecosystems, sites and landscapes and the environment in general against the effects of harmful waste, by ensuring the following:

- The reduction of harmful waste production;
- The organization of the collection, transport, storage, waste treatment and disposal in an environmentally sound manner;
- The recovery of waste by reuse, recycling or any other operation reusable means for energy recovery;
- Planning national, regional and local management and disposal waste;
- Informing the public about the harmful effects of waste on public health and environment as well as measures to prevent or compensate for their adverse effects;
- The establishment of a system of control and punishment for offenses.

4.2 International and Regional Conventions ratified by Morocco

The international and regional conventions and protocols that are relevant to protection of environment will be acknowledged in relation to the environmental impact assessment of the proposed Integrated Ouarzazate SPC, are provided below:

- Bonn Convention on Migratory Species of Wild Animals (1983).

This global convention created in 1979 by the United Nations Environment Program (UNEP) is an agreement for the conservation of migratory species of wild animals. Two appendices list migratory species that require conservation measures.

Appendix 1 includes species threatened with extinction, and Appendix 2 lists migratory species whose conservation status requires an international agreement of cooperation.

Under the Bonn Convention Morocco has signed several agreements including the Agreement on the Conservation of Migratory Waterbirds in Africa - (AEWA). To this end the Contracting Parties "... investigate problems that arise due to human activities and endeavor to implement remedial measures including restoration and habitat rehabilitation and compensatory measures for loss of habitat. "

- Washington Convention on International Trade in Endangered Flora and Wildlife (CITES 1975).

Morocco has signed the Convention in 1975 and entered into force in 1976. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species in the wild, and it accords varying degrees of protection to more than 34,000 species of animals and plants. This convention is regularly cited as a reference to the threat level of the species.

- Protecting the ozone layer: the Montreal Protocol (1992);

As a party to the Montreal Protocol, has the obligation to protect the ozone layer by taking precautionary measures to control equitably total global emissions of substances that deplete it, with the ultimate objective of their elimination on the basis of developments in scientific knowledge, taking into account technical and economic considerations and bearing in mind the developmental needs of developing countries.

- RAMSAR convention on the protection of Wetlands of International Importance (1971, updated 1980).

Morocco has committed to maintain the ecological character of its Wetlands of International Importance and to plan for the sustainable use, of all of the wetlands in its territories.

The Convention uses a broad definition of the types of wetlands covered in its mission, including lakes and rivers, oases, estuaries, and human-made sites such as fish ponds, and reservoirs, to name a few.

- Climate Change Framework: United Nations Convention on Climate Change (1995) and protocol of Kyoto (2002)

Morocco has committed to develop national inventories of anthropogenic emissions and removals of greenhouse gases, consider climate change in policies and actions and adopt methods such as impact assessments, and formulate mitigation measures.

- Biodiversity Convention of Rio Janeiro on Biological Diversity (1995)

Committed to the conservation and maintenance of biological diversity alongside economic development.

- Vienna Convention and the London amendment (1995)

Morocco was committed to adopt appropriate legislative or administrative measures and co-operate in harmonizing appropriate policies to control, limit, reduce or prevent human activities under their jurisdiction or control should it be found that these activities have or are likely to have adverse effects resulting to the depletion of the ozone layer.

- African Convention on the Conservation of Nature and Natural Resources whose acts were reaffirmed at Earth Summit in Johannesburg in South Africa in 2002

This agreement was signed in Algiers on 15 September 1968, replacing the London Convention 1933. Its objectives include the conservation of species, the creation of protected areas and conservation, utilization and development of soil, water, flora and fauna. The Convention establishes three categories of protected areas in parks, reserves and special reserves and introduces the concept of optimal handling for sustainable wildlife resources.

- The International Convention for the Protection of Birds.

Replaces and enhances the Convention for the Protection of Birds Useful to Agriculture, held in Paris in 1902. The updated convention is essentially based on ecological considerations, even if Article 5 introduces an ethical argument and it prohibits the infliction of unnecessary suffering to birds. This Convention shall be applied without exception to all wild birds and designed specifically to protection of all species during their breeding and migration.

- The World Heritage Convention

The World Heritage Convention was adopted by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) General Conference, in Paris 1972. It aims to promote cooperation among nations to protect heritage around the world that is of such outstanding universal value that its conservation is important for current and future generations. It is intended that, unlike the seven wonders of the ancient world, properties on the World Heritage List will be conserved for all time.

4.3 Use of Environmental Standards in the SESIA

Throughout this SESIA, the relevant standards from the bodies described in the above documents have been extracted and presented per chapter as per the relevant environmental parameter.

5 SESIA ASSESSMENT METHOD

5.1 Introduction

The SESIA 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 baseline situation and predict impacts, and described below for the relevant issues.

5.2 Assessment of Impact Significance

Assessing the significance of issues may include some or all of the following:

- Potential impact in relation to MEMEE or international (e.g. World Bank) environmental standards;
- The sensitivity of the receiving environment or receptor locations;
- The reversibility and/or duration of the potential impact; and
- The potential concerns and issues identified by stakeholders.

The determination of 'significance' incorporates judgments of the above together with the potential magnitude of the impact. In addition, the frequency of impacts upon the receiving environment is a factor in determining the significance. An impact that is moderate in size but continuous can be more significant than one that is larger in size, but which is infrequent or rare.

Project impacts can also be considered direct or indirect:

Direct: Effects directly attributable to the plant activities or actions; and

Indirect: Effects not directly attributable to the plant activities or actions.

The determination of significance is therefore dependent upon decisions of the following factors:

Table 5-1 Determination of Impact Significance

| Significance Factors | Description |
|---------------------------------|--|
| Extent/Magnitude | Potential impact will be quantified with range limits wherever possible and relevant modelling may be necessary in order to predict impacts for appropriate factors. |
| Reversibility | A reversible impact is one in which the condition which the impact effects can be returned to the baseline condition prior to the impact. |
| Duration | The length of time of an impact may be short, medium or long term. Typically, with regard to SESIA, this is defined as 2-5 years, 5-15 years and > 15 years respectively. |
| Standards | Complying with the national and international standards, which may exist for a particular impact also helps define the potential significance of an issue. With regard to the proposed project, this would consist of both MEMEE and international guidelines. |
| Sensitivity of receptors | In many areas the sensitivity is further defined by consultation and baseline surveys, which help detail the existing environment. Areas designated nationally or internationally will be considered as sensitive areas and impacts minimised wherever possible. |

5.3 Impacts

After consideration of these variables, an informed decision can be made as to the overall significance of the impact. This will be reported within the SESIA on the following scales, prior to, and after, mitigation measures:

Table 5-2 SESIA Impact Scale

| Impact | Description |
|---|---|
| Major negative or positive impact | Where the development would cause a significant worsening (or improvement) of the receiving environment |
| Moderate negative or positive impact | Where the development would cause noticeable worsening (or improvement) of the receiving environment |
| Minor negative or positive | Where the development would cause very little worsening of the receiving environment |
| No change - Negligible | Where no noticeable impact would occur on the receiving environment |

Primarily the project characteristics relate to:

Physical presence; may include:

- Area of footprint;
- Change/loss of land use;
- Disruption to other infrastructure;
- Visual presence.

Use of resources; may include

- Water use;
- Energy use;
- Raw material use; and
- Resource consumption.

Generation and disposal of waste; may include:

- Gaseous emissions;
- Effluent discharges;
- Solid wastes; and
- Noise and vibration.

5.4 Environmental Issues

On the basis of the Terms of Reference provided by MASEN and approved by the Ministry, and the project team's site visit undertaken in October 2012 and a desk study, a scope was established for the SESIA, in which some issues were deemed of potentially greater significance than others.

The plant will be operated in accordance with conventional and standard processes and procedures for CSPs. Therefore, no environmental issues arising from a specific operation mode that was not experimented elsewhere are likely to occur.

The issues associated with the construction and operation of the proposed plant have been identified and separated into Primary Issues and Secondary issues. Primary issues are those that are of high importance to the project, typically where an impact of a significant magnitude is likely to affect sensitive receptors. Secondary issues include impacts of a lesser magnitude, where there are no sensitive receptors or where mitigation measures can reduce or negate the impact.

5.4.1 Primary issues

The primary issues have been assessed as the following:

- Soil contamination; and
- Water and Wastewater Management

5.4.2 Secondary Issues

The secondary issues have been assessed as the following:

- Air quality;
- Noise;
- Solid and hazardous waste;
- Storm Water Management and Erosion Control;
- Ecology and Biodiversity;
- Social and economic issues;
- Traffic and Transportation;
- Cultural heritage and archaeology, and
- Landscape and Visual Impact.

5.4.3 Baseline Surveys

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

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

- Site walkover survey – October 2012;
- Terrestrial ecology baseline survey – October 2012;
- Noise baseline survey – November 2012;
- Air Quality Monitoring – October/November 2012
- Soil sampling survey – November 2012;
- Community consultation – November 2012;

These surveys are described further within the relevant chapters.

In addition, the following project information has been reviewed within the course of this assessment:

- Framework Environmental Impact Assessment (FESIA) of the Ouarzazate Solar Complex project. January 2011, prepared by Burgeap and Phénixa for MASEN. *Original document in French*
- Ouarzazate Solar Complex Minimal Functional Specifications. May 2011, prepared by MASEN
- Ouarzazate Solar Power Complex – First Phase – Final Technical Proposal. February 2012, Technical Offer prepared by ACWA Power Consortium.
- Ouarzazate Solar Complex Terms of Reference (ToR) for the SESIA. September 2012, prepared by MASEN
- Ouarzazate Solar Power Complex Methodological Framework (MF). October 2012, prepared by 5 Capitals and Phénixa.

5.4.4 Consultation Process

The scale and nature of the proposed project and the emphasis that the Equator Principles and associated Performance Standards place upon community involvement or affected parties emphasise this important aspect of the environmental impact assessment process. It is preferable to incorporate the viewpoints of relevant stakeholders in such a nationally and regionally important development and mitigation for the social or environmental concerns of these stakeholders will be incorporated within the design at an early stage as possible.

In Morocco, the public consultation process is well defined under decree no. 2-04-564 and is a pre-requisite to carrying out the SESIA. The procedures and objectives are similar to those defined under the IFC Performance Standards 1, 4, 5, 7 and 8, which ensure that the development of the Project considers any impacts or practices which may affect local communities or other stakeholders.

Furthermore, Principle 5 of the Equator Principles details that, for all 'Category A' projects, and as appropriate for 'Category A' projects, the Consortium is required to incorporate the communities' concerns.

The site location may have an impact on communities that use the surrounding area on a seasonal or permanent basis, and consultation is key to understanding the existing land use, identifying any community grievances and identifying mitigation measures.

Further details relating to the consultation process that led to the definition of the mitigation measures can be found in the ESMP under the Section 5-10 Consultation Process.

For this project, the public consultation process had already been undertaken in accordance with the procedures outlined for the FESIA preparation. These meetings included:

- First Public Consultation to introduce the project concept. November 3rd 2010.
- Meeting with the CNEIE to discuss the framework of the ESIA. December 10th 2010.
- Public Enquiry for the FESIA was held in September 2011.
- A presentation of the ESIA framework and environmental acceptability was given to the CNEIE. February 22nd 2012.

- Second Public Consultation to provide an update of the ESIA framework. March 6th 2012.
- MASEN provided a presentation of the results of the FESIA on April 24th 2012.

However, in order to meet the EFI's requirements, additional and project specific public consultation was carried out by Phénixa on November 2nd 2012.

The detailed report of the community consultation meeting is provided in Appendix 1.

The public consultation meeting was advertised through the publication of an advert in two national newspapers and the invitation of identified stakeholders in the province of Ouarzazate. The meeting was lead by representatives of Phenixa, ACWA Power and MASEN. Arabic and French were spoken during the meeting and 40 people attended.

An initial presentation was undertaken to outline the main elements of the first phase of the Ouarzazate solar complex, to summarise the environmental baseline on the study area (physical, biological and human), to outline the positive and negative impacts identified, explain the preliminary assessment undertaken and specify the mitigation measures that were being considered.

The stakeholders present at the meeting consisted of the following:

- 40% of participants were local stakeholders (politicians, inhabitants of the Ghassate commune, cultural associations, etc.)
- 32.5% represented different government bodies such as the Délégation de Energies et Mines , Délégation de l'ABHSM (Agence du Bassin Hydraulique de Souss Massa), Haut commissariat aux Eaux et Forêts, Agence urbaine de Ouarzazate, Délégation du Ministère de la Santé..etc) and
- 27.5% were representing local private companies.

Considering that extensive consultations had already been undertaken during the FESIA, the attendance to the meeting was considered very positive.

Regarding the content of the points raised in the meeting, 53% were direct questions and 47% were proposals or comments. The following is a summary of the perspectives and concerns of the stakeholders:

- 34.5% points raised issues related to health, particularly concerns about air emissions and waste water,
- 17% of the comments were about water use,

- 24.5% referred to the protection of the local environment in relation to the fauna and cultural environment and
- 24% raised concerns about social and economic issues, in particular the delayed compensation for land acquisition and the use of local labour in the project.

The following table summarises the most commonly raised questions and concerns raised, and the mechanism proposed/addressed in the design of the project:

| Question/Concerns | Project's Design |
|---|---|
| <p>What is the destination of the water used in the plant? What is the quality? Will the water be reused by the population or for irrigation?</p> | <p>The used water of the plant will be treated in accordance with Moroccan wastewater treatment standards. The treated water will be recycled for use by the plant. This helps to minimise overall use of the water resource in the region.</p> |
| <p>Is the industrial water (washing mirrors, cooling, other) harmful to the natural environment? What is the destination of these waters?</p> | <p>The water will be treated within specialised chemical waste treatment facilities. The untreated wastewater never comes into contact with the environment, as the system is a closed/contained drainage system from the wastewater generating facilities to the treatment plant. Any remaining treated water, that is not recycled to the plant, is evaporated in specifically designed ponds (they are sealed, therefore no leaching can occur).</p> |
| <p>What is the impact of the project on historic and cultural heritage?</p> | <p>MASEN has developed a voluntary action plan to mitigate against any perceived social issues. A specific socio-economic study has been carried out to identify the mechanism and activities that can be implemented using the funds from the land acquisition plan to</p> |

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| | <p>realise these remedial actions.</p> <p>A tourist centre will be built within the CSP.</p> |
| <p>N10 national road, has increasingly heavy traffic, and the quality of the road is deteriorating.</p> | <p>MASEN is shouldering the cost of the upgrade of a new road to Tasselmant.</p> |
| <p>What are the actual measures taken to avoid disruption of traffic through the N10?</p> | <p>Construction traffic will be monitored for density, frequency and speed. Schedules and timing of deliveries will be organised around the least busy times of day. Any changes in the route will be notified to the public via notice boards/publications in a timely manner with alternative routes given and sign posted.</p> |
| <p>The amount of water used for the operation of the project, will it not be at the expense of local needs in the region (irrigation, drinking water and industrial, etc.)</p> | <p>The water use during construction represents 0.03% of the average contribution to the Mansour Ed Dahbi Reservoir.</p> <p>The water use during operation represents 0.41% of the average yearly contribution to the Mansour Ed Dahbi Reservoir in the wet years, and 2.57% of the lowest recorded yearly contribution to the reservoir.</p> <p>Water will be treated and recycled at the plant, further minimising the reliance on the Dam's supply.</p> |
| <p>Measures to mitigate adverse impacts on flora and fauna should be developed.</p> | <p>The lay down areas and construction measures have been clearly defined, and mechanisms to avoid and limit impacts are clearly outlined in the SESIA. Preserving the seed bank, replanting of native species and remediation in kind are some of the many</p> |

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| | mechanisms that will be implemented. |
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The meeting was considered to fulfil its aims, for the following reasons:

- It allowed for scientific information to be provided regarding the expected extent of impacts on air quality and wastewater.
- It allowed for precise information to be provided about water use.
- It confirmed that the concerns raised by the population (employment of local people, air pollution, wastewater discharges) were in line with the mitigation measures being proposed (e.g. zero wastewater discharges, water treatment for reuse onsite, inclusion of provisions in the CESMP / ESMP to promote the employment of the local population and the provision of training).

The amount of issues raised and the time that it took to reply to them made the meeting to last over an hour and a half over the expected time. This time allowed for a proper discussion and addressing of the concerns raised.

Several issues were raised on the meeting that lay beyond the aim of this SESIA. These included questions to MASEN regarding delays in compensation for land acquisition from the Provincial Government, issues about the implementation of mitigation measures agreed for the FESIA, such as the calendar for the execution of a road to some villages in the areas that lie beyond the study area, or the preparation of a framework for collaboration between MASEN and the Ministry of Health to improve healthcare infrastructure in some areas of the province.

PRIMARY ISSUES

6 SOIL CONTAMINATION

6.1 Introduction

This chapter assesses the potential impacts to soil resulting from the construction and operation activities of the proposed Phase 1 Ouarzazate SPC on soil quality.

The relatively undisturbed and undeveloped nature of the sites signifies that the potential for existing contamination to the soils is unlikely. However, the construction phase may potentially increase the risk of contamination through poor site management practices and inadequate waste disposal management. At the operational stage of the proposed project, the greatest risk of contamination will be from leaks of the HTF over unsealed grounds.

Other general contamination risks are associated with the handling and processing of products where liquid waste and hazardous material can escape into the soil. These are associated with the transport, handling and storage of such materials and the potential threat of releases and spills onto the ground.

6.2 Regulatory Requirements

As specific Moroccan standards and guidelines for soil protection are currently unavailable, internationally recognized assessment values for soil contamination set by the Dutch Ministry of Housing, Spatial Planning and Environment have been applied. The baseline results are compared against standard values and guidelines.

In the Netherlands, environmental quality values have been established based on the philosophy of protecting ecosystems, environmental functions and ensuring the multi-functionality of soil and groundwater quality. These are discussed below:

- Target Value: average background concentration or detection limit; exceeding this value indicates a possible diminishing of the functional abilities of the soil for humans, plants or animals.
- Intervention Value: concentration level above which there is a serious or threatening diminishing of the functional abilities of the soil for humans, plants or animals.

Table 6-1 provides a list of the Dutch Soil and Groundwater standards that the proposed project will be required to comply with.

With reference to these standard values, the target values for soil represent the level at which environmental sustainable soil quality is present.

Constituent levels greater than the target value indicate that the soil has lost some of its multi-functional properties and can be considered as contaminated soil. If the contamination level is exceeding the intervention value, further investigation will be carried out. The soil intervention values indicate when the functional properties of the soil are seriously impaired or threatened.

It will be noted that the target values are not specific clean up criteria. They represent targeted objectives. Also, in the latest (2009) version of the Dutch Standard, Target values for soils have been removed for all compounds except Metals.

The IFC EHS regulations do not specify pollutant standards for soils. In light of this, sector-specific guidance documents on pollution prevention and good practices produced by the IFC (e.g. IFC 'Environmental Health and Safety Guidelines (EHS) Guidelines: Contaminated Land' (2007)) will be referred to in the assessment. Such guidance includes the following:

The General EHS guidelines detail that the '*...Transfer of pollutants to another phase, such as air, soil, or the sub-surface, will be minimized through process and engineering controls.*'

Section 1.8 of the IFC's General Guidelines details the specific requirements with regards to contaminated land. It notes that: "*Contamination of land will 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 will be identified and corrected to avoid further releases and associated adverse impacts.*"

Table 6-1 Dutch Standards: Soil Standards

| Contaminant | Dutch Soil (mg/kg dry weight) | |
|-------------------------|----------------------------------|--------------|
| | Target | Intervention |
| Arsenic | 29 | 55 |
| Barium | 200 | 625 |
| Beryllium | 1.1 | 30 |
| Cadmium | 0.8 | 12 |
| Chromium (total) | 100 | 220 |
| Cobalt | 20 | 180 |
| Copper | 36 | 96 |
| Lead | 85 | 530 |
| Nickel | 35 | 100 |
| Mercury | 0.3 | 10 |
| Molybdenum | 3 | 190 |
| Selenium | 0.7 | 100 |
| Thallium | 1 | 15 |
| Vanadium | 42 | 250 |
| Zinc | 140 | 350 |
| Benzene | 0.05 | 2 |
| Total PAH | 1 | 40 |

6.3 Methodology

The assessment of the potential impact of the Phase 1 Ouarzazate SPC project is based on desktop research as well as actual soil information gathered from the baseline survey, sampling, testing and investigations undertaken for the project area.

In order to develop this chapter, in addition to undertaking a site walkover and subsequent assessment, 5 Capitals has reviewed the following studies:

- Review of relevant guidelines identified within the IFC/World Bank including IFC Performance Standards;

- Review of Dutch Ministry of Housing, Spatial Planning and Environment guidelines for assessing soil; and
- Consultant's research and desktop review.

The desk study includes the assessment of the proposed design, procedures for construction and operational issues that may impact on both the society and environment. Based on the findings of the assessment, measures have been identified to mitigate any negative effect and promote the positive effects associated with both construction and operational phases (including commissioning of the plant).

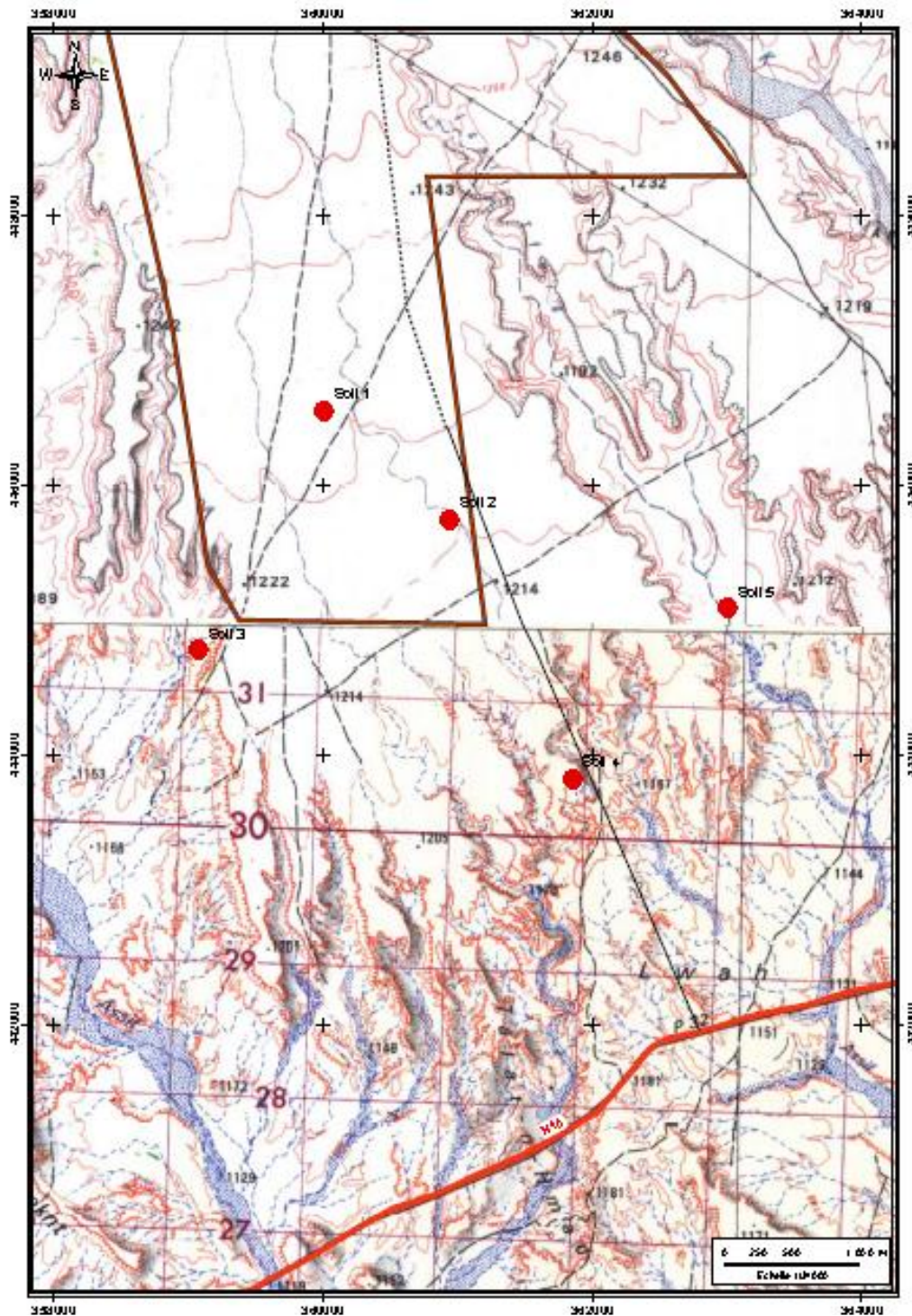
As part of the establishment of the baseline soil conditions at the proposed site, 5 Capitals undertook a limited soil sampling and analysis campaign. The sampling comprised the collection of top layer soil samples (at 0.1m depth) taken at 5 locations, which were then analysed for heavy metals (Cd, Cr, Cu, Pb, Hg, Ni, Zn) and Hydrocarbons (C₁₀C₅₀).

The purpose of the soil sampling activity was to establish a benchmark of the soil conditions at the site, which will be used for the long-term monitoring and environmental management of the site. Particularly if a spill or leak were to occur, the successful clean up procedure would include soil testing for any residual contaminants and the benchmark would be used in the assessment.

Table 6-2 Soil Sampling Locations

| Location ID | GPS Co-ordinates | |
|-------------|------------------|--------------|
| | Northing | Easting |
| Soil 1 | 31°00'51.60" N | 6°51'58.30"W |
| Soil 2 | 31°00'25.84" N | 6°51'22.84"W |
| Soil 3 | 30°59'53.67" N | 6°52'32.71"W |
| Soil 4 | 30°59'23.64" N | 6°50'47.45"W |
| Soil 5 | 31°00'05.33" N | 6°50'04.53"W |

Figure 6-1 Soil Sampling Locations



6.4 SESIA Baseline

Geology

The proposed site is located within the Ouarzazate basin, which is bordered to the north by the foothills of the High Atlas Mountains. The area is characterised by faults and thrust faults, and the southern basin is composed of igneous rock and sedimentary deposits of the Mesozoic, Tertiary and Quaternary period.

Soils

Within the project site, the soils consist of alluvial and lacustrine/palustrine limestone from the Quaternary period, with the surrounding areas consisting of conglomerates or lacustrine limestone from the Mio-Pliocene period.

Stratigraphic surveys identified the following sequence:

- 0.0 – 6.0 m: Sandy loam with considerable gravel comprising the surface layer.
- 5.5 -16.0 m: polygenic conglomerates with un-cemented successions.
- 8.0 – 16.0 m: a layer of Sandy clay can appear between the conglomerate layers.
- 16.0 – 30.0 m: layer of massive sandstone.
- From 30 m deep: Clayey – marl substrate

The following figures depict the appearance and composition of the soil layers in the Wadis and ditches located within the proposed site.

Plate 6-1 Site Soil Profile at Wadi



Plate 6-2 Soil profile within the site



Analytical Results

The following table provides the results for the 5 soil samples collected within the plot boundaries and within the buffer zone of the proposed project.

Table 6-3: Soil Analytical Results

| Sample ID | Parameter | | | | | | | | | | | | | |
|------------------------|------------|-----------|------------|------------|-----------|------------|------------|-----------|------------|-------------|-----------|------------|------------|------------|
| | THC | As | Ba | Cd | Co | Cr T | Cu | Fe | Hg | Mn | Mo | Ni | Pb | Zn |
| Soil 1 11h35 | <3 | 8,37 | 100 | <0,004 | 10,2 | 38,9 | 6,60 | 21 560 | 0,097 | 347 | <0,86 | 19,6 | 4,33 | 41,1 |
| Soil 2 10h58 | <3 | 8,65 | 94,2 | <0,004 | 11,0 | 38,3 | 8,63 | 22 600 | 0,057 | 367 | <0,86 | 19,8 | 3,97 | 41,0 |
| Soil 3 13h06 | <3 | 8,96 | 94,6 | <0,004 | 10,3 | 38,4 | 8,19 | 22 820 | 0,074 | 362 | <0,86 | 19,7 | 4,15 | 38,8 |
| Soil 4 09h10 | <3 | 5,24 | 118 | <0,004 | 12,2 | 41,6 | 9,99 | 26 610 | 0,055 | 479 | <0,86 | 23,0 | 5,74 | 45,1 |
| Soil 5 10h08 | <3 | 8,40 | 95,9 | <0,004 | 10,1 | 37,8 | 6,38 | 22 270 | 0,073 | 354 | <0,86 | 18,8 | 3,74 | 33,7 |
| Dutch Target | NA | 29 | 200 | 0.8 | 20 | 100 | 36 | NA | 0.3 | NA | 3 | 35 | 85 | 140 |
| CICS Limits * | 700 | 30 | 500 | 5 | 50 | 250 | 100 | NA | 2 | 1000 | 10 | 100 | 500 | 500 |

Dutch Target Value: average background concentration or detection limit; exceeding this value indicates a possible diminishing of the functional abilities of the soil for humans, plants or animals.

(*): Canadian Indicative Soil Contamination Levels (Québec).

The results show that at all 5 sampling locations the levels of heavy metals were well below the Dutch target values and Canadian Indicative values. Therefore, based on the analytical information, historical land use and site observations, it can be concluded that the soils are not contaminated by heavy metals.

With respect to the presence of any hydrocarbons in the topsoil layer, the results indicated levels below the detectable limits and therefore below the Canadian indicative levels. Therefore, based on the analytical information, historical land use and site observations, it can be concluded that the soils are not contaminated by hydrocarbon C₁₀C₅₀.

Groundwater

Within the proposed SPC site, the geologic composition of the rocky plateau consists of tertiary and quaternary formation that is highly permeable and subterraneously inclined. Consequently, no groundwater tables or reservoirs are likely present within the project area.

With respect to the presence of groundwater in the surrounding areas, the nearest town Tasselmant uses artisanal wells for the supply of irrigation water. The depth of these wells ranged from 10m to 14m. Three other wells were identified over 2.5km from the site, however, these wells were much deeper (23m to 26m) and were no longer in use.

Seismicity

The SPC site is bordered by complex tectonic structure, around the Toundout-Boumalene zone, and is characterised by compression of the faults along a SSE-NNW alignment. These faults and fold run parallel to the massif of the High Atlas and the Anti-Atlas.

A seismicity study, which was undertaken by the consortium, identified that the maximum horizontal acceleration would be an earthquake of 5.3 magnitude, with value $a_{max} = 0.14 \cdot g$, for a return period of 475 years with a probability rate of 10%.

6.5 Construction Assessment

6.5.1 Assessment of Impacts

There is a range of construction related activities that could pose a threat and lead to changes in the chemical properties of the soil, 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 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 to major negative significance.

Waste Management: Construction of Concentrated Solar 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 minor to 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. Currently the general soil conditions on site appear to be good. Soil analysis at the proposed project site was investigated as

part of the baseline survey described above. The survey concluded that no contamination is present in the soil samples taken at the site. However, isolated points of contamination, perhaps through localised spills during construction activities may occur on site. If this contaminated soil was relocated during levelling activities, a chance of spreading the 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 moderate negative significance prior to the implementation of appropriate measures.

6.5.2 Mitigation Measures

As far as the construction of the proposed project is concerned, the CESMP will cover all the necessary measures to be taken prior to and during the construction phase. This will include outlining the appropriate waste storage protocols and soil and groundwater protection measures required to prevent the occurrence of spillage to the ground, and the risk of contamination. The EPC employed on site will be required to design, operate and update the CESMP during the construction phase. This is a requirement of the Performance Standard 1 in determining an 'action plan' and management system. A key part of this document will be the soil and groundwater protection measures on the site, which will include the following measures:

- Effective management of supply chain, including selection of material suppliers which minimise packaging where possible;
- Wherever possible, reduce the quantity of chemicals and fuel stored on site to minimum practical level. Infrequently used chemicals will be ordered before they are needed;
- Storage of chemicals, fuels, lubricants and paints on dedicated locations such as paved ground surfaces to prevent leakage into the ground;
- Storage of hazardous liquid waste and chemicals, such as oils, etc. in contained areas where oil drums have dripping collectors to avoid spillage to the ground;
- Spillage and leakage prevention measures including regular inspection of containers;
- Clean up of any spillage with spill absorbents;
- Establish spill emergency and contingency plan;

- Mandatory training program for employees to increase their awareness of chemical management protocols including proper handling and storage of chemicals, emergency response, contingency plans and appropriate PPE.
- Contaminated aggregate wastes or excavation material shall be disposed through registered/approved waste vendor at appropriate facilities.

It is also recommended that before construction begins, each contractor should collect and test a minimum of 3 soil samples from their designated laydown areas to supplement this benchmark and to be used for verification purposes post completion of the construction activities and upon handover of the temporary laydown area. If any soil contamination is detected, then remediation of the soils should be carried out, and successful closeout of the event should be determined on the basis of the benchmark values.

In order to avoid the risk of cross-contamination, any identified contaminated soil will be excavated separately, and stored or disposed in accordance with environmentally adequate measures for waste management. Furthermore, if contaminated soil observed during construction activity, the same protocol must be taken with separate excavation, in order to ensure that cross contamination does not take place.

- Implementation of good house keeping practices during construction activities including procedure and requirements for proper handling, storage, and transport of hazardous chemicals and waste
- Procedures for emergency response and contingency plan will be in place. A mechanism will be provided to immediately remediate the affected area in the event of a spill or leakage of chemicals, fuels, paints, and any hazardous material. A structure for emergency response and contingency plan is provided in the Environmental and Social Management Plan section. It is suggested that the EPC must incorporate this in their CESMP and implement throughout the site.
- The EPC, sub-contractors employed for the construction period will be required to put in place adequate training programmes, safety induction sessions with regards to the transportation and handling of hazardous materials.
- All hazardous construction waste and chemicals, such as oils, will be stored in well-equipped, leak-tight enclosures where oil drums have dripping collectors to avoid spillage to the ground. The storage tanks of fuels /chemicals will be

properly maintained and stored in bunded area of 110% of their storage capacity.

- Washing of equipment, machineries, and vehicles will not be permitted on site and on un-paved road.
- Refuelling will only be carried out in designated areas following specified procedures, not at machinery work locations, to reduce potential spillages. A dedicated refuelling area near to the servicing area will be established. Refuelling areas will be communicated to all site personnel by signs and notice boards.
- All servicing, refuelling, stockpiles, waste disposal and storage areas will be located as far as possible from the water bodies to reduce potential of pollution via spillage or windblown debris.
- Excavated materials will be kept in the stockpile for as short a time as possible.
- No hazardous material will be stockpiled.
- Minimise the size and height of the stockpile as far as possible.
- The EPC will also be required to carry out dedicated risk assessment sessions to identify risks relevant to particular activities involving the use of hazardous materials and, put in place, appropriate risk reducing measures. The figure below provides an overview of determining risk assessment with regards to contamination.

6.5.3 Residual Effects

Following the implementation of the mitigation measures detailed above and further measures which are outline in the environmental and social management plan followed during construction, the potential impacts of soil and groundwater on site is expected to be significantly reduced to minor negative impact.

6.6 Operation Assessment

6.6.1 Assessment of Impacts

During the operational phase, potential releases to the soil and groundwater may occur from a number of routine maintenance activities, such as material transportation, handling and storage as well as during cleaning activities. However, the main risk of soil contamination at the operational phase could result from leaks at the HTF system.

HTF Leaks could occur at the following plant, from metal tubing, seals, flanges and other such connection points:

- HTF/Salts exchangers,
- Expansion and overflow vessels,
- HTF system pumps,
- HTF line instrument connections,
- Purification Flash and drainage tank,
- Condensation Tanks,
- Control valves

These types of leaks may occasionally occur, particularly over the lifetime operation of the plant. Typically the maintenance programme of the various facilities would ensure that such events are rare and that volumes would be minimal and quickly contained and cleaned. Therefore impacts would be temporary in nature and of minor negative significance.

The maintenance of plant and machinery at the Phase 1 Ouarzazate SPC project will involve usage of oil as a lubricant/solvents. This therefore requires appropriate storage, transportation, and handling of such oils and greases etc. These materials if not handled appropriately will have a negative impact on soil which would result with an impact of minor to moderate negative significance.

Waste oils generated following the maintenance and operation of the plant and machinery also have the potential for contamination of soil if inappropriate disposal methods are followed. Prior to mitigation, the potential impact would be of minor to moderate negative impact.

Wastewater Management

The proposed Phase 1 Ouarzazate SPC will treat process plant wastewater at an onsite facility, and subsequently all treated wastewater will be discharged to the on-site evaporation ponds. Therefore, potential for soil contamination from mishandling of wastewater or failure of the wastewater treatment system is likely. The impact and mitigations measures for this component are discussed in Chapter 10 – Water and Wastewater Management.

6.6.2 Mitigation Measures

The pathways for soil contamination during the operational phase are more or less similar to the construction phase. Therefore, similar control techniques and mitigation measures will be in place to tackle such risks. Best house keeping practices will be adopted to ensure proper measures are in place.

The O&M will implement the mitigation measures listed below. Day to day measures included in the OESMP will determine the storage of hazardous chemicals as key concerns with maintenance, storage requirements, refuelling procedures and spill cleanup procedures being particular issues which will be adequately covered in the ESMP.

- The Operational Environmental and Social Management Plan that is a requirement of the IFC Performance Standards will need to ascertain the potential risks to the soil media during the operations of the plant and assign appropriate mitigation measures..
- Storage areas for hazardous material will be sealed, covered and paved with secondary containment such as bunded walls, leak tight collection reservoirs, leak tight flooring, and correct shelving / cabinets in order to prevent spillage and leakage into the ground.
- The storage tanks of fuels/HTF/chemicals will be properly maintained and stored within a bunded area of 110% of their storage capacity.
- Each bund will include a pump to empty the oil/chemical in case of an emergency.
- A dedicated storage for large volumes of solid and liquid (especially for hazardous waste) material from several sources is recommended. This storage area will be provided with leak tight flooring, secondary containment as bunded walls, leak tight collection reservoirs and correct shelving/cabinets to prevent spillage.
- Fencing around the perimeter of the work area will be erected, in order demarcate the designated work areas and limit damage to surrounding undeveloped areas.
- Plant workshops will be constructed over impervious/sealed surfaces. A drainage system with collection tank will be included to facilitate collection storage and handling of any spills.

- Proper procedures, such as regular inspections, audits, and monitoring, will be put in place to ensure that all necessary mitigation measures are being implemented.
- Leakage monitoring system will be installed in order to determine any leakage issue at an early stage and minimize any relevant environmental issues associated with the leakage.
- HTF leak detection system will be used to detect leaks as soon as they occur, to separate the HTF present in the salt circuit, and to identify the exact location of the leak. The system will comprise of pressure gauges installed between the exchangers, analysers installed in the nitrogen collector, and sampling with flanges for the HTF leak detection.
- Twice yearly groundwater monitoring at two wells of Tasselmant will be implemented, in order to confirm no migration and pollution of the groundwater.

Soil Remediation strategy in the event of an HTF Leak

In the event of an accidental contamination a bio-remediation system will be used to treat the contaminated soils. This system of bioremediation was developed and has been tested in SEGS (Solar Electricity Generating Systems), which is located in Kramer Junction (California) and in various projects in Spain. This system will comprise of:

- Impermeable cement wells will be used to contain the contaminated soils. The wells will be capable of treating up to 200 m³ of soil at a time.
- The treatment process uses a type of bacteria that breaks up the elements of the HTF, thereby reducing the concentration of the contamination from 20 gr/kg to 0,5 gr/kg in a period of some 2 – 4 months. In order to aid the treatment, nutritional elements are added such as monopotassium phosphate and urea. Additionally, the moisture content is maintained at between 50 to 70% using a sprinkler system and the soil is superficially aerated in order to encourage bacterial activity.

6.6.3 Residual Effects

Following the implementation of the mitigations detailed above and further measures which will be outlined in the environmental and social management plans followed

during operation, the potential impacts on soil and groundwater on site is expected to be significantly reduced to minor negative impact.

7 WATER AND WASTEWATER MANAGEMENT

7.1 Introduction

This chapter identifies the main issues associated with water consumption and the management of the wastewater generated by the construction and operation phases of the proposed Phase 1, Ouarzazate Solar Power Complex.

During both construction and operation, water from the Mansour Ed Dahbi reservoir will be piped to the project site for use in the various power producing facilities. Consequently, several wastewater streams will be generated, which will include power cycle blowdown, floor drainage in process buildings, effluents of very high conductivity and sewage. All wastewaters will be treated by onsite wastewater treatment facilities, with the resulting treated wastewater sent to onsite evaporation ponds. Therefore, no emissions of wastewater to the soils, wadis or stormwater drainage system are anticipated.

The typical environmental impacts from poor wastewater management include the contamination of soils and stormwater. Both the construction and operational phases of the Ouarzazate SPC (phase 1) will generate wastewater and will have the potential to detrimentally impact upon the surrounding environment.

The recommendations and mitigation measures provided within this chapter will be utilised in the preparation of the CESMP and OESMP, to ensure that appropriate management is achieved during construction and operation.

7.2 Regulatory Requirements

7.2.1 Moroccan Environmental Standards

The Water Act, Law 10-95 on water and its implementing regulations, was promulgated on 16 August 1995. It aims to ensure the rational use of water and access to this resource throughout the Kingdom. The main decrees implementing this law published to date are:

- Decree No. 2-04-553 of 13 Hijja 1425 (24 January 2005) relating to spills and direct and indirect discharges into surface or groundwater (O.B. No. 5292 of 17 February 2005)
- Dahir 1-69-170 (25 July 1969) on the protection and restoration of soil

This decree regulates water discharges, including runoff and direct or indirect discharges to surface water or groundwater.

As a result of the implementation of this decree an authorization has to be requested for water discharges from the relevant authorities.

In addition, domestic discharge standards set by Order No. 1607-06 (July 25, 2006).

- Decree No. 2-05-1533 covers wastewater discharges from rural settlements.
- Decree No. 2-97-875 of 6 Shawwal 1418 (4 February 1998) on the use of wastewater (O.B. 5 February 1998). This Decree regulates the reutilization of wastewater. An authorization is required for wastewater reuse except for onsite reutilization.
- Decree No. 2-97-657 of 6 Shawwal 1418 (4 February 1998) on the delimitation of protected areas (B.O. February 5, 1998), which regulates zoning around public waters.
- Decree No. 2-97-787 of 6 Shawwal (4 February 1998) on water quality standards and water pollution inventories (O.B. No. 4558 of 5 February 1998). This Decree defines, inter alia, the necessary parameters for the assessment of water quality and the quality standards that water must meet depending on its use.

To date, the legislations enacted based on this decree are:

- Decree n ° 1277-1201 enacted on the 17th of October 2002 on quality standards for water used for the production of drinking water. These standards are specified in Chapter 11,
- Order 1276-01 enacted on the 17th of October 2002 on quality standards for irrigation water. These standards are specified in Chapter 11;
- Decree n ° 1275-1201 enacted on the 17th of October 2002 on quality of surface waters;
- Decree No. 2028-03 enacted on the 10th of November 2003 on quality standards for fishing waters.

Table 7-1 Water Standards for Irrigation

| PARAMETERS | UNITS | VALUE | SPECIFICATIONS |
|--|-------|----------|---|
| Bacteriological parameters | | | |
| Faecal Coliform | ml | 1000/100 | 100ml for agricultural products eaten raw |
| Salmonella | | Absence | in 5 litres |
| Vibrio cholera | | Absence | in 450ml |
| Parasitological parameters | | | |
| Pathogenic parasites | | Absence | |
| Parasite cysts | | Absence | |
| Larvae of Ankylostomides | | Absence | |
| Fluococercaires of Schistosoma haemotobium | | Absence | |
| Toxic parameters | | | |
| Mercury | mg/l | 0.001 | |
| Cadmium | mg/l | 0.01 | |
| Arsenic | mg/l | 0.1 | |
| Total Chromium | mg/l | 1 | |
| Lead | mg/l | 5 | |
| Copper | mg/l | 2 | |
| Zinc | mg/l | 2 | |
| Selenium | mg/l | 0.02 | |
| Fluorine | mg/l | 1 | |
| Cyanides | mg/l | 1 | |
| Phenols | mg/l | 3 | |
| Aluminium | mg/l | 5 | |
| Beryllium | mg/l | 0.1 | |
| Cobalt | mg/l | 0.5 | |
| Iron | mg/l | 5 | |
| Lithium | mg/l | 2.5 | |
| Manganese | mg/l | 0.2 | |
| Molybdenum | mg/l | 0.01 | |
| Nickel | mg/l | 2 | |
| Vanadium | mg/l | 0.1 | |
| Physical and chemical parameters | | | |
| Salinity | | | |
| Total salinity | mg/l | 7680 | |
| Electrical conductivity | mS/cm | 12 | at 25°C |

| | | |
|--|------|------------|
| Infiltration | | |
| - Sodium Absorption Ratio | EC | < 0.2 |
| 0-3 | | |
| - Sodium Absorption Ratio | | < 0.3 |
| 3-6 | | |
| - Sodium Absorption Ratio | | < 0.5 |
| 6-12 | | |
| - Sodium Absorption Ratio | | < 1.3 |
| 12-20 | | |
| - Sodium Absorption Ratio | | < 3 |
| 20-40 | | |
| Toxic Ions (affecting sensitive agricultural product receptors) | | |
| Sodium | | |
| - Surface Irrigation | mg/l | 69 |
| - Overhead irrigation | mg/l | 9 |
| Chloride | | |
| - Surface Irrigation | mg/l | 350 |
| - Overhead irrigation | mg/l | 15 |
| Boron | mg/l | 3 |
| Effect drivers (affecting sensitive agricultural product receptors) | | |
| Temperature | °C | 35 |
| pH | | 6.5 to 8.4 |
| Suspended solids | | |
| - Gravitational Irrigation | mg/l | 200 |
| - Localised overhead irrigation | mg/l | 100 |
| Nitrate (N-NO ₃ -) | mg/l | 30 |
| Bicarbonate (HCO ₃) [overhead irrigation] | mg/l | 518 |
| Sulphates (SO ₄ ²⁻) | mg/l | 250 |

Table 7-2 Drinking water standards

| PARAMETER | UNITS | A1-G | A1-I | A2-G | A2-I | A3-G | A3-I |
|-------------------------|-------|------|------|------|------|------|------|
| Toxic Substances | | | | | | | |
| Arsenic | µg/l | - | 50 | - | 50 | - | 100 |
| Cadmium | µg/l | 1 | 5 | 1 | 5 | - | 5 |
| Chromium (total) | µg/l | - | 50 | - | 50 | - | 50 |
| Cyanides | µg/l | - | 50 | - | 50 | - | 50 |
| Lead | µg/l | - | 50 | - | 50 | - | 50 |
| Mercury | µg/l | - | 1 | - | 1 | - | 1 |
| Nickel | µg/l | - | 50 | - | 50 | - | 50 |
| Selenium | µg/l | - | 10 | - | 10 | - | 10 |

| | | | | | | | |
|-------------------------------------|-------|---------|------|---------|------|---------|------|
| Pesticides, per substance | µg/l | - | 0.1 | - | 0.1 | - | 0.1 |
| Pesticides, total | µg/l | - | 0.5 | - | 0.5 | - | 0.5 |
| HPA | µg/l | - | 0.2 | - | 0.2 | - | 0.2 |
| Undesirable substances | | | | | | | |
| Boron | mg/l | - | 1 | - | 1 | - | 1 |
| Ammonia | mg/l | 0.05 | 0.5 | 1 | 1.5 | 2 | 4 |
| TKN | mg/l | 1 | - | 2 | - | 3 | - |
| Nitrates | mg/l | - | 5 | - | 50 | - | 50 |
| Phosphorous | mg/l | 0.4 | - | 0.7 | - | 0.7 | - |
| Barium | mg/l | - | 1 | - | 1 | - | 1 |
| Copper | mg/l | - | 1 | - | 2 | - | 2 |
| Zinc | mg/l | - | 50 | - | 5 | - | 5 |
| Manganese | mg/l | - | 0.1 | 0.1 | 0.1 | 1 | - |
| Dissolved iron | mg/l | - | 0.3 | 1 | 2 | 1 | 3 |
| Fluorides | mg/l | 0.7 | 1.5 | 0.7 | 1.5 | 0.7 | 1.5 |
| Dissolved hydrocarbons | mg/l | - | 0.05 | - | 0.2 | 0.5 | 1 |
| Phenols | mg/l | - | 0.01 | - | 0.05 | - | 0.1 |
| Anionic detergents | mg/l | - | 0.5 | - | 0.5 | - | 0.5 |
| Physical-chemical parameters | | | | | | | |
| Temperature | °C | 20 | 30 | 20 | 30 | 20 | 30 |
| pH | | 6.5-8.5 | - | 6.5-9.2 | - | 6.5-9.2 | - |
| Conductivity at 20°C | µS/cm | 1300 | 2700 | 1300 | 2700 | 1300 | 2700 |
| Chlorides | mg/l | 300 | 750 | 300 | 750 | 300 | 750 |
| Sulfates | mg/l | 200 | - | 200 | - | 200 | - |
| Suspended materials | mg/l | 50 | - | 1000 | - | 2000 | - |
| Dissolved Oxygen | mg/l | 7 (90%) | - | 5 (70%) | - | 3 (50%) | - |
| BOD5 | mg/l | 3 | - | 7 | - | 10 | - |
| COD | mg/l | - | - | 25 | - | 40 | - |
| Oxydability | mg/l | 2 | - | 5 | - | 10 | - |

Category A1: Water requiring a simple physical treatment and disinfection, including filtration, to be drunk.

Category A2: Water requiring normal physical and chemical processing and disinfection, including pre-chlorination, coagulation, flocculation, sedimentation, filtration and disinfection (final chlorination), to be drunk.

Category A3: Waters requiring physical treatment, chemical pushed refining and including disinfection by chlorination, coagulation, flocculation, sedimentation, filtration, adsorption and disinfection (ozone, final chlorination), to be drunk.

Within each category, there are two columns:

Column G (guideline values): correspond to the recommended values that surface water to be used for the production of drinking water will satisfy to be classified into one of three categories.

Column I (mandatory values): values that are shown are the requirements that any surface water used for the production drinking water must meet to be classified in one of three categories.

Table 7-3 Domestic discharge standards

| PARAMETERS | UNITS | VALUE |
|---------------------|-------------------|-------|
| BOD ₅ | O ₂ /l | 120 |
| COD | O ₂ /l | 250 |
| Suspended Materials | mg/l | 150 |

7.2.2 International requirements

Two sections of the IFC general HSE guidelines, namely section 1.3 ‘Wastewater and Ambient Water Quality’ and section 1.4 ‘Water Conservation’ have to be considered for this project.

Table 7-4 Indicative Values for Treated Sanitary Sewage Discharges

| Pollutants | Units | Guideline Value |
|-------------------------|---------------------------|------------------|
| pH | pH | 6 – 9 |
| BOD | mg/l | 30 |
| COD | mg/l | 125 |
| Total nitrogen | mg/l | 10 |
| Total phosphorus | mg/l | 2 |
| Oil and grease | mg/l | 10 |
| Total suspended solids | mg/l | 50 |
| Total coliform bacteria | MPN ^b / 100 ml | 400 ^a |

Notes:

^a Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation.

^b MPN = Most Probable Number

7.3 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 bid proposal.

The rivers and wadis on and around the site are ephemeral streams that flow after rain events. The erosion and flood risks posed by these streams are considered in chapter 11 Stormwater Management and Erosion Control. This section is concerned with the project's water use and the possibilities for contamination of the water reservoir, the rivers and wadis from the project's wastewater.

7.4 SESIA Baseline

The proposed source of water for this project is the Mansour Ed Dahbi reservoir, which had a calculated capacity of 439 Mm³ on 2010. Contributions to the dam Mansour Ed Dahbi average 420 Mm³ per year. The rate of filling of the dam has experienced fluctuations over the years ranging from 12% to 40% and over 90% in the last few years (97% on 04/05/2010).

The rivers and wadis on and around the site are ephemeral streams that flow after rain events. There is no groundwater on the site.

7.5 Construction Assessment

7.5.1 Construction Water Consumption and Wastewater Generation and Management

The table below provides estimates of water consumption during construction and start-up. The main uses for water during the construction and commissioning phases are domestic consumption, dust control, earthworks, civil works and commissioning. The total water consumption for construction and commissioning is estimated to be approximately 300,000 m³ during 27 months, with an estimated monthly peak consumption of 20,000 m³.

Table 7-5 Water Consumption during construction and commissioning

| Month | Man consumption | Dust control | Earth works | Civil works | Commissioning | Total |
|-------|-----------------|--------------|-------------|-------------|---------------|-----------|
| 1 | 44 | 0 | 0 | 0 | 0 | 44 |
| 2 | 88 | 0 | 0 | 0 | 0 | 88 |
| 3 | 193.6 | 950.4 | 14,662.50 | 0 | 0 | 15,806.50 |
| 4 | 536.8 | 950.4 | 14,662.50 | 0 | 0 | 16,149.70 |
| 5 | 800.8 | 950.4 | 14,662.50 | 0 | 0 | 16,413.70 |
| 6 | 968 | 950.4 | 14,662.50 | 0 | 0 | 16,580.90 |
| 7 | 1531.2 | 950.4 | 14,662.50 | 0 | 0 | 17,144.10 |

| | | | | | | |
|------------------|-----------------|---------------|----------------|---------------|---------------|------------------|
| 8 | 1760 | 950.4 | 14,662.50 | 2,006.67 | 0 | 19,379.57 |
| 9 | 1804 | 950.4 | 14,662.50 | 2,006.67 | 0 | 19,423.57 |
| 10 | 2024 | 950.4 | 14,662.50 | 2,006.67 | 0 | 19,643.57 |
| 11 | 2200 | 950.4 | 14,662.50 | 2,006.67 | 0 | 19,819.57 |
| 12 | 2288 | 950.4 | 14,662.50 | 2,006.67 | 0 | 19,907.57 |
| 13 | 2288 | 950.4 | 0 | 2,006.67 | 0 | 5,245.07 |
| 14 | 2640 | 950.4 | 0 | 3,006.67 | 0 | 6,597.07 |
| 15 | 3080 | 950.4 | 0 | 3,006.67 | 0 | 7,037.07 |
| 16 | 3344 | 950.4 | 0 | 3,006.67 | 0 | 7,301.07 |
| 17 | 3960 | 950.4 | 0 | 3,006.67 | 0 | 7,917.07 |
| 18 | 4224 | 950.4 | 0 | 1,666.67 | 0 | 6,841.07 |
| 19 | 3432 | 950.4 | 0 | 1,666.67 | 0 | 6,049.07 |
| 20 | 3432 | 950.4 | 0 | 0 | 0 | 4,382.40 |
| 21 | 3080 | 950.4 | 0 | 0 | 11,250.00 | 15,280.40 |
| 22 | 2200 | 950.4 | 0 | 0 | 12,430.17 | 15,580.57 |
| 23 | 2200 | 950.4 | 0 | 0 | 12,430.17 | 15,580.57 |
| 24 | 1760 | 950.4 | 0 | 0 | 12,430.17 | 15,140.57 |
| 25 | 1320 | 950.4 | 0 | 0 | 1,180.17 | 3,450.57 |
| 26 | 880 | 950.4 | 0 | 0 | 1,180.17 | 3,010.57 |
| 27 | 704 | 950.4 | 0 | 0 | 1,180.17 | 2,834.57 |
| TOTAL | 52,782.4 | 23,760 | 146,625 | 27,400 | 52,081 | 302,648.4 |
| TOTAL (%) | 17% | 8% | 48% | 9% | 17% | |

The main source of wastewater during construction will be sanitary wastewater. 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 46,184.6 m³ over the construction and commissioning period. This wastewater will be stored in septic tanks and tankered to the Ouarzazate wastewater treatment facility by licensed subcontractors with an acceptable frequency.

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.

Most freshwater during commissioning is used for the testing of the tanks. This water will be channelled to an evaporation pond, depending on the quality of the water. If monitoring results show that this wastewater could be treated in the water treatment plant and recycled, this option would be considered.

7.5.2 Assessment of Impacts

The water use during construction of Phase 1 Ouarzazate SPC will be 0.3 Mm³ over 27 months (0.13 Mm³/year). This represents 0.03% of the average contribution to the Mansour Ed Dahbi Reservoir, that is 420 Mm³, and 0.19% of the lowest recorded yearly contribution to the reservoir, that was 68 Mm³. This impact is considered to be of negligible significance.

The main wastewater contamination risks arising during construction relate to sanitary waste and to contaminated wastewater generated by storm water events washing oil spills.

The quantities of sanitary wastewater can be estimated at approximately 46,184.6 m³ during construction and commissioning. This wastewater will be generated and stored on-site prior to removal by a licensed contractor. If the storage tanks and removal process are not properly managed and handled, contamination to soils or surface waters can take place. Prior to mitigation, this can be assessed as a moderate negative impact.

Storm water runoff can wash areas containing hazardous materials and either infiltrate into the soil or carry them off site, potentially contaminating watercourses or groundwater. This potential impact can be assessed as being a moderate negative impact prior to wastewater and soil (Section 11) mitigation measures.

7.5.3 Mitigation Measures

During construction, the following mitigation measures shall be taken:

- Chemical toilets will be available on site and septic tanks will be installed at the labour accommodation and administration buildings. The number of septic tanks will be proportional to the increased of workers on site. These will also be regularly emptied by a licensed waste contractor and transported to an approved sanitary waste facility off site. The EPC contractor will keep records of the disposal events in order to give an indication of required frequency of removal and for auditing purposes. If possible, meters will be installed on the tanks to monitor the volumes and prevent overflows. 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.

- The EPC contractor will develop procedures for the demobilisation of the septic tanks once site construction has ended to ensure that appropriate procedures/methods will be employed and no contamination to the site area will occur during the demobilisation period.
- Site inspections will be carried out regularly by the EPC contractor to ensure that all wastewater generated is properly managed, and no leakages or spillovers occur. In the event of a spill or overflow, immediate action will be taken in accordance with spill containment procedures.
- Construction of a specific area for site machinery maintenance work (lubrication, oil and filter changes, repair work, etc.). A waterproof concrete area shall be provided with a tank or perimeter ditch to collect any liquid waste.
- Oily wastewater from vehicle maintenance will be collected via interceptors. A specialist contractor will remove the recovered oil for recycling. Any residual sludge will be taken to a licensed hazardous waste facility.
- Storage of wastewater in areas adjacent to rivers or streams shall be avoided. Any such storage under specific circumstance permitted by the Environmental manager will be only temporary measures.
- Where suspended solids are above normal levels, specific measures shall be taken: settling basins, drainage ditches, filtering geotextiles
- Construction of a settling basin to retain water until it is cleared following the settling of the solids it contains. Wastewater from the cleaning of concrete trucks that could include cement and concrete waste shall be directed to this basin. Water free of sediments may be used to irrigate the site area and access routes.
- The basins must be monitored to establish the regularity of sludge drainage.
- The quality of the effluent shall be regularly controlled and all necessary maintenance work shall be performed, including the regular removal of sludge.
- Effluents, once treated in the processing systems, must be taken to the authorised disposal point without the entrainment of soil, material or any other substance that could contaminate them.
- On all accounts, the spillage and runoff of oils, greases and other toxic liquid waste from the machinery fleet outside this waterproofed area will be avoided.

- The machinery to be used in the work shall be inspected regularly to avoid losses of lubricants and fuel.
- The storage of waste generated on site shall be located outside areas in which runoff could affect nearby watercourses and preferably within the area used by the machinery fleet.
- As a means of protection during the concreting work, ditches shall be dug to wash concrete from tanks and chutes, etc., with the slurry being collected in a controlled manner. No area outside the planned areas shall be used for this purpose, nor shall areas that are highly likely to contaminate aquifers. These ditches may measure approximately 2 x 2 x 2 m. Will they become blocked, they shall be filled in and a new ditch dug.
- Following the IFC EHS Guidelines, 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.
- Once the work is complete, these will be duly dismantled. This dismantling shall include the final drainage of any existing water and sludge, removal of the waterproofing sheet, filling in of the basin until the land returns to its initial configuration and the demolition of ditches. All excess products must be taken to the landfill site

7.5.4 Residual Effects

The water use during construction of Phase 1 Ouarzazate SPC will be 0.3 Mm³ over 27 months (0.13 Mm³/year). This represents 0.03% of the average contribution to the Mansour Ed Dahbi Reservoir, that is 420 Mm³. This impact is considered to be of negligible significance.

After the mitigation measures outlined above, the negative impacts resulting from sanitary wastewater during the construction phases are minimised to be of negligible to minor negative significance.

The potential impact of rainwater runoff washing areas containing hazardous materials can be assessed as a minor negative impact after to wastewater and soil (Section 6) mitigation measures are applied.

7.6 Operation Assessment

7.6.1 Operation Water Consumption and Wastewater Generation and Treatment

Water Consumption and Management

The water requirements for the operational phase of the plant are estimated to be 1,750,000 m³/year. This estimate was calculated using the following data:

- Raw water quality;
- Suspending solids content in raw water;
- Removing efficiencies in pre-treatment;
- Reverse osmosis and electrode ionization efficiencies;
- Number of workers required during the operational phase (60 people, two shifts, annual working time 1750 h/worker);
- Cycle make up water (1% cycle flow);
- 3 cycles of concentration in the cooling tower;
- Solar field cleaning:
 - Incremental dirty losses (0,5%/day);
 - Allowable average dirty losses (2%);
 - Required cleaning water per unit of mirror area (0.5 l/m²);
- Solar Power Complex running time;

This water will be treated prior to its use onsite to ensure that it is suitable for its different uses. The following units constitute the water treatment plant that will be used onsite to meet the project's water needs:

The pretreatment unit:

Includes a disinfection system with hypochlorite, coagulation-flocculation, floatation and solids removing system by means of anthracite-sand filters.

Part of the pretreated water is destined for make-up of cooling tower; it will feed by a chemical 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 be fed into a polishing system composed by a chemical conditioning system, microfiltration, a second step of the reverse osmosis and an electro deionization stage.

Drinking water production unit:

Drinking water will be filtered with activated granular carbon and will be subject to post-chlorination in the drinking water tank.

It is estimated that the initial water treatment will produce the following waste during operation:

- Activated carbon: 3,240 kg/5 years;
- Sand: 38,010 kg/5 years;
- Anthracite: 39,236 kg/5 years;
- Filtration cartridges: 660 cartridges/5 years;
- Reverse osmosis membranes: 270 membranes/5 years;
- EDI modules: 1 complete module/5 years (the whole resins and membranes will be replaced).

The management of this solid waste is discussed in Chapter 9.

Wastewater Generation and Treatment

The following wastewaters will be generated in the plant:

- Sludge from Dissolved Air Floatation;
- Cooling tower blow down;
- Concentrated of ROC reverse osmosis;
- Boiler blow down;
- Tempering water;
- Oily water;
- Water with HTF;
- Sanitary water.

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 pretreatment, 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 pretreatment.

In order to estimate the quantity of solid waste to be managed after dehydration, the suspended solids content in raw water and the different efficiencies of the pretreatment equipment have been considered. The estimated quantity of waste from water treatment is about 5,215 kg wet sludge/h. The management of this solid waste is discussed in Chapter 9.

Tower purge treatment

The purge of the cooling circuit will be fed to a chemical conditioning system and a first step of reverse osmosis.

The purified water will be pumped to the Cooling Tower Feeding Tank. The concentrate from the first reverse osmosis will be treated by a second reverse osmosis system in order to minimize the flow to the evaporation ponds. The permeate from this second reverse osmosis will also be pumped to the Cooling Tower Feeding Tank; while the concentrate will be channelled to the evaporation ponds.

Treatment of oily water and water with HTF

Storm water management is discussed in the following section. However the first rainwater that falls into areas where there is a risk of oil or HTF spills is considered wastewater and needs to be treated appropriately. It is therefore discussed in this section.

The area of the plant with some risk of fuel or HTF spillage is 3,756 m² and it will be asphalted. The first rainwater falling onto this area will be collected by a specifically designed drainage system and channelled two separate rainwater tanks.

The maximum time intensity of rain in the area for a return period of 10 years and for a concentration time of 5 minutes is 264.3 mm/h.

It can be considered that after 10 minutes of rain the collection surface will be cleaned and all the greases/oils/HTF dragged, so the storms tanks will have a capacity of 150 m³ to contain oily water and 200 m³ to contain water with HTF.

The water from the oily water storm tank will be channelled to an oily water treatment system, and the water from the HTF water storm tank will be channelled to the HTF separator.

In both separators the effluent enters into a first feeding chamber, where the separation of the biggest drops starts, and passes to a second chamber through a coalescent plate's package where the oil finest drops are separated.

The sludge, oils and HTF will be removed and stored for its later management, discussed in Chapter 9. The estimated quantities of sludge, oils and HTF are specified below:

- Sludge from oily water separator: 105 kg wet sludge/h;
- Oils from oily water separator: 5 kg oils/h;
- Sludge from HTF separator: 140 kg wet sludge/h;
- HTF from HTF separator: 7 kg HTF/h.

Treated water will be driven to the effluent treatment plant, where will be joined with the rest of flows and channelled to the evaporation ponds.

Sanitary water treatment

In order to estimate the sanitary water total flow to be treated, the following data have been considered as design basis:

- Number of workers: 60 people;
- Generation rate: 200 L/(person ·day);
- Working time of 3500 h/worker;

An average of 4.8 m³/d of sanitary water is expected, what will create an averaged estimated quantity of sludge from sanitary treatment of 8 kg wet/h.

The sanitary waste water will be treated in a module of biological treatment previous to its sending to the homogenization/neutralization pit.

The biological treatment is made up of a ventilation tank and primary decantation tank. It is designed to work according to the principle of activated sludge by prolonged aeration, using a horizontal cylindrical tank made of two chambers.

In the first chamber a biological reactor is used. It has a diffuser grid at the bottom that supplies air in order to keep the fluid moving and avoid deposition at the bottom, and at the same time it supplies the necessary oxygen for aerobic digestion.

The second chamber has a secondary decanter, to separate the bacteria and suspended solids present in the water and once clarified allow for its discharge.

The composition of the sanitary water treatment sludge will include suspended solids, organic material, iron, aluminium and silica.

Boiler blow down / tempering

The flow from the boiler blow down and the flow from tempering will be channelled, together with the treated oily waters and the treated sanitary 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 ponds.

Evaporation ponds

The estimated total wastewater flow to be discharged to the evaporation ponds is 425.000m³/year. The following parameters are expected in the effluent:

- pH: 7.6;
- Conductivity: 15,200 uS/cm;
- TDS: 9,728 ppm;
- SS: 70 ppm;
- COD: 6 mg O₂/L;

Eight evaporation ponds have been designed to collect the effluent from the plant. They will be located to the south of the site. The evaporation area of each of the ponds is provided on the table below. The ponds will have a depth of 1 m. The ponds will be allowed to fill to a depth of 0.5 m, with a reserve of 0.5 m to the crown on the least favourable side.

Table 7-6 Evaporation Pond Areas

| Pond No. | Area (m ²) | Pond No. | Area (m ²) |
|----------|------------------------|------------|------------------------|
| 1 | 15,664.8 | 5 | 24,760.4 |
| 2 | 7,626.8 | 6 | 25,467.4 |
| 3 | 24,238.4 | 7 | 26,759.4 |
| 4 | 24,558.5 | 8 | 28,258.5 |
| Total | | 177,339.20 | |

The ponds 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 ponds is accomplished through a 1.5 mm thick high-density polyethylene (HDPE) geo-membrane sheet. This sheet will be laid over a geo-drain made from a 300 g/m² 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.

Other water uses on site do not generate wastewater streams. Demineralised water used to clean the dust that is naturally deposited on the parabolic mirrors will evaporate without creating significant runoff.

7.6.2 Assessment of Impacts

The water use during operation of Phase 1 Ouarzazate SPC will be 1.75 Mm³. This represents 0.41% of the average yearly contribution to the Mansour Ed Dahbi Reservoir, that is 420 Mm³, and 2.57% of the lowest recorded yearly contribution to the reservoir, that was 68 Mm³. This impact is considered to be of minor to moderate negative significance.

The Ouarzazate SPC (phase 1) will generate several wastewater streams that could have a potential impact on the environment. These include the power cycle blow down, floor drainage in process buildings, effluents of very high conductivity, the reject from reverse osmosis treatment at the water treatment plant and the cooling tower purging, and a relatively small amount of sewage from the workforce.

These wastewaters, if improperly treated could result in an impact of moderate negative significance.

7.6.3 Mitigation Measures

Several mitigation measures have been included in the design of the first phase of the Ouarzazate SPC to reduce water use and treat wastewater streams following BAT. As a result of this design, several loops have been designed in the plant water cycle to reuse water and all the wastewater streams are appropriately treated before they are discharged into the evaporation ponds, resulting in zero wastewater discharges.

In addition, provisions have been made for wastewater monitoring, to ensure that all the measures described in Chapter 10.6.1 function adequately. Standards outlined in Table 10-2 shall be used to ensure that drinking water quality is acceptable.

Other mitigation measures that will be implemented include:

- In common with the IFC EHS Guidelines, 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.
- 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.
- Routine testing of the effluents will verify compliance with the technical specifications, national legislation and IFC requirements;
- Routine testing on drinking water to ensure compliance with the natural standards, outlined in Chapter 10.2 above.
- The drainage wells located under the evaporation ponds to detect leaks shall be routinely inspected.
- All above ground tanks and basins will have overflow pipes to an effluent collection point;
- The time that it takes for rainwater to wash off the surfaces where there is a risk of HTF and oil spills will be monitored to ensure that 10 minutes is sufficient to collect all the potentially polluted wastewater.

7.6.4 Residual Effects

Following the implementation of the designed outlined in Chapter 10.6.1 and the mitigation measures detailed above it is expected that the residual impacts may be assessed as the following:

The water use during operation will be 1.75 Mm³. This represents 0.41% of the average yearly contributions to the Mansour Ed Dahbi Reservoir and 2.57% of the lowest recorded yearly contribution to the reservoir. This impact can be assessed as minor to moderate negative significance.

All process wastewater will be collected, treated separately depending on its characteristics, reused when possible and channelled to evaporation ponds. For this reason, there will be zero wastewater discharges from the plant, and the residual impact of wastewater can be assessed as of negligible negative significance.

7.7 Summary and Recommendations

The level of water consumption during construction and operation are low compared to the yearly contributions to the Mansour Ed Dahbi Reservoir. Several loops in the wastewater treatment have been designed to reuse as much water as possible.

After the implementation of the mitigation measures outlined above the risks of water pollution during construction is low.

Due to water treatment and reuse and the use of evaporation ponds, there will be zero wastewater discharges from the plant.

SECONDARY ISSUES

8 AIR QUALITY

8.1 Introduction

This chapter describes the potential impacts and effects that may occur as a result of the proposed construction and operation of the power plant, and identifies the measures that will be implemented, in order to mitigate these impacts. The assessment of impacts has been measured against national Moroccan standards and applicable WB/ IFC standards and guidelines.

It will be noted that impacts to the air at the operational phase will be significantly reduced and will consist mainly of potential fugitive emissions of VOCs from the Heated Transfer Fluid (HTF). All other typical air pollutants, such as NO_x and, SO_x will be emitted only infrequently, when the boiler is operated. However, to ensure a comprehensive air quality assessment, the key pollutants that have been monitored and assessed include: oxides of Nitrogen (NO_x as NO₂), Sulphur dioxide (SO₂), Particulates (PM) and Volatile Organic Compounds (VOC).

8.2 Regulatory Requirements

8.2.1 Moroccan Environmental Standards

Moroccan Law No. 13-03 establishes the regulations for prevention of air pollution. The law identifies and addresses the sources and types of air pollution, and stipulates that in the absence of any defined national regulations, the polluter is required to integrate and implement the latest technology available to reduce or prevent pollution to the air.

Decrees No. 2-09-286 establishes the national ambient air quality standards and monitoring mechanisms. These are presented in Table 8-1

Decree No. 2-09-631 establishes point source and non point source emission levels, and the mechanism to control these emissions. These are presented in Table 8-2

8.2.2 World Bank / IFC

This SESIA has been prepared in accordance with the principles set out by financial lenders to ensure that their financed projects are developed in a manner that reflect sound environmental management practices whilst being socially responsible.

Phase 1 of the Ouarzazate SPC is committed to meet international best practice. To fulfil that commitment, the following guidelines will be considered in this chapter:

- IFC Environmental, Health and Safety General Guidelines (2007) and specifically sections relating to Ambient Air quality.
- IFC/WB EHS Guidelines for Thermal Power Plants (2008) and specifically sections relating to Air Emissions.

The IFC Thermal Power Plant Boiler Emissions Guidelines has been chosen, given that two boilers will be used intermittently, (during low solar radiation) to maintain the optimal operating conditions of the HTF and Thermal Storage System, and therefore indirectly contribute to the overall operation of the Steam Generation System and production of power by thermal processes.

The assessment of air quality primarily ensures compliance with Moroccan regulations and standards. Where national regulations differ from the guidelines and standards presented in the IFC/WB guidelines, the project will be required to achieve whichever is the more stringent. As per the IFC/WB EHS Guidelines, the WHO ambient air quality standards are applicable in the absence of any national ambient air quality standards.

The following tables present the air emission standards that must be achieved, including those described above, extracted from: Decree 286 and 631 and World Bank/IFC EHS Guidelines.

Table 8-1 Ambient Air Quality Standards ($\mu\text{g}/\text{m}^3$ unless otherwise specified)

| Parameter | IFC EHS General GLs/WHO GLs | | Moroccan | | |
|---|---|---------------------------|--------------------------------|-------------------------------|----------------------------|
| | 24 hour | Annual | 1 hour | 24 hour | Annual |
| PM10 | 150 (Interim target 1) | 70 (Interim target 1) | - | 90.4 50%centile | - |
| | 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 | 98 200%centile | - | 50 health 30 vegetation |
| Sulphur Dioxide | 125 (Interim target 1) | 500 (10 minute guideline) | - | 99.2 125%centile Health | 20 (ecosystem) |
| | 50 (Interim target 2) | | | | |
| | 20 (guideline) | | | | |
| Ozone | 100 (8 hour daily maximum guideline) | - | 110 for 8hr | 65 vegetation | - |
| Carbon Monoxide | - | - | 10mg/m ³ for 8hr | - | - |
| Cadmium | - | - | - | - | 5ng/m ³ Health |
| Benzene (C₆H₆) | - | - | - | - | 10 Health |
| Pb | - | - | - | - | 1 Health |

Table 8-2 Moroccan and IFC Maximum Permissible Emission Rates for Boilers

| Pollutant | Units | Moroccan | IFC Boilers (One Hour Average) | |
|---------------------------------------|--------------------|---|--------------------------------|-----------------|
| | | | NDA ¹ | DA ² |
| Particulate Matter Total | mg/Nm ³ | 5mg/m ³ for an emission rate of 25g/hr | 50 | 30 |
| No _x (as NO ₂) | mg/Nm ³ | 500mg/m ³ at emission rate of 5000g/h | 400 | 200 |
| So _x (as SO ₂) | mg/Nm ³ | 500mg/m ³ at emission rate of 5000g/h | 900-1,500 | 400 |
| HCl | mg/Nm ³ | 1mg/m ³ at emission rate of 5g/h | | |

1 NDA is non degraded airshed (i.e. Ouarzazate Project Site)

2 DA is degraded airshed (this does not apply to Ouarzazate).

8.3 Methodology

Baseline information regarding the existing air quality at the site has been compiled through a combination of primary and secondary data, gathered via field studies and a review of previous studies undertaken in the surrounding area.

Primary baseline data was obtained in October-November 2012 through the use of diffusion tubes, which sampled ambient concentration of NO₂ SO₂ and VOC's. Diffusion tube monitoring was carried out at 3 locations over a 2-week period. Continuous monitoring of PM₁₀ was carried out at the same 3 locations for a period of 48hrs each.

Upon completion of the monitoring period the diffusion tubes were sent to PASSAM laboratory accredited under STS 149 in accordance with ISO 17025 standard. The tubes

were prepared and installed in accordance with the European Guideline 'Ambient Air Quality – Diffusive samplers for the determination of gases and vapours- requirements and test methods' (EN 13528:2002).

The purpose of the monitoring campaign was to establish a benchmark for the parameters that will be emitted during the operational phase of the proposed SPC, and will therefore be used for evaluation purposes and compliance verification during the monitoring phase. The results and discussion are provided in the next section. Additionally, the assessment of impacts from the construction and operation phase can be adequately based on the information gathered during the site visits and summarised from the secondary studies relating to transportation, socio-economy, land-use and ecology.

Table 8-3 Diffusion Tube and PM₁₀ Monitoring Coordinates

| Site Reference | Northing | Easting |
|----------------|----------------|--------------|
| Air 1 | 31°01'01.69" N | 6°52'27.53"W |
| Air 2 | 30°00'13.83" N | 6°51'00.08"W |
| Air 3 | 30°58'04.56" N | 6°50'26.93"W |
| Dust 1 | 31°00'59.92" N | 6°52'28.38"W |
| Dust 2 | 31°01'06.84" N | 6°51'33.29"W |
| Dust 3 | 31°00'14.03" N | 6°50'58.81"W |

Figure 8-1 Diffusion tube monitoring locations

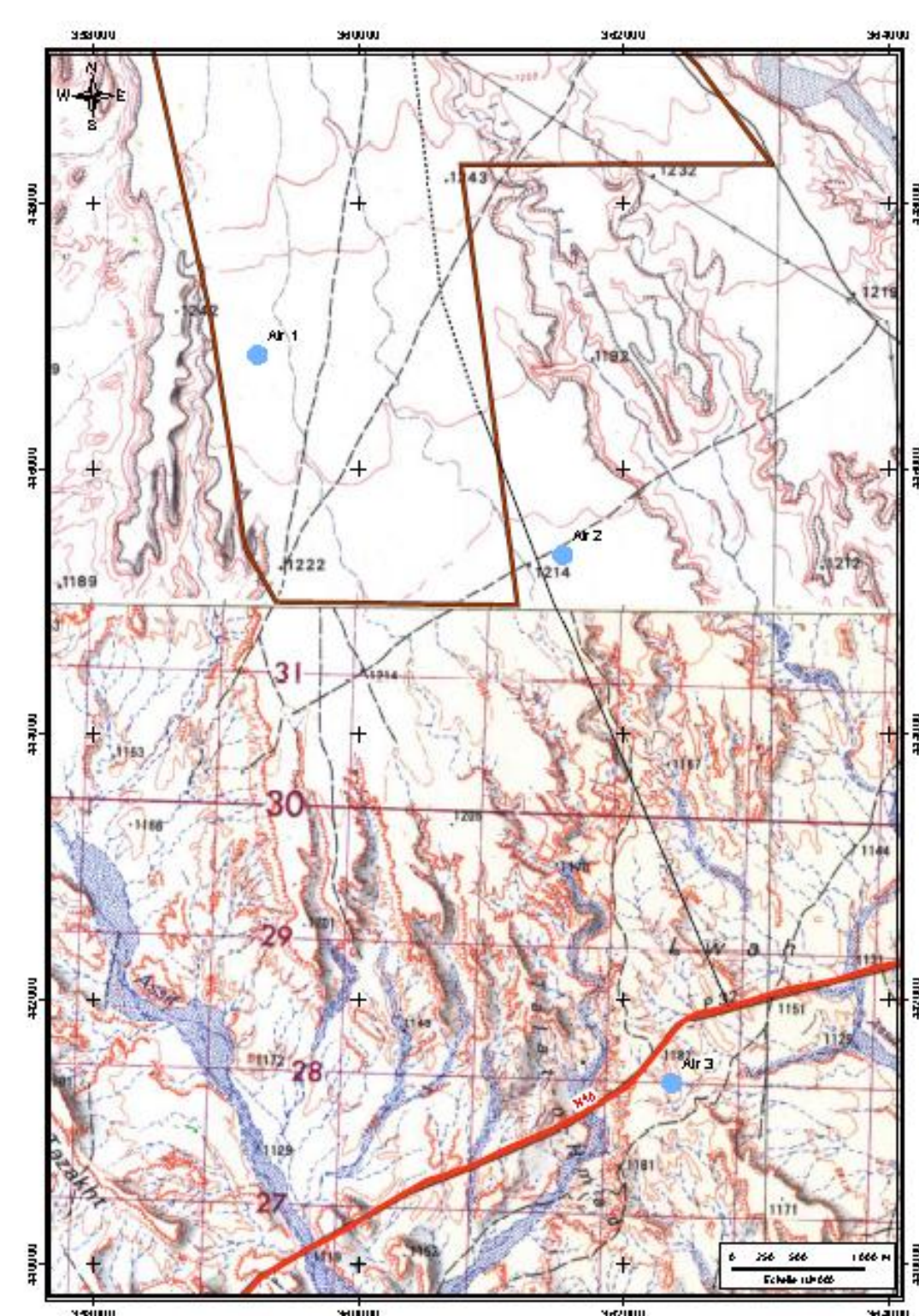


Plate 8-1 Diffusion Tube Monitoring Stations



Figure 8-2: PM₁₀ Monitoring Locations

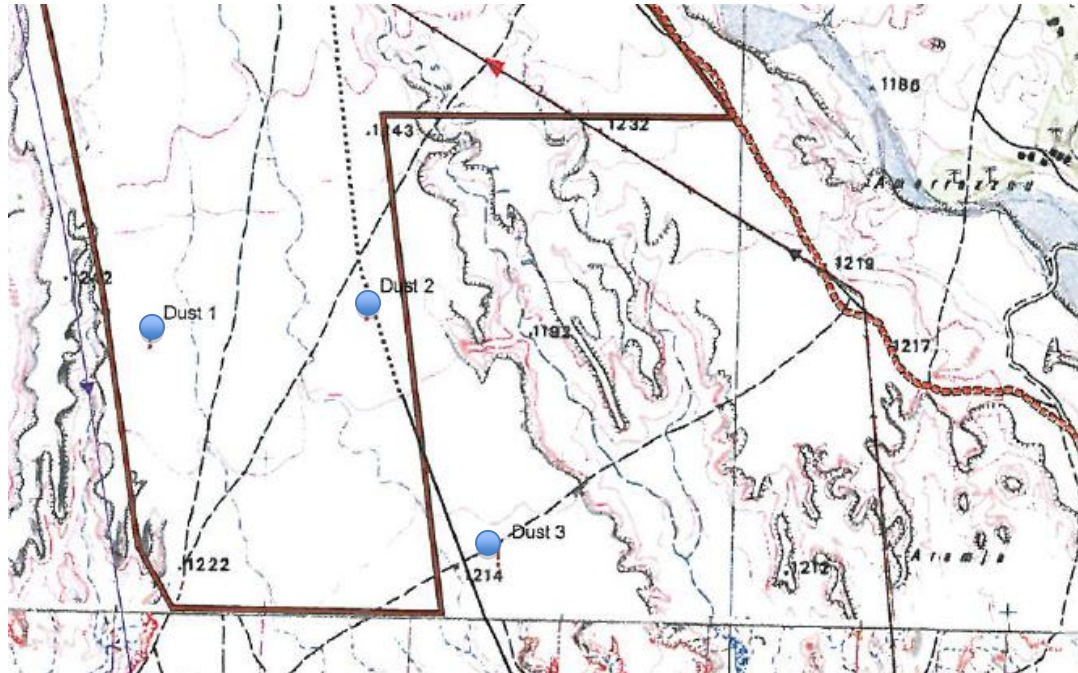


Plate 8-2 PM₁₀ Monitoring Station



8.4 SESIA Baseline

8.4.1 Background Air Quality Data

The proposed Phase 1 Ouarzazate SPC will be built in a relatively isolated area. The closest cities are over 10Km from the site and only two roads, RN 10 and RP 1511, currently pass adjacent to the project. Traffic on these roads is limited to light commercial and private transport, with few heavy vehicles being used for small construction projects, such as houses or small/low-rise buildings. Recently, heavy vehicle traffic has increased but is still limited to the new road under construction.

No heavy industries are found as far as 75Km upwind from the site, this is due to the topography of the Atlas Mountains range. Equally, further north in the Province of Marrakesh, no heavily polluting industries are found. The main commercial activities in the area are agro-industries (processing of fruit and vegetables, wool, flour), building materials, leather goods production and carpet production.

As a result, point source and non-point source emissions around the proposed project area are insignificant and any impacts to the ambient air quality are considered negligible.

Analytical Results

a. Diffusion Tubes

The following table provides the analytical results for the analysis of the diffusion tubes.

Table 8-4 Diffusion Tube Results for NO₂ and SO₂

| Monitoring Location | Pollutant | Monitoring Period | Recorded values | Regulatory Limit | Comments |
|---------------------|-----------------|---|-----------------------------|----------------------|---|
| Air 1 | NO ₂ | Nov 1 st to Nov 16 th | 1 and 1,2 µg/m ³ | 30 µg/m ³ | Site is far from point source emissions |
| | SO ₂ | | 0,3 µg/ m ³ | 20 µg/m ³ | |
| Air2 | NO ₂ | Nov 1 st to Nov 16 th | 2,3 µg/ m ³ | 30 µg/m ³ | Site is close to the access road |

| Monitoring Location | Pollutant | Monitoring Period | Recorded values | Regulatory Limit | Comments |
|---------------------|-----------------|---|--------------------------------|----------------------|--|
| | SO ₂ | | 3,1 µg/ m ³ | 20 µg/m ³ | construction laydown area containing the generators |
| Air 3 | NO ₂ | Nov 1 st to Nov 16 th | 21,7 µg/ m ³ | 30 µg/m ³ | Relatively elevated NO ₂ values. Site is adjacent to the road and the generators used for the road construction project |
| | SO ₂ | | 0,9 and 1,6 µg/ m ³ | 20 µg/m ³ | |

Table 8-5 Diffusion Tube Results for VOC

Note: Only regulatory limit for Benzene is available.

| Monitoring Location | Pollutant | Monitoring Period | Recorded values | Regulatory Limit | Comments |
|---------------------|---------------|---|------------------------|-----------------------|--|
| Air 1 | Benzene | Nov 1 st to Nov 16 th | 0,4 µg/m ³ | 10 µg/m ³ | Site is far from point source emissions |
| | Toluene | | <0,4 µg/m ³ | - | |
| | Ethyl benzene | | <0,4 µg/m ³ | - | |
| | P-Xylene | | <0,4 µg/m ³ | - | |
| | m-Xylene | | <0,4 µg/m ³ | - | |
| | O-Xylene | | <0,4 µg/m ³ | - | |
| Air2 | Benzene | Nov 1 st to Nov 16 th | 1,2 µg/m ³ | 10 µg/ m ³ | Site is close to the access road construction laydown area containing the generators |
| | Toluene | | 1,7 µg/m ³ | - | |
| | Ethyl benzene | | 0,5 µg/m ³ | - | |
| | P-Xylene | | 0,9 µg/m ³ | - | |
| | m-Xylene | | 0,4 µg/m ³ | - | |
| | O-Xylene | | 0,5 µg/m ³ | - | |
| Air 3 | Benzene | Nov 1 st to Nov 16 th | 0,4 µg/m ³ | 10 µg/ m ³ | Relatively elevated NO ₂ values. Site is adjacent to the road and the generators used for the road construction project |
| | Toluene | | 0,5 µg/m ³ | - | |
| | Ethyl benzene | | <0,4 µg/m ³ | - | |
| | P-Xylene | | <0,4 µg/m ³ | - | |
| | m-Xylene | | <0,4 µg/m ³ | - | |

| | | | | | |
|--|----------|--|---------------------------|---|--|
| | O-Xylene | | <0,4 µg/m ³ | - | |
|--|----------|--|---------------------------|---|--|

Overall the monitoring values observed for NO₂, SO₂ and VOC, show that the ambient air quality conditions within and adjacent to the Ouarzazate proposed Solar Power Complex, are well within the national ambient air quality guidelines, and considered good.

It should be noted that at Site 3, the measured value of NO₂ was 21.7 µg/m³, which is a reflection of its location adjacent to the road construction works and associated heavy vehicles and plant operations. Therefore this elevated NO₂ reading is a temporary effect of the high vehicle activity currently taking place on the road.

With regards to the measured concentrations of VOC, and in particular Benzene, these were all well below the national ambient guideline.

b. Dust/PM₁₀

The following table provides the results of for dust monitoring at the 3 surveyed locations.

Table 8-6: PM₁₀ Monitoring Results

| Monitoring Location | No. of Events | Monitoring Duration | [PM ₁₀] _{24h} (µg/m ³) |
|---------------------|-------------------------------|--|---|
| Dust 1 | 1 | From 04/11/2012 at 16h00 To 05/11/2012 at 16h00 | 43 |
| | 2 | From 05/11/2012 at 16h05 To 06/11/2012 at 16h05 | 39 |
| | 3 | From 06/11/2012 at 16h10 To 07/11/2012 at 16h10 | 16 |
| | Centile 90.4 (Av.-24h) | | 04 - 07/11/2012 |
| Dust 2 | 1 | From 01/11/2012 at 15h00 To 02/11/2012 at 15h00 | 9 |
| | 2 | From 02/11/2012 at 15h05 To 03/11/2012 at 15h05 | 11 |
| | 3 | From 03/11/2012 at 15h10 To 04/11/2012 at 15h10 | 51 |
| | Centile 90.4 (Av.-24h) | | 01 - 04/11/2012 |
| Dust 3 | 1 | From 07/11/2012 at 17h10 To 08/11/2012 at 17h10 | 41 |
| | 2 | From 08/11/2012 at 17h15 To 09/11/2012 at 17h15 | 39 |
| | 3 | From 09/11/2012 at 17h20 To 10/11/2012 at 17h20 | 18 |
| | Centile 90.4 (Av.-24h) | | 07 - 10/11/2012 |

| | |
|---|-----------|
| Moroccan Maximum Allowable Limit | 50 |
|---|-----------|

Overall, the 24hr average concentration of suspended dust is below the Moroccan maximum allowable limit (MAL) for PM₁₀. However, on one occasion at site 2 (Dust 2) the observed concentration was 51 µg/m³, which is just above the MAL.

It should also be noted, that values observed for the 90.4 percentile of the average 24hr monitoring values, are just 14% below the MAL of 50 µg/m³. This would indicate that for the greatest part of the day, the natural background dust levels are close to the national MAL.

8.5 Construction Assessment

8.5.1 Assessment of Impacts

During construction, the ambient air quality at local receptor sites may potentially be affected by increased dust, particularly during the earthworks phase and by gaseous exhaust fumes from construction vehicles, plant and additional vehicle movements to and from the site.

The principle sources of dust and emissions during construction will be:

- Excavation and earthwork, such as ground breaking, cutting and levelling;
- Truck movement over unpaved surfaces;
- Movement of vehicles to and from the site (e.g. for deliveries);
- Dust from uncovered truckloads;
- Emissions (e.g. NO_x, SO_x and CO) and particulates from vehicles, generators, heavy plant and other mechanical equipment; and
- Stored VOCs and other volatile hazardous materials.

As outlined in Section 2.3 there are few sensitive receptors within close proximity of the site. This includes the village of Tasselmant 7Km north of the site and the city of Ouarzazate 10-14 Km the south of the site. However, due to their location and distance from the site there is little potential to be impacted by the above emissions sources during the construction phase.

The following table summarises the predicted impact levels from the various sources on the nearest sensitive receptors.

| Source | Duration | Significance |
|---------------------------------------|---|----------------------------|
| Dust from Earthworks | Temporary (initial construction phase) | Minor negative |
| Dust from Vehicles | Temporary (throughout construction / until hard standing roads are laid) | Minor to Moderate negative |
| Emissions from Vehicles | Temporary (throughout the construction phase) | Moderate negative |
| VOCs and other hazardous volatiles | Temporary (Throughout construction) | Minor to moderate negative |

8.5.2 Mitigation Measures

The EPC contracted to deliver the works will be responsible for the preparation and implementation of a detailed Construction Environmental and Social Management Plan, in accordance with the requirements included within the Environmental and Social Management and Monitoring section of this SESIA. This will include a detailed list of the potential environmental aspects associated with the construction process. The air mitigation measures will be followed by contractors on site and will include at least the following:

- Access roads from the entrance to the site will be compacted and sprayed with water to minimise the dust generated from the vehicles and trucks;
- Deliveries of equipment/plant to the site will be efficiently managed to reduce the number of trips;
- Ground-work activities will be minimised when high winds are present;
- Any land grading, improvement or moving of materials will be undertaken during periods of low winds.

- Large sand piles will be avoided where possible. Otherwise covers, or dust suppression sprays will be utilized on any piles, particularly during periods where the wind speed exceeds 15km/h.
- A visual assessment of dust emissions (visual monitoring) will be undertaken on a regular basis;
- The provisions of wheel-washing facilities or high-pressure hose to ensure all vehicles leaving the site are in a satisfactory state of cleanliness.
- Designated roads will be made clear to the drivers and signs for the directions and speed limit will be placed all along the roads.
- Where sand and other dusty material (e.g. cement) is transported to the site, trucks will not be overloaded and will be appropriately covered / sheeted to eliminate the contamination to the air.
- Sand and other materials will be stored in specific designated areas and will be properly stored on site and will be water-sprayed or covered.
- Exhaust fumes and particulates emitted from trucks and vehicles will be minimised by assuring the use of good condition vehicles and conducting regular maintenance. The vehicles will be tested to ensure compliance with local standards.
- Periodic ambient air quality monitoring (NO_x & SO_x) will be undertaken at the identified sensitive receptors, in order verify that national ambient air quality MALs are not exceeded.
- Routine monitoring of the dust levels and wind conditions at the site will be conducted, in order to verify that on site operational activities are not contributing to any potential increases in dust levels.
- Vehicles and plant will be turned off while waiting on site to minimise gas emissions. This can be achieved by providing air-conditioned shelters for drivers especially when loading/unloading.
- Dusty materials stockpiles and dusty activities such as stone cutting and grinding will be sited away from the site boundaries and/or effectively screened.
- Fires and material burning is not allowed on the Project site.
- Hazardous materials stored and used on site with potential gas emissions (e.g. VOCs) will be located in well ventilated secure areas away from major transport routes.

- Any on-site staff accommodation will have adequate sanitary waste and domestic waste facilities and collection in order to minimize odour issues and reduce the potential for spillages and ground/water contamination.

8.5.3 Residual Effects

Following the implementation of an appropriate CESMP (which will at least include the mitigation measures outlined above, and others as noted within the Environmental and Social Management and Monitoring section) the overall residual effects are expected to be of a temporary/short-term duration and of minor negative significance.

8.6 Operation Assessment

Generally, solar power plants by their very nature are low emitters of air pollutants. The objective of the facility is to use renewable and clean fuel to generate power. The clean fuel in this type of operation is solar heat that is magnified by the mirrors, trapped by an oil which is then converted into thermal energy within a boiler to produce steam for a conventional steam turbine. In fact, the solar power plant will have a net positive impact on the regional air quality, as it will prevent approximately one million tonnes of CO₂ per year from being emitted, if a conventional fossil fuel power plant had been used (according to the MEMEE estimates). Therefore, the solar plant is helping to offset negative impacts from CO₂ emissions and the effects of Global Warming.

Nevertheless, this solar plant is not a zero emission facility, and point source and non point source emissions will occur, albeit in limited quantities and intermittently.

Boilers

During certain operational modes of the solar power plant, fossil fuel (diesel) will be used in the HTF boiler and auxiliary boilers in order to ensure optimal power production during low solar irradiation periods.

Two auxiliary boilers of 36MWt will be run on low sulphur diesel. The following table provides the emission estimates from these boilers.

Table 8-7 Auxiliary Boiler Exhaust Gases

| Pollutant | Emission Rate (g/s) | Chimney Height (m) | Chimney Diameter (m) | T (°C) | Exit Velocity (m/s) |
|------------------|---------------------|--------------------|----------------------|--------|---------------------|
| CO | 1.24 | 15 | 1.45 | 250 | 13.2 |
| NO _x | 2.48 | | | | |
| SO ₂ | 1.24 | | | | |
| PM ₁₀ | 0.62 | | | | |

Table 8-8 HTF Boiler Exhaust Gases

| Pollutant | Emission Rate (g/s) | Chimney Height (m) | Chimney Diameter (m) | T (°C) | Exit Velocity (m/s) |
|------------------|---------------------|--------------------|----------------------|--------|---------------------|
| CO | 0.028 | 15 | 1.00 | 250 | 0.6 |
| NO _x | 0.055 | | | | |
| SO ₂ | 0.028 | | | | |
| PM ₁₀ | 0.014 | | | | |

HTF Venting Emissions

Although the HTF has a high thermal stability, over time the oil will degrade and volatile compounds, known-as 'low boilers' will be generated, which will need periodic elimination. This process is handled in the Ullage system (Condensation and Purification system), as described in Chapter 2.5. This emission is considered a point source and the main VOC pollutant is benzene and phenol.

Non point source emissions will also occur at the piping network of the HTF, with benzene as the primary pollutant. The estimates of these fugitive emissions are based on the number of loops and pipe joints.

Table 8-9 Ullage System Emissions

| Pollutant | Emission Rate (g/s) | Chimney Height (m) | Chimney Diameter (m) | T (°C) | Exit Velocity (m/s) |
|------------------|--------------------------------|-------------------------------|---------------------------------|-------------------|--------------------------------|
| Benzene | 0.00267 | 5 | 0.59 | 35 | 1.95 |

Cooling Towers

In large industrial facilities, steam emissions from cooling towers may be visible as plumes due to steam condensation if the quantity of humid air released is significant and if the ambient temperature and humidity are close to saturation. The visibility of the steam plume is also amplified if the atmospheric dispersion capacity is limited.

The projected steam emissions from the cooling tower will not be significant as the power plant's output capacity is small, and the flow circulation at the stack will quickly dissipate the heat, subsequently further reducing the visibility of the plume.

8.6.1 Assessment of Impacts

Air Emissions Modelling

The main aim of the air quality modelling study is to determine the likely future impacts of the proposed Solar Power Complex on its surroundings and sensitive receptors (existing and future receptors). The model provides predicted concentration contributions of these pollutants at the receptor locations in terms of their sole contributions from the Solar Power. Given that no other significant emissions have been identified within the catchment area of the proposed solar plant, a cumulative modelling assessment would not be applicable.

The results are provided in regard to annual mean concentrations and 24-hour or 1-hour mean concentrations, depending on the applicable national standards (to allow comparison).

Air modelling, using AERMOD, was conducted for the proposed plant's boiler and ullage system emissions to assess impacts and verify compliance with National air quality

regulations. The analysis consisted of modelling the following pollutant: NO₂, SO₂, CO, PM₁₀ and benzene.

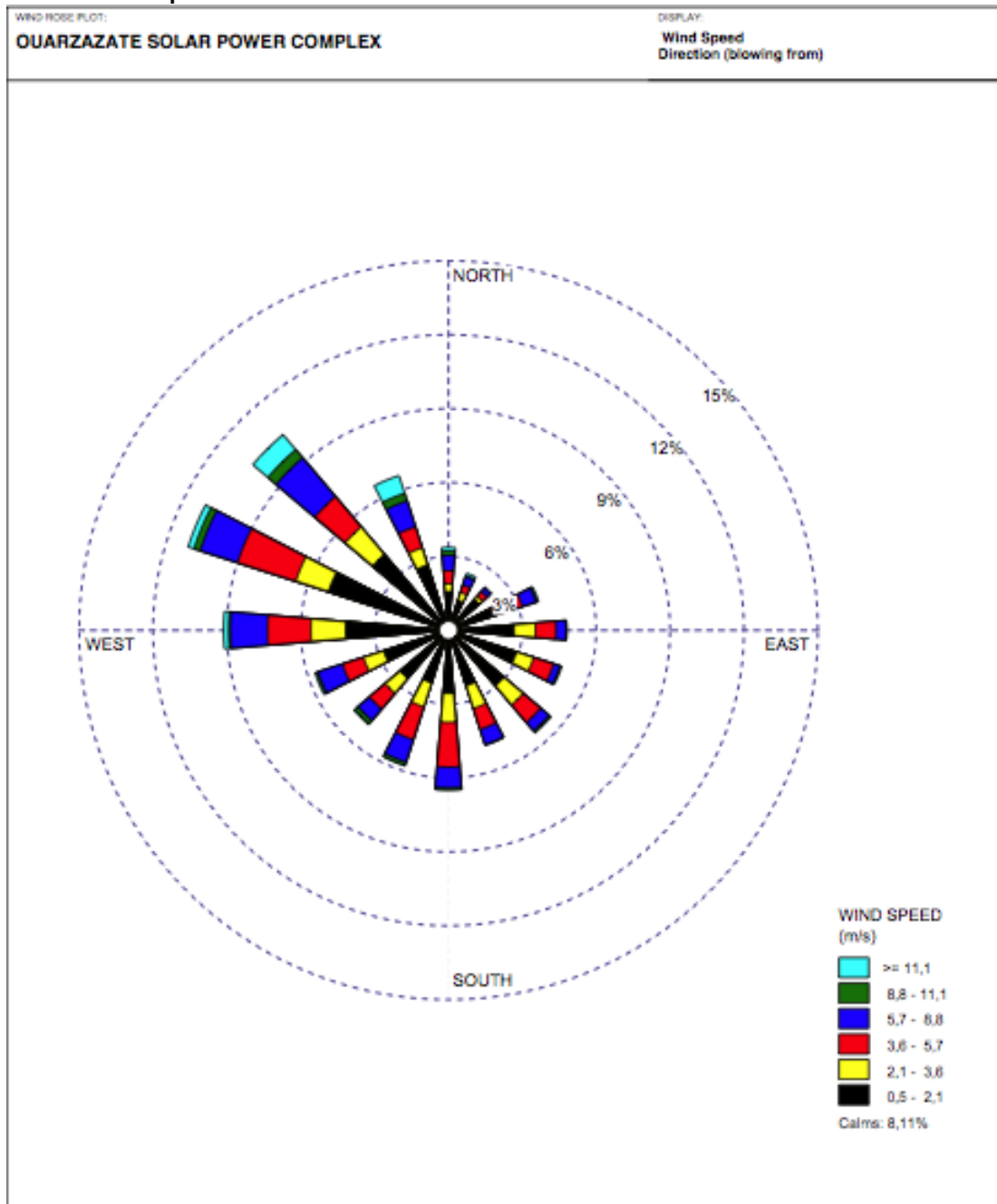
The model input data used the Pasquill- Gifford model, which was developed by ISC-AERMOD program and is specially designed to assist the U.S. EPA (Environmental Protection Agency) air quality prediction studies.

Local Meteorological Data

To ensure representative modelling conditions of the locality, the AERMOD model has included local meteorological data to simulate the emissions dispersion from the facility within the surrounding area.

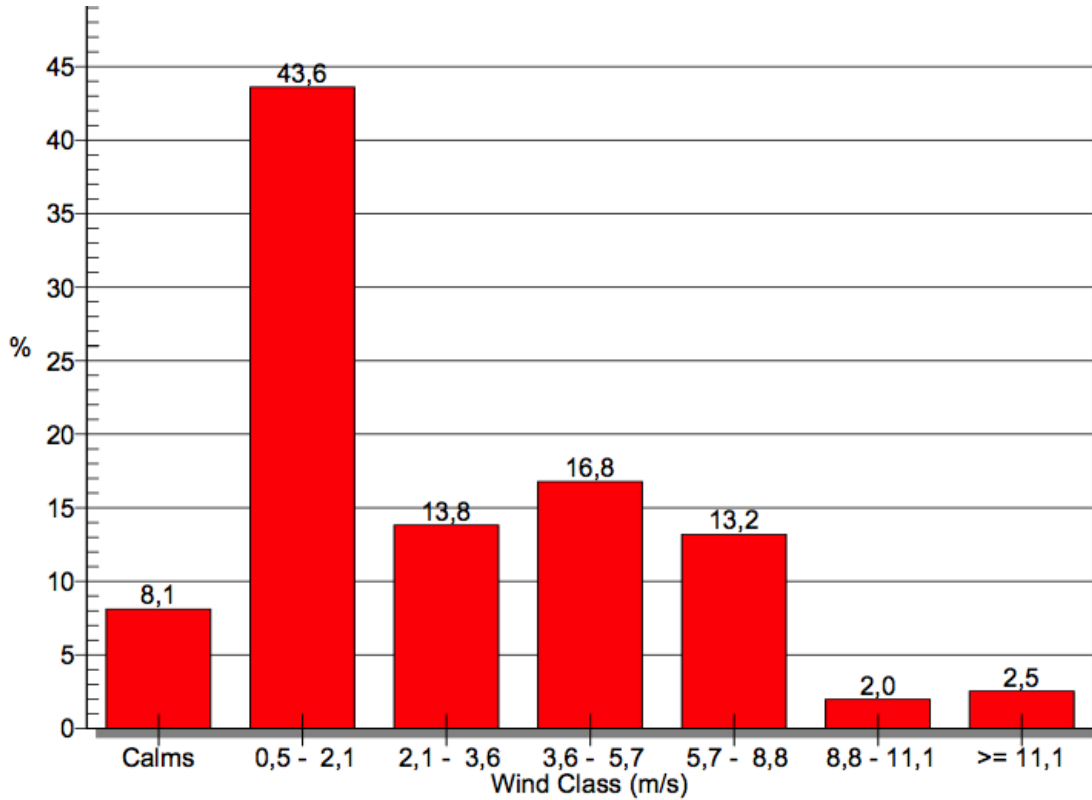
The figures below provide the wind rose for year 2011 and frequency distribution in the Ouarzazate area.

Figure 8-3 Wind Speed



| | | | |
|-----------------------------------|---|---------------------------------------|---|
| COMMENTS: WIND ROSE QUARZAZATE | DATA PERIOD: 2011 ene 1 - dic 31 00:00 - 23:00 | COMPANY NAME: ACCIONA | |
| | CALM WINDS: 8,11% | MODELER: ACCIONA INGENIERÍA | |
| | AVG. WIND SPEED: 3,37 m/s | TOTAL COUNT: 8760 hrs. | |
| | | FIG. Nº: | 1 |

Figure 8-4 Wind Class Frequency Distribution



The data show that the predominant wind direction is from the Northwest and that the velocity is generally within 0.5-2.1 m/s, which is defined as Light Air under the Beaufort Scale, and described as 'leaves and wind vanes would remain stationary'. The highest wind speed attained is approximately 11.1m/s, which is considered a Strong Breeze (Beaufort No. 6), but occurs less than 2.5 % of the time over the course of a year.

Modelled Receptors

Chapter 2-3 describes the variety of key sensitive receptors identified within a 15 Km radius of the proposed project, and Figure 2-3 illustrates the locations of these modelled receptors in relation to the proposed project. Given that the predominant wind is from the north, only those sensitive receptors located downwind of the solar plant have been considered in this impact assessment.

Modelled Phase 1 Ouarzazate SPC project Contributions

The following tables provide the maximum concentration emission contributions from the solar plant, at the receptors, in $\mu\text{g}/\text{m}^3$ obtained from the AERMOD model.

Table 8-10 AERMOD predicted maximum concentration values

| Pollutant | Averaging Period | Results $\mu\text{g}/\text{m}^3$ | IFC/Moroccan $\mu\text{g}/\text{m}^3$ |
|------------------|------------------|-------------------------------------|--|
| SO ₂ | 24 Hours | 35.13 | 125 |
| SO ₂ | Annual | 1.915 | 20 |
| NO ₂ | 1 Hour | 121.33 | 200 |
| NO ₂ | Annual | 3.825 | 40 |
| CO | 8 Hours | 46.13 | 10mg/m ³ |
| PM ₁₀ | 24 Hours | 17.56 | 150 |
| Benzene | Annual | 0.029 | 10 |

The subsequent figures show the emissions dispersion pattern for each of the parameters modelled.

The results show that for all parameters, the modelled emissions values are well within the IFC and Moroccan national standards for ambient air quality. Furthermore, given the low emission values, the dispersion models show that the plume quickly dissipates within the first 120m from the emission point, and is halved within the first 300-500m from the emission point.

With respect to the sensitive receptors, the City of Ouarzazate is located 10km downwind from the project and the town of Tasselmant is located 7km north of the project. In either case, the dispersion model shows that ambient levels of each pollutant will have returned to the background concentrations within the first kilometre from the emission point.

Therefore, impacts from the plants emissions on the sensitive receptors are considered negligible.

Figure 8-5 24-Hour and Annual Emission model for SO₂

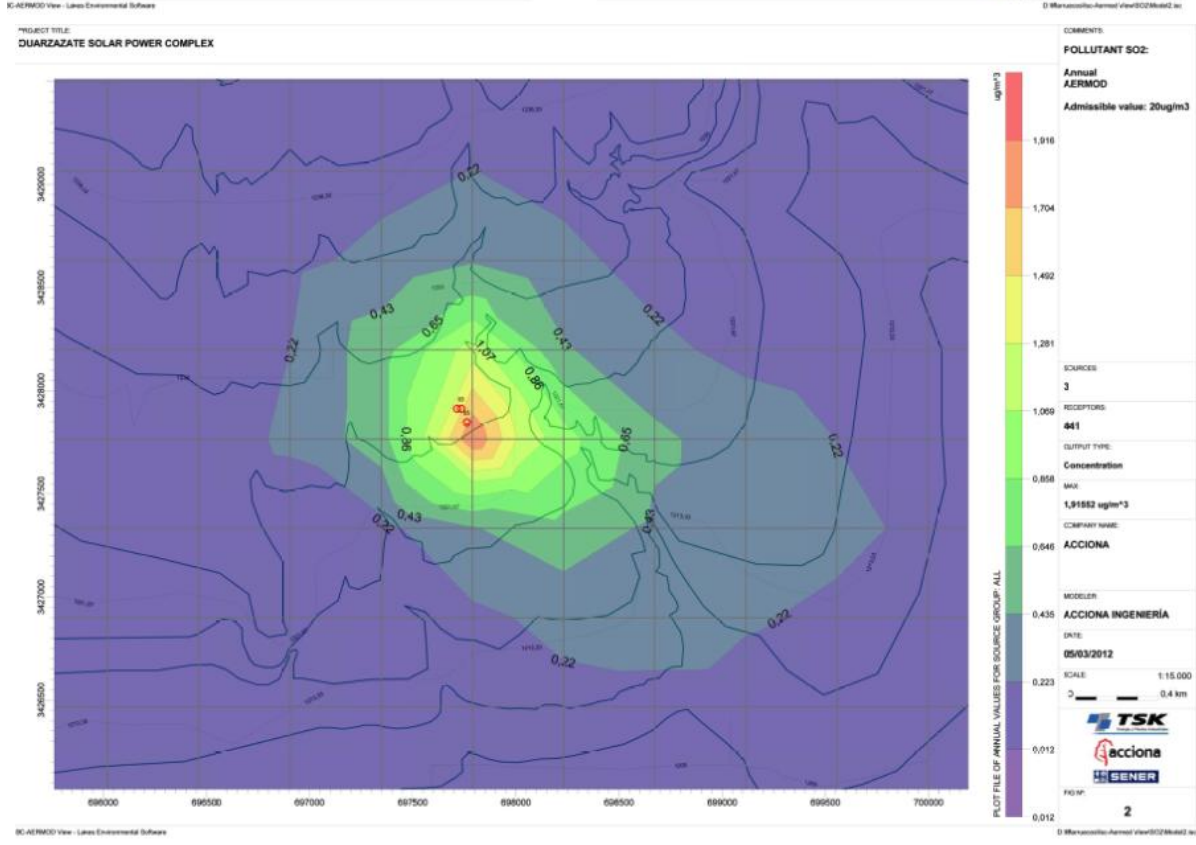
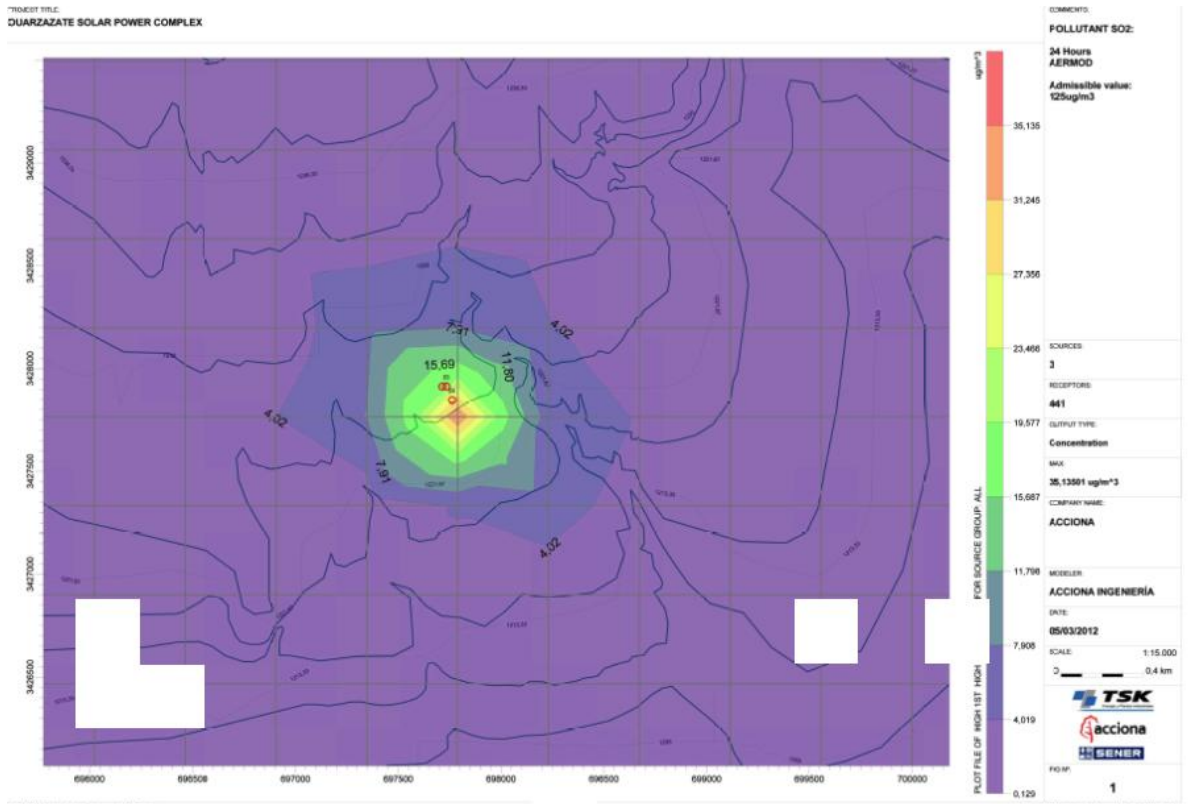
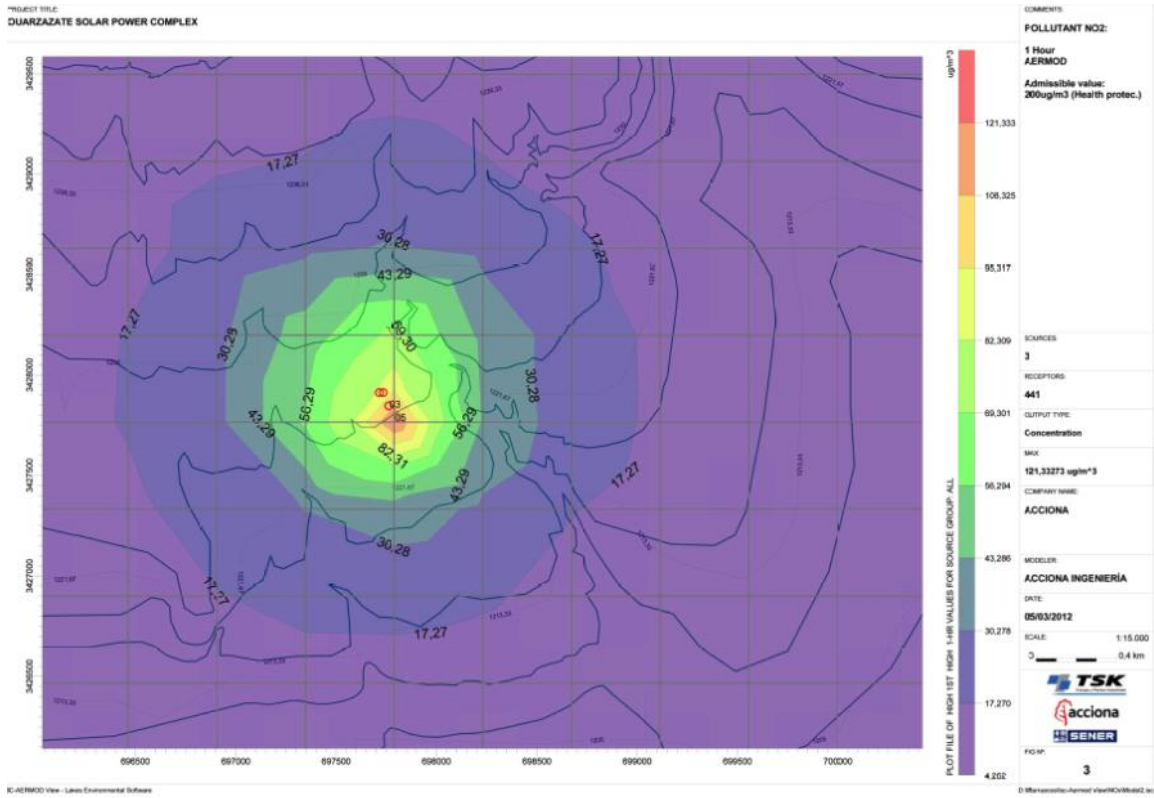
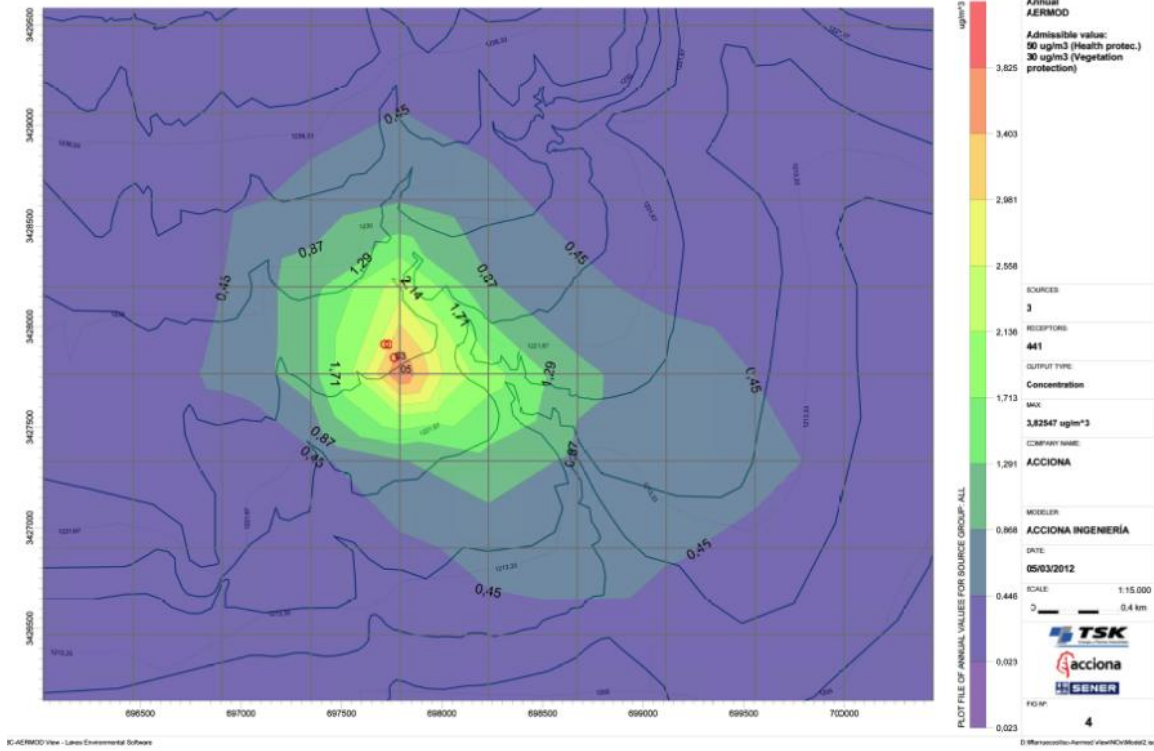


Figure 8-6 1-Hour and Annual Emission model for NO₂



PROJECT FILE:
DUARZAZATE SOLAR POWER COMPLEX



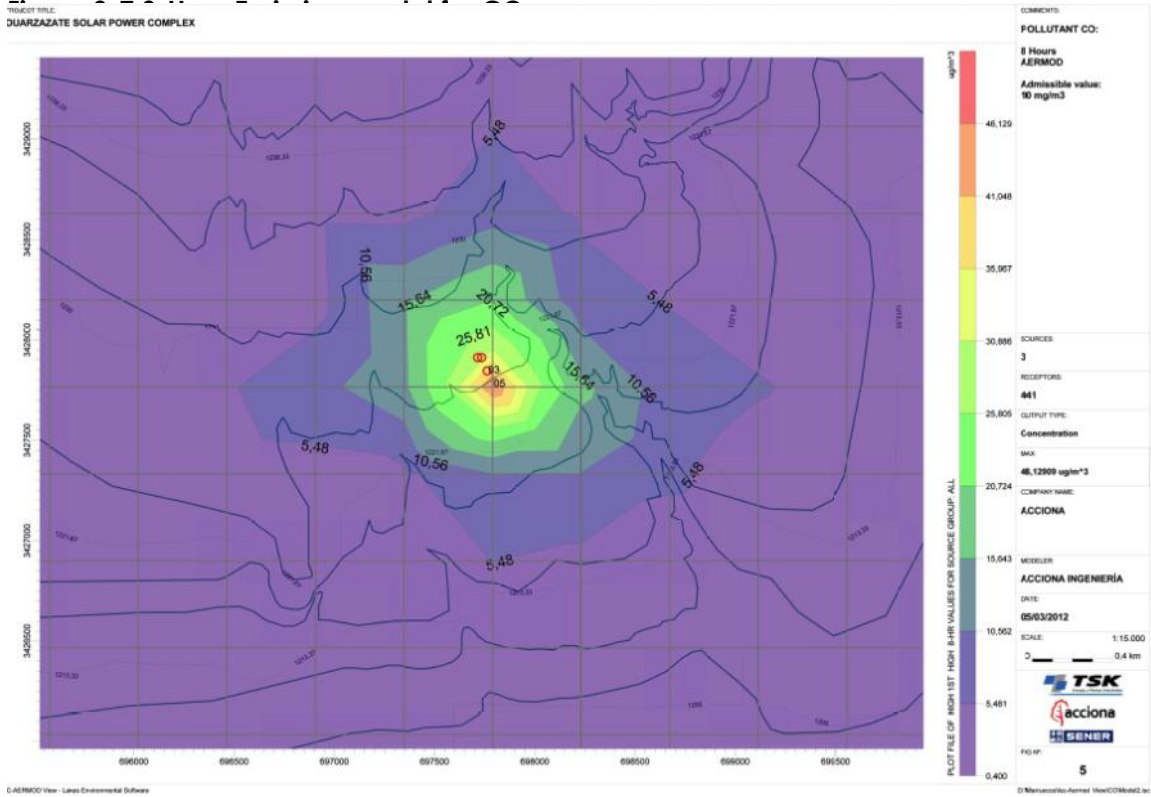


Figure 8-8 24-Hour Emission model for PM₁₀

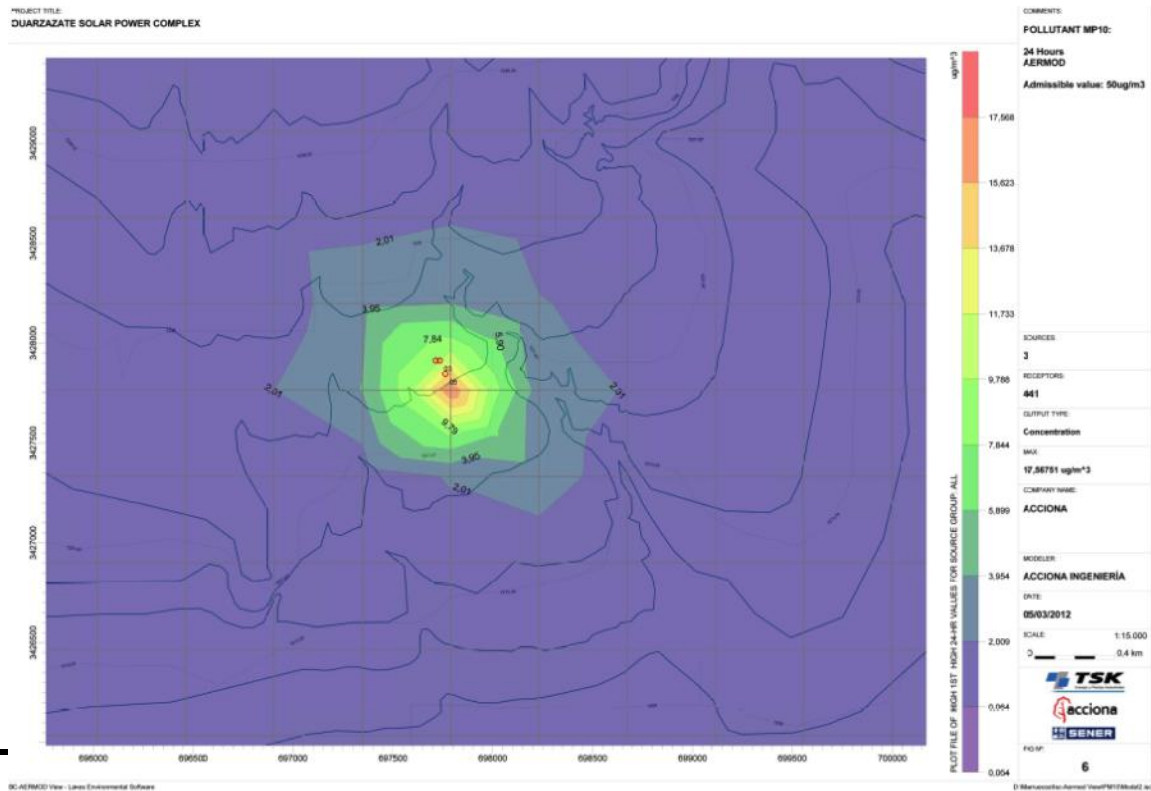
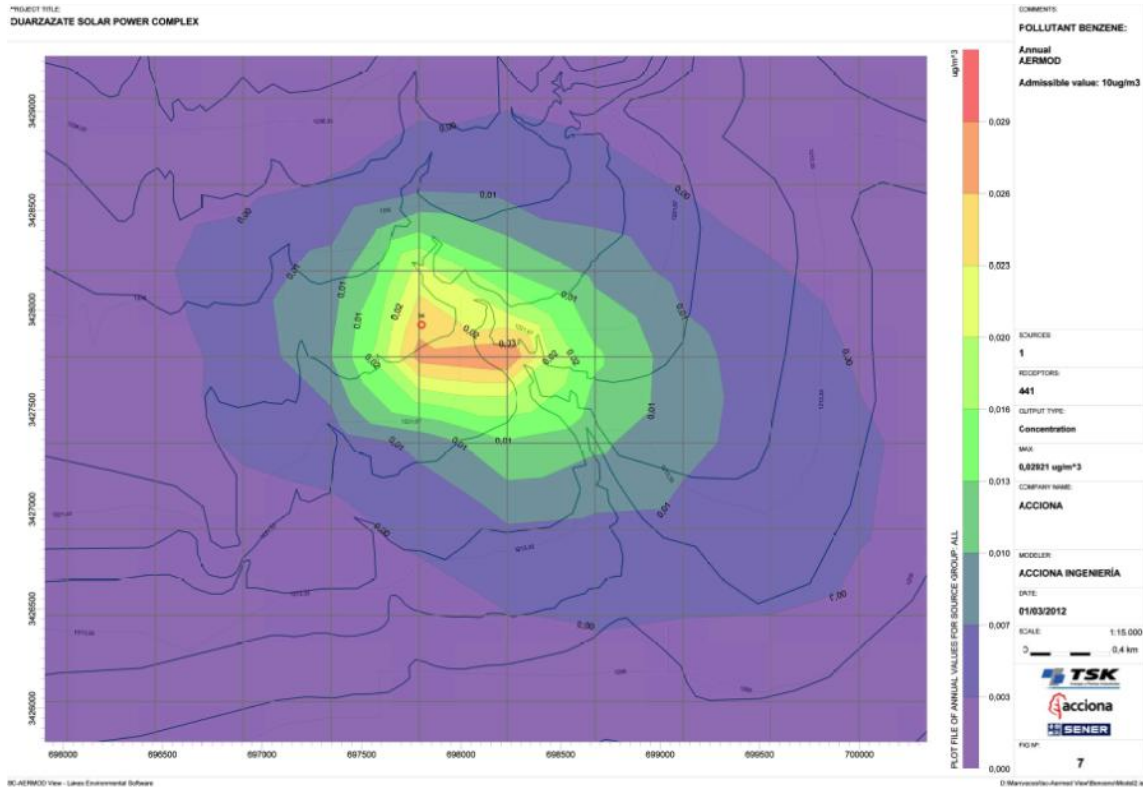


Figure 8-9 Annual Emission model for Benzene



8.6.2 Mitigation Measures

Although the modelling study has shown that the operation of the facility will not have any negative impacts to the air quality, the following mitigation measures will be implemented as a course of best practice in order to ensure that the longterm operation of the facility does not result with any cumulative negative impacts.

- All internal roads within the project will be paved in order to prevent dust generation from vehicle movements.
- Vehicle speeds will be less than 10Km/hr during the mirror cleaning process, and if necessary road wetting will be carried out to suppress dust.
- If it is necessary to protect the plant from dust generation at the outside boundary of the project then barriers could be erected in areas exposed to wind. However, studies to verify material permeability, minimum height and distance from the first loops would be needed in order to avoid shadows.

- Low Sulphur Fuel (<50ppm) will be used for the boilers and all other fossil fuel burning plant. The boilers will have one common exhaust stack. The flue stack will include sample points for the temperature analysis and control of combustion.
- The vent of the condensation tank will be equipped with an active carbon filter to avoid emissions of volatile compounds to the atmosphere.

The proposed system for removal of VOC will be in accordance with BAT (BREF: Best Available Technique Reference Document) of Common Waste Water and Waste Gas Treatment / Management Systems. It is stated that for VOC removal BAT is:

1. Removing VOC from waste gas streams, using techniques (or a combination thereof) described in Sections 3.5.1 and 3.5.2 and listed in Table 4.10.
 - Condensation and Adsorption are both appearing techniques in the proposed treatment process.
2. Using recovery techniques such as condensation, membrane separation or adsorption whenever feasible to regain raw material and solvents. Waste gas streams with high VOC concentrations are best pre-treated by techniques such as condensation or membrane separation / condensation to recover the main load before sending them to adsorption, wet scrubbing or combustion.
 - In the case of adsorption and combustion this can also be a safety issue, keeping VOC concentration below 25 % LEL. The proposed design has provided for a double condensation system prior to reaching the adsorption stage.

To guarantee a safe emission to the atmosphere a final stage of activated carbon adsorption will be implemented. The active carbon filter allows achieving the following levels of HTF System VOC emissions (after treatment):

- Vented VOC flow: < 0.16kg/h
- VOC concentration after treatment: < 75 mg Carbon / m³ (Complies with specification)
- Benzene concentration: up to 5mg/m³
- Phenols, cresols and xylols (as phenols); 10 mg/m³
- Total annual VOC vented: < 0.5 T/year

8.6.3 Residual Effects

The air quality modelling study undertaken by the Consortium identified that emissions contributions from the operation of the proposed Phase 1 Ouarzazate SPC will not adversely affect the existing air quality and that emissions values remain well below the IFC and Moroccan maximum allowable limits for point source emissions.

Following the implementation of an appropriate OESMP (which will at least include the mitigation measures outlined previously), and others as noted within the Environmental and Social Management and Monitoring section, the overall residual effects are expected to be of negligible significance.

9 NOISE AND VIBRATION

9.1 Introduction

Noise is an environmental impact that will be generated by both construction activities and the operational phase of the proposed Phase 1 Ouarzazate SPC. Vibration may also be generated by equipment during the construction period but is unlikely to be evident during operations.

This section considers the potential effects associated with the generation of noise and vibration during the construction and operational phases of the proposed project. It includes the results of a baseline noise survey, which was undertaken to establish the existing ambient noise levels in the proposed site and interpretation of analytical noise modelling undertaken to determine operational noise emissions from the plant.

The potential impacts are assessed, mitigation measures considered and the residual impacts reported.

9.2 Regulatory Requirements

9.2.1 Noise

Currently no noise regulations or standards are available within the Moroccan environmental regulatory system. Therefore, the proposed plant will be required to comply with the noise limits as specified by the IFC EHS General Guidelines (2007).

These guidelines represent maximum noise values that must be achieved at surrounding/nearby receptors. It is stated within the IFC EHS Noise Level Guidelines that noise impacts will not exceed the levels which are presented in Table 9-1, or result in a maximum increase in background levels of 3dB at the nearest off-site point of reception.

Table 9-1 IFC EHS General Noise Guidelines (At off-site receptors)

| Receptor | One Hour L _{Aeq} (dBA) | |
|---|---------------------------------|-----------------------------|
| | Daytime 07:00 – 22:00 | Night time 22:00 – 07:00 |
| Residential, Institutional, Educational | 55 | 45 |
| Industrial, Commercial | 70 | 70 |

Furthermore, the following requirements have also been specified in the IFC EHS Occupational Health and Safety Guidelines (April 2007) regarding noise exposure limits:

- No employee will be exposed to a noise level greater than 85 dB (A) for duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear will be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C);
- The use of hearing protection will be enforced actively when the equivalent sound level over 8 hours reaches 85 dB (A), the peak sound level reaches 140 dB(C), or the average maximum sound level reaches 110 dB (A). Hearing protective devices provided will be capable of reducing sound level at the ear to at least 85 dB (A);
- For every 3 dB (A) increase in sound levels, the allowed exposure period or duration will be reduced by 50%;
- Where feasible, use of acoustic insulating materials isolations of the noise source and other engineering controls will be investigated and implemented prior to the issuance of hearing protection devices as the final control mechanism; and
- Medical hearing checks on workers exposed to high noise levels will be performed periodically.

To help provide an understanding to the magnitude of noise, the following table describes noise levels subjectively in comparison to example sources/situations.

Table 9-2 Relative assessment of noise

| Noise Level (dbA) | Examples | Subjective Evaluation |
|-------------------|---|--|
| 150 | Jet take-off (at 25 metres) | Ear drum rupture |
| 140 | Near Jet Engine | Deafening |
| 130 | Threshold of pain | |
| 120 | Threshold of feeling - loud rock band, jet aircraft overhead. 32 times as loud as 70dB. | |
| 110 | Accelerating motor cycle nearby | |
| 100 | Loud vehicle horn | |
| 90 | Noisy urban street, motor mower nearby, noisy factory | Very Loud |
| 80 | Telephone ringing in same room, diesel truck at 65Km/h at 15m | Twice as loud as 70db |
| 70 | Baby crying in same room, vacuum cleaner being used, passenger car at 105Km/h at 7m | Loud. Upper 70 becomes annoying to some people |
| 60 | Freeway vehicle traffic nearby | |
| 50 | Average office, washing machine, large electrical transformers at 30m | Moderate |
| 40 | Soft radio music indoors, wind in trees | Low |
| 30 | Average residence | Faint |
| 20 | Close to average whisper | |
| 10 | Rustle of leaves in wind, human breathing | Very Faint |
| 0 | Threshold of audibility | |

Source: U.S Department of Transportation. Federal Highway Administration, and Outdoor Noise and the Metropolitan Environment, M.C Branch et al., Department of City Planning, City of Los Angeles, 1970.

9.2.2 Vibration

It will be noted that none of the above standards set out specific standards in relation to vibration impacts at either the construction or operation phase. The IFC's General EHS Guidelines (2007) do however reference potential impacts from vibrations due to the use of hand held power tools and other equipment, as below:

“Exposure to hand-arm vibration from equipment such as hand and power tools, or whole-body vibrations from surfaces on which the worker stands or sits, will be controlled through choice of equipment, installation of vibration dampening pads or devices, and limiting the duration of exposure. Limits for vibration and action values, (i.e. the level of exposure at which remediation will be initiated) are provided by the ACGIH66. Exposure levels will be checked on the basis of daily exposure time and data provided by equipment manufacturers.”

9.3 Methodology

9.3.1 Noise

This study has been undertaken based on the following:

- Initial identification of the relevant national and international standards and requirements relating to noise during the construction and operational phases.
- An assessment of the likely construction activities and basic modelling of the potential operation phase noise generation (in line with British Standard 5228). The assessment has been made against the permitted standards, IFC and as stipulated in the RFP, with the impacts on workers and nearby receptors noted.
- Determination of required mitigation measures, including noise abatement technologies that might be needed to comply with national and international noise limits. Mitigation measures have been recommended in light of the results of the modelling study and the residual impacts on receptors outside the site and workers at the site predicted.

In order to establish a benchmark of the noise conditions at the site, an environmental noise survey was undertaken in the day and night time in November 2012.

During this survey, noise monitoring measurements were conducted at seven (7) locations to consider the ambient noise levels within the site and the influence of existing and surrounding noise sources. The following table and figure provide the location details.

The monitoring was undertaken using a pre-calibrated sound level meter, which was connected to a laptop for direct download of the data. A computer software specifically developed for the instrument, then interpolated the data and provided tables and graphs of the noise levels. Measurements were taken for a 15 minute period,

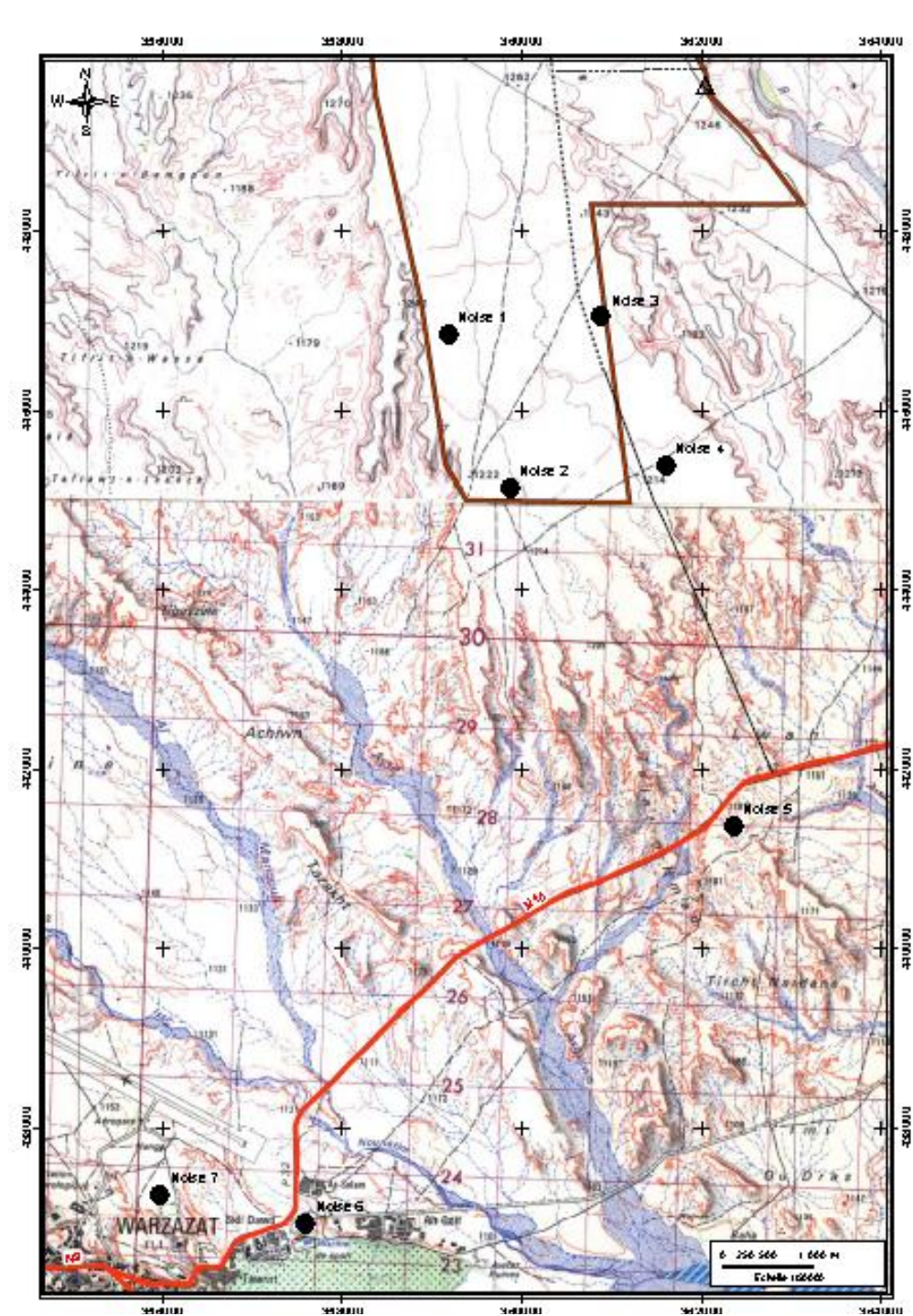
in the day time and night time, at each location using a broadband noise setting, within a measurement range of 30-100 dB.

The results of the noise monitoring survey will be used as a benchmark for the programmed noise monitoring activities, which will be implemented for the construction and operation phase within the ESMP.

Table 9-3 Noise sampling Coordinates

| Monitoring Station | Location | Description | Sampling Time |
|--------------------|-------------------------------|---|--------------------------|
| N-1 | 31°01'01.22" N / 6°52'29.79"W | Monitoring sites located at the four corners of the site | 15 mn day and night time |
| N-2 | 31°00'05.66" N/6°52'03.02"W | | |
| N-3 | 31°01'08.04" N/6°51'25.96"W | | |
| N-4 | 31°00'14.33" N/6°50'57.59"W | | |
| N-5 | 30°58'03.97" N/6°50'27.32"W | Monitoring locations stretched along the site access road | |
| N-6 | 30°55'38.40" N/6°53'24.83"W | | |
| N-7 | 30°55'48.03" N/6°54'25.73"W | | |

Figure 9-1 Noise Survey Locations



9.4 SESIA Baseline

Noise

The proposed site is located in an isolated area, with no significant developments or commercial activities located within a 6 Km radius. The only identified source of noise is sporadic in nature and emanates from the two roads, which run parallel to the site. In the past, traffic was light and consisted of private vehicles and light commercial trucks.

However, recently, road expansion and construction activities have started and as a result noise levels will have increased, however this is considered uncharacteristic of the typical historical noise conditions and is temporary in nature.

Analytical results

The following tables provide the measurements for noise levels collected at the 7 locations.

Table 9-4 Noise Monitoring Results, Day Time

| Noise station | Measured Noise Level Day Time | | | Comments |
|---------------|-------------------------------|-------------|--------------|---|
| | Leq, dB (A) | Lmax dB (A) | Lmin, dB (A) | |
| N-1 | 40.5 | 66.1 | 28.6 | Noise levels reflect a quiet environment, and are below the maximum allowable limit |
| N-2 | 41.7 | 62.3 | 31.1 | |
| N-3 | 41.1 | 70.8 | 27.4 | |
| N-4 | 42.5 | 64.8 | 33.8 | |
| N-5 | 47.3 | 81.2 | 29.0 | The averaged noise level across the three sites, is marginally above the maximum allowable limit for residential areas, but below the limit for industrial areas. Given that these measurements were taken from the road, it is to be expected that noise levels will exceed the Industrial/Commercial limit. |
| N-6 | 62.5 | 85.3 | 48.7 | |
| N-7 | 58.5 | 78.0 | 41.2 | |

Table 9-5 Noise Monitoring Results, Night Time

| Noise station | Measured Noise Level | | | Comments |
|---------------|----------------------|-------------|--------------|---|
| | Night Time | | | |
| | Leq, dB (A) | Lmax dB (A) | Lmin, dB (A) | |
| N-1 | 38.5 | 59.5 | 29.6 | Noise levels are not significantly changed from the day time levels and are still within the regulatory limits. |
| N-2 | 42.3 | 60.4 | 30.0 | |
| N-3 | 39.1 | 62.3 | 30.6 | |
| N-4 | 40.2 | 61.2 | 29.5 | |
| N-5 | 54.6 | 80.8 | 32.5 | The average noise level is slightly higher than the day time, but is still within the maximum allowable noise levels for Industrial/Commercial areas. |
| N-6 | 65.6 | 85.3 | 51.4 | |
| N-7 | 58.0 | 73.9 | 40.0 | |

Table 9-6 Noise Monitoring Results, Averages

| Monitoring Location | Average sound level in dB | |
|---------------------|---------------------------|-------|
| | Day | Night |
| N1 | 40.5 | 38.5 |
| N2 | 41.7 | 42.3 |
| N3 | 41.1 | 39.1 |
| N4 | 42.5 | 40.2 |
| N5 | 47.3 | 54.6 |
| N6 | 62.5 | 65.6 |
| N7 | 58.5 | 58.0 |

The wind speed, during the monitoring period, was weak with a minimum of 0.3m/s and a maximum of 4.9m/s. The predominant direction was SE-NW.

Generally, both the day time and night time noise levels at the boundaries of the SPC, reflect a quiet, undeveloped area. The levels do not change significantly between night and day and they are below the maximum allowable noise limits for residential areas.

The average noise levels along the road, reflect typical noise levels that would be generated by light traffic. Additionally, there is no significant change between the night and day readings, and in comparison to the Industrial/Commercial limits, the levels are compliant.

Vibration

The impacts due to vibration have been determined by considering the likely construction and operational processes involved at the proposed Phase 1 Ouarzazate SPC project site. As such, a discussion of the impacts and any necessary mitigations measures has been provided in the following sections.

In terms of a baseline, no noticeable vibrations were encountered on the site during the site visits. It is anticipated that very low level vibration may occur on the eastern boundary of the site where the new road runs adjacent to the boundary. No other industrial facilities are located within 15 km radius of the site, therefore off-site vibrations are not anticipated.

9.5 Construction Assessment

9.5.1 Assessment of Impacts - Noise

At this stage of the project it is envisaged that the construction 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 and plant 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*', blockwork, steel/scaffold erection and the installation of plant etc. 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.

With regard to the impacts upon ambient noise levels, a basic assessment of the likely construction noise levels to be experienced at the site boundary has been undertaken in regard to the expected construction plant/machinery to be used at the site. This basic assessment is provided below, but it will be noted that the predicted noise levels are indicative and are subject to variables including location, buildings, specifications of construction plant (including power output, silencers etc) and works phasing.

Noise data for the likely plant/equipment to be used at the site has been obtained from 'BS:5228, British Standards: Code of practice for noise and vibration on construction and open sites'. Noise values for likely site plant/equipment have been set out in Table 8-6. These noise levels represent the typical magnitudes observed at 10m from the operation of the construction plant.

Table 9-7 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 |
| Cumulative noise at 10m assuming 50% on time | 89 | |

For the assessment it is assumed that each item of plant/equipment is utilised at approximately half its operational capacity (over a given period of time), rather than continuously at full power; as is typical with any construction process. A 50% on time factor has therefore been applied in the calculation.

As such, the accumulation of the noise levels from all the above equipment at a reception point 10m away will be approximately 89 dB(A). It will be noted that this basic assessment assumes that the noise is being received at a distance of 10m from the source and does not account for any other background noises.

It is known that noise levels dissipate with distance propagation and the following table (Table 8-7) sets out the anticipated noise levels at distances from the construction

sources. The propagation due to distance has been calculated from the appropriate attenuation formula for distance, as set out in the BS:5228 British Standard.

Table 9-8 Construction noise levels in terms of distance from the source

| Distance from Construction Works (m) | Noise Level dB (A) |
|--------------------------------------|--------------------|
| 10 | 89 |
| 20 | 83 |
| 50 | 73 |
| 100 | 66 |
| 200 | 58 |
| 300 | 53.6 |
| 500 | 48.1 |
| 1000 | 40.6 |

Table 8-5, demonstrates that the attenuating effects of distance on a noise source is profound; reducing noise levels when at greater distances from the source. Given the expanse of the site, and that the power island will be located at the centre of the solar field, the construction activities on site are unlikely to affect the offsite ambient noise levels.

Prior to the implementation of mitigation measures, this impact can be assessed as being of minor negative significance. However, measures will be introduced to reduce noise levels when working in close proximity to the site boundary, as they could exceed the required standards without mitigation. It is likely that at certain locations of the site, noise levels will be in excess of 85 dB(A), for which ear protection would be required for the personnel on site. Such areas will include those immediately next to plant or machinery. Prior to the mitigation measures, the impact to workers can be deemed to be of a minor to moderate negative impact.

9.5.2 Assessment of Impacts - Vibration

Certain construction processes, particularly those involved with site preparation and civil works, e.g. ground breaking 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, due to the isolated nature of the site and lack of sensitive receptors within its vicinity, any vibrations caused during construction are unlikely to provide impacts.

The nearest receptors to the site are the towns and cities to the north and south of the Phase 1 Ouarzazate SPC. As vibration dissipates rapidly with distance (due to its spreading loss from the source), there are anticipated to be few and minor vibration impacts due to construction upon sensitive receptors. Due to the nature of earthworks being relatively minor, it is unlikely that the impacts upon the surrounding receptors caused by vibration will be significant (in terms of disturbance to humans or damage to structures). Where any vibration impacts do occur they will be temporary in nature. Prior to the implementation of mitigation measures, this impact can be assessed as being negligible.

Vibration impacts to construction workers may directly occur to those who are in operation of vibration creating machinery or, who are in close proximity to piling and excavation works. Such impacts may include 'white finger', which is typically caused by the use of vibrating hand held machinery.

9.5.3 Mitigation Measures

The following measures will be considered where appropriate and will be implemented throughout the construction of the Phase 1 Ouarzazate SPC:

- Activities with highest noise emissions will be undertaken during daytime hours between Monday and Friday and not during official holidays;
- 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 plant will also be fitted with suitable silencers;
- Where appropriate, bored piling techniques will be considered in preference to impact piling;
- Delivery vehicles will be prohibited from waiting within or near the site with their engines running. The movement of heavy vehicles during the night will be avoided wherever practical;
- When working in close proximity to the site boundary, extra care will be taken to ensure the mitigation measures in use are effective.

- Independent noise monitoring will be undertaken as appropriate to demonstrate that noise levels at the site boundary are acceptable and within the RFP specified limits;
- Items of plant on site operating intermittently will be shut down in the intervening periods between uses;
- The 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;
- Where appropriate, noise barriers /attenuation to be employed (e.g. for generators) to ensure that the maximum noise level at 1 m distance from a single source will not exceed 85 dB(A); and
- Where noise levels exceeds 85dB(A) noise protection devices shall be provided to personnel on-site.
- If particularly noisy works are scheduled, these will be undertaken within the daytime and the nearest sensitive receptors informed to the timing and duration of the nuisance.
- Operators of vibrating hand held machinery will be provided with appropriate PPE (e.g. protective gloves) and be given suitable breaks from using such equipment to reduce the impacts of vibration.

9.5.4 Residual Effects

Following the effective implementation of mitigation measures outlined above, the residual impacts resulting from noise generated during the construction phase are considered to be of neutral to minor negative significance.

9.6 Operation Assessment – Noise and Vibration

The RFP provided by MASEN has stipulated specific on-site noise levels which will be complied with during the operation of the Phase 1 Ouarzazate SPC.

Table 9-9 RFP Noise Requirements

| Location | One Hour LAeq (dBA) |
|---|---------------------|
| At one (1) meter outside the Plant fence/boundary when all equipment is running | 60 |

| | |
|---|----|
| At one (1) meter away from open air installations | 85 |
| Within the central control room | 50 |
| Within other machine rooms, workshops, etc | 85 |

9.6.1 Assessment of Impacts

The operation of the Phase 1 Ouarzazate SPC project will not include the use of heavy machinery and equipment. The main plant which are likely to emit high noise levels are within the power block (BOP) and include the steam turbines, cooling towers, HTF pumps, compressed air systems etc. Such processes are likely to be continuous and sustained during daily activities, due to the 24 hour operation of the plant. By contrast the solar field area will not contribute any significant noise levels.

A preliminary noise modelling study was undertaken by the consortium, using CADNA-Av.4.1 software from Datakustic. The simulation was based on the sound pressure levels at 1 m from the main noise sources in the power block at normal operating conditions. The results are depicted in the following graphics and table below.

Table 9-10 Summary of Expected noise levels from the Phase 1 Ouarzazate SPC plant

| Source | Modelled Maximum Noise | Likely Hours of operation | Noise Level |
|----------------|------------------------|---------------------------|------------------|
| Turbines | 65-70 | 24hrs | Moderate (40-70) |
| Water pumps | 70-75 | 24hrs | Loud (70-90) |
| Compressed Air | 65-70 | 24hrs | Moderate (40-70) |
| Cooling Towers | 65-70 | 24hrs | Moderate (40-70) |
| HTF Main Pump | 70-75 | 24hrs | Loud (70-90) |

Figure 9-2 Solar field preliminary noise map

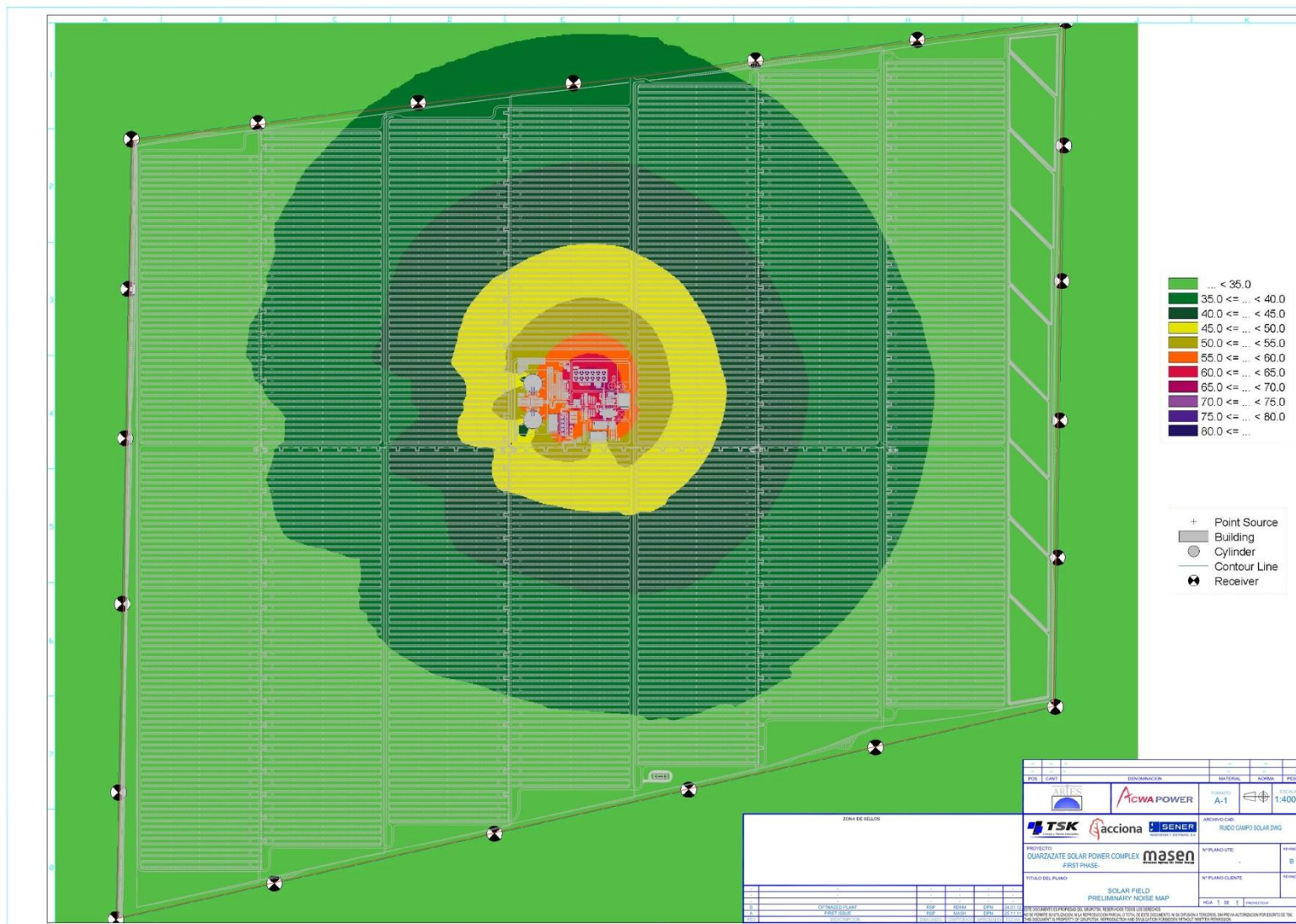
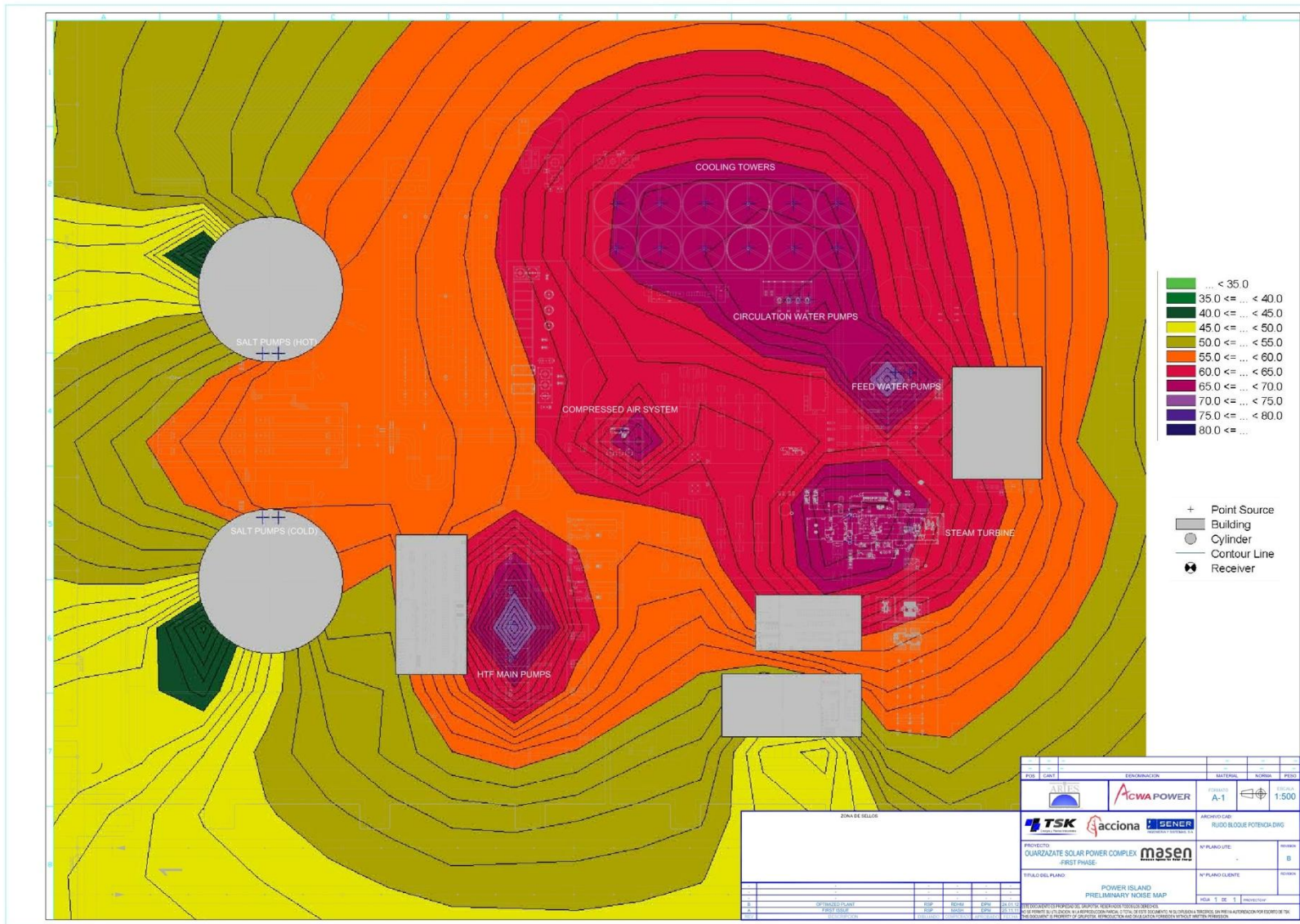


Figure 2-2 Power Island preliminary noise map



The maximum collective plant noise at the site boundary was estimated at 45dB. Within the plant's BOP boundary the model showed that the maximum attained noise level was 65dB, and the maximum noise level attained at the site offices was 60dB.

Due to the continuous nature of the operations, it is anticipated that the noise impacts 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, however it is not likely to exceed the IFC noise limits if left untreated.

Given the arrangement of the facilities with respect to the offices it is unavoidable that one or two of them will be located closer to the offices. It will be noted that the site layout has ensured that the loudest noise sources are furthest away from the sensitive on-site receptors. The predicted noise impacts are "freefield" outside the buildings and therefore the noise levels experienced by workers inside will be considerably reduced by the building façade and the window glazing etc.

In addition, the distance at which these noises have to travel will still result in propagation and a reduction in the noise levels when encountered at these receptors. Furthermore, due to the built up nature of the site and intervening structures between the noisy processes and the sensitive receptors, there is likely to be reflection, which will also reduce the noise level at the reception point.

The potential magnitudes of these impacts have been assessed as being of moderate negative significance, prior to the implementation of any mitigation measures.

In terms of vibration, the processes involved during the operational phase of the project are not anticipated to result in impacts at or surrounding the site. Any vibrations that may occur during operation are likely to be sporadic in nature (e.g. from plant/vehicle movements) and would dissipate effectively over distance. Therefore, vibration during operation is not envisaged to result in impacts to nearby or site receptors and can be deemed as neutral.

9.6.2 Mitigation Measures

With regard to normal operation, the following mitigation measures will be required:

- All equipment specifications, will limit near field noise to 85 dB(A) at 1m.

- Where equipment and plant exceed 85 dB(A) at 1m under typical operating conditions, noise suppression techniques will be developed, these may include: silencers, noise insulation, noise attenuation barriers and housing for equipment. This will be determined and validated during performance testing.
- All pumps will incorporate primary vibration measurement elements.
- Areas of high noise (>85 dB (A)) will be designated as such and it will be mandatory for site personnel to wear hearing protection within these areas.
- Silencer performance specifications will be provided to allow the plant to maintain compliance with the noise limits during start-up.
- Ongoing noise monitoring will be carried out at the SPC and at sensitive receptors to ensure noise levels are within regulators specifications. The analytical results provided above will be used as the basis for verifying that the noise conditions at the operational stage have not significantly changed from the background and not negatively impacting the neighbouring sensitive receptors.
- Noise surveys and/or modelling will be carried out by the appointed EPC at the commissioning stage, to ensure that the equipment operates within the acceptable levels stipulated by MASEN and IFC regulations for industrial areas. If necessary, further mitigation measures will be implemented based on the modelling results. Noise performance testing will then be undertaken to validate any modelled observations and to ensure that legislative requirements are being complied with.

9.6.3 Residual Effects

Following application of the above mitigation measures it is considered that residual operational noise impacts will be of minor negative significance at the site boundary and nearby receptors.

10 SOLID AND HAZARDOUS MATERIAL MANAGEMENT

10.1 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 Ouarzazate Solar Power Complex. Additionally, activity specific mitigation 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 groundwater and indirect contamination to sensitive receptors is likely. With proper management, a large amount of non-hazardous materials discarded 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.

10.2 Regulatory Requirements

10.2.1 National Requirements

Law No. 28-00 establishes the framework for waste management and has set out guidelines and a methodology concerning the classification, transportation and disposal of waste.

Consequently, several decrees have been promulgated, which outline the procedures and standards that will be implemented to ensure compliant transport and disposal of wastes based on their classification. With respect to this project the following Decrees will be applied:

- Decree No. 2-07-253 Identifies and lists hazardous wastes by Industrial process.
- Decree No 2-09-538 Identifies hazardous wastes management procedures.

- Decree No. 2-09-683 Identifies non-hazardous wastes management procedures

10.2.2 IFC/World Bank Requirements

Section 1.5: Hazardous Materials Management and Section 1.6: Waste Management of the IFC General EHS Guidelines (2007) are applicable to all projects that generate, store or handle any quantity of waste. The waste management guidelines state that facilities that generate and store wastes will practice the following:

- Establish waste management priorities at the outset of activities based on an understanding of potential waste streams;
- 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 minimise the generation 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.

In addition, Morocco is a non-OECD country. Therefore, the IFC Performance Standard 3: Resource Efficiency and Pollution Prevention has been considered during the assessment of waste in relation to the Project. Section 12 of this document specifically details that waste will be minimised, reused or recycled where possible, and treated and disposed in an environmentally sound manner.

Similarly, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal obliges its Parties to ensure that hazardous and other wastes are managed and disposed in an environmentally sound manner. Parties are expected to minimise the quantities that are moved across border, to treat and dispose of waste as close as possible to their place of generation and to prevent or minimise the generation of wastes at source. Strong controls have to be applied from the moment of generation of a hazardous waste to its storage, transport, treatment, reuse, recycling, recovery and final disposal.

10.3 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 other industrial facilities. The following specific information has been reviewed as part of the desk study:

- Assessment of applicable national and international standards and guidelines identified within the IFC / World Bank Performance Standards;
- Assessment of available site specific information relating to waste generation;
- 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
- Walkover survey; to identify sensitive receptors and determine the existing baseline conditions.

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 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 for the operational phases. Inclusion of detailed methods for appropriate storage, transfer and disposal of both hazardous and non-hazardous waste streams.

10.4 SESIA Baseline

Solid waste generation in Morocco 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 Morocco, it is vital to consider the methods for handling, storage and management of waste generated in conjunction with progressions in a country's economy.

Waste management sites and facilities in Morocco are operated and managed by private companies or local municipalities. When new sites are proposed and constructed, the regulator plays an important role in advising the operators on the environmental protection requirements for each facility.

10.4.1 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 Phase 1 Ouarzazate Solar Power project may use or generate hazardous materials in all of the categories listed above.

10.4.2 Construction Waste Generation

During construction, waste would be generated during earthworks, construction of the fence, paths, road accesses and buildings, and connecting the gas and 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.

10.4.3 Operational Waste Generation

Solid wastes will be generated at several facilities within the power block. Some of these will be direct products resulting from the operation and maintenance of the facilities, whilst other wastes will be the byproducts of primary waste treatment processes, for example the sludge that results from wastewater treatment.

The following table summarises the types of wastes, which will be generated.

Table 10-1 Wastes Streams and Estimated Quantities

| Plant | Waste | Quantities |
|---------------------------|------------------|----------------|
| Raw Water Treatment Plant | Activated Carbon | 3,240Kg/5yrs |
| | Sand | 43,212 Kg/5yrs |
| | Anthracite | 44,607 Kg/5yrs |

| Plant | Waste | Quantities |
|---------------------------|---|-----------------------|
| | Filtration Cartridge | 1,310 cartridges/5yrs |
| | R/O Membranes | 198membreane/5yrs |
| | EDI Module | 1 module/5yrs |
| Effluents Treatment Plant | Sludge | 5,215Kg wet sludge/h |
| Oil water separator | Sludge | 105kg wet sludge/h |
| HTF Separator | Sludge | 140kg wet sludge/h |
| Sanitary Treatment | Sludge | 8kg wet sludge/h |
| Industrial Maintenance | Scrap metal, glass, plastics, tires etc | 20 Tons/year |
| Office wastes | Paper, plastics, putrescible etc | 18 Tons/year |
| Health Clinic | Medications, syringes, gloves, gauzes | 50Kg/year |

(*) The quantities given in this document are an average estimation; they will depend on the oils drainages/spillages, rainfall intensity, quality of raw water, etc.

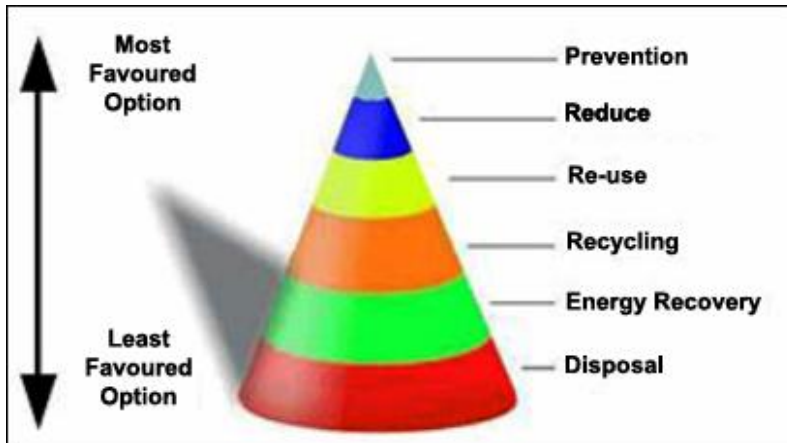
In addition to solid waste generation from the SPC, domestic waste will also be generated from the following sources: administration building, canteen, security cabins, and clinic. These wastes will generally include paper, plastics, aluminium, glass and putrescible wastes.

10.4.4 Waste Management Hierarchy

The waste management hierarchy is a key element of waste management. Minimising the amount of waste to be stored and disposed 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 Figure 9-1.

Figure 10-1 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 will be considered. Where waste generation cannot be avoided or further reduced at source, opportunities for reuse of materials will 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.

10.4.5 Sensitive Receptors

The following are considered to be project specific sensitive receptors during both construction and operational phase of the facility:

Local landfills within the vicinity of the Project Site represent potential sensitive receptors, since the construction and operational phases will result in an additional input of waste materials into these landfills.

The generation of both hazardous and non-hazardous wastes will be expected. The municipality of Ouarzazate has a licensed waste company that handles industrial and

domestic wastes. The handling and disposal of hazardous wastes will follow the regulations of law no. 28-00 for waste management and will also meet international best practice (IFC 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.

10.5 Construction Assessment

10.5.1 Assessment of Impacts

During the construction phase, the main impacts relating to waste generation are expected to result from the generation of substantial quantities of hazardous wastes and non-hazardous waste.

Non-Hazardous Waste

During the construction phase, a number of activities will result in waste generation. These activities include, but are not limited to:

- Site clearance and levelling;
- Backfilling and excavation;
- Constructing a boundary wall and site offices;
- Power and water connections; and
- Temporary sewerage and drainage network construction.

The types of waste generated by these activities include:

- Sand;
- Gravel;
- Concrete;
- Asphalt paving;
- Scrap steel;
- Glass;
- Plastics;
- Packaging materials;
- Wood; and
- Municipal 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 local landfills and result in a reduced capacity for handling waste from municipal sources.

Prior to the implementation of mitigation measures, it is considered that the generation of non-hazardous waste during the construction phase will result in a temporary impact of moderate to major negative significance.

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 disposal requires careful consideration. Typical hazardous waste streams that may arise during construction include:

- Solvents;
- Used oil;
- Hydraulic fluid;
- Resins and paints;
- Batteries;
- Waterproofing compounds;
- Adhesives;
- Machinery lubricants;
- Waste chemicals - used in the concrete forming process;
- Clean-up materials (such as 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 transportation by waste contractors who have not been approved by MEMEE or disposal to unlicensed landfills. Increased pressure may be placed upon local hazardous waste landfills and result in a reduced capacity for handling waste from municipal sources.

Therefore, prior to the implementation of mitigation 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.

10.5.2 Mitigation Measures

The mitigation measures provided refer to both hazardous and non-hazardous wastes. Whilst some mitigation 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. The following mitigation measures will contribute to the reduction of overall waste generated by the Project:

Waste Management Plan

Prior to the start of construction activities, a CESMP will need to be prepared by the EPC. This is a requirement of the IFC Performance Standard 1 in determining an 'action plan' and management system. 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. Practical examples of reduction or recycling opportunities, include the following:

- Waste concrete and masonry can be re-used in road construction and base fillings; reasonable levels of utilisation is 80 to 90%;

- 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 can be recycled;
- Waste metal can readily be recycled, 100% of this waste stream can be eliminated;
- It is conservatively estimated that 80% of oils can be refurbished or reused through environmentally friendly energy recovery; and
- Ordering materials that have reusable packaging and/or in bulk can significantly reduce waste generated.
- 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;
- Refillable containers will be used, where possible, for collection of waste fluids such as waste oil, hydraulic oils, and used grease.

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. Good housekeeping practices will be incorporated within the construction waste management plan, including the following:

- Separation of waste streams to facilitate recycling;
- Adequate storage facilities for non-hazardous waste storage in designated areas to prevent waste from dispersing throughout the site;
- Adequate hazardous waste storage in bunded containers stored in dedicated, covered storage areas with impermeable bases, sufficient containment capacity and equipped with spill kits;
- Immediate spill response protocol and contingency plans to detail the clean up of any spillages;
- Procedures and rules for hazardous waste handling;

- 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.

Waste Storage

The storage of waste will meet and comply with the following requirements:

- Food waste: Must be stored within a sealed metal or plastic skip or bin, in order to prevent vermin/pests gaining access;
- 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;
- Heavy waste: To be contained within an open skip, providing that segregation occurs effectively enough to remove all lightweight material that could be blown away;
- Hazardous waste: 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.
- Extinguishers (1 every 500 m²) must be placed in the most strategic points and preferably in the areas close to flammable/combustible leftover storage area.
- The storage shed will be built over a concrete pad to protect the stored waste from stormwater run off.
- Storage sheds will also have a built in drainage system to contain any spills or leaks and facilitate safe removal.

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 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 French and Arabic. Wherever possible, chemicals will be kept in their original container;
- 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 review by the concerned authority; and
- Regular training of site personnel in proper waste management and chemical handling procedures will be conducted at regular intervals.

Hazardous Waste

Impacts associated with hazardous waste can also be effectively mitigated through the implementation of best practice and regulations. Specifically, this involves the implementation of procedures for adequate handling, establishment of secure temporary storage areas, and disposal of waste by approved contractors. These measures, if implemented correctly, will prove sufficient to prevent contamination of soil and groundwater and associated secondary impacts. The EPC, sub contractors will be required to ensure the proper handling, storage and disposal of hazardous waste, according to best environmental practices and guidelines.

10.5.3 Residual Effects

Following the implementation of the mitigation 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 likely to be negligible in significance.

10.6 Operation Assessment

10.6.1 Assessment of Impacts

The operational phase of the Project will result in the production of a limited number of waste streams which will primarily be of light commercial nature. Likely waste streams that will be generated during operation are as follows:

Domestic Waste

The operation of the proposed Project will generate domestic waste from the operation of the administration and canteen 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. The quantity of domestic waste that will be generated will be minor given that a total of approximately 60 employees will be working in shifts on a continuous basis. Prior to the implementation of mitigation measures, this waste, if disposed improperly, and depending on the sensitivity of the location, could result in an impact of moderate negative significance.

Industrial Non-Hazardous Waste

Industrial non-hazardous waste refers to waste generated by operation activities that do not exhibit any characteristics which can 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 Phase 1 of the Solar Power Complex 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. 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. Prior to any mitigation measures this can be deemed to be temporary and of minor negative significance.

Industrial Hazardous Waste

This fraction of waste streams generated can potentially cause significant adverse impacts on human health and the environment if managed improperly.

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;
- Heavy metals within the sludge;
- Waste oil, oily sludge, 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, wire cables, 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 measures are addressed within Chapter 6: Soil Contamination.

Inappropriate handling through lack of personnel training on site may lead to accidental spills or leaks to the soil which leads to a contamination event, resulting in a potential health risk to workers and environmental impacts. Contamination may also arise 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 and result in a reduced capacity for handling waste from municipal sources.

Prior to the implementation of mitigation measures, the operation phase of the Project and resultant hazardous waste streams generated is likely to result with an impact of moderate negative significance upon the waste infrastructure and receiving environment within the vicinity of the Project.

10.6.2 Mitigation Measures

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 and IFC/World Bank standards will form the basis of the mitigation measures prescribed 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. The mitigation 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 measures are applicable during the operational phase:

- A bioremediation tank will be built on site to process soil contaminated by HTF.
- 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;
- Reduce packaging of materials and order in bulk. If appropriate, request supplier to minimise packaging;
- Recycle paper, metal, plastic and packaging;
- Implement a recording system for the amount of wastes generated on-site;
- Undertake regular inspections, audits, and monitoring of waste streams generated to ensure that all necessary mitigation measures are being implemented;
- Waste solvents, oils and other hazardous materials used at the site will be collected in suitably bunded and protected areas.
- Hazardous waste will be collected and transported by appropriately licensed transporters to approved hazardous waste disposal sites when re-use is not an option;
- Consignment details and records of the hazardous waste generated shall be maintained in the facility;
- 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 in an appropriate way;
- Only trained personnel will be permitted to handle hazardous waste;

- Implementation of spillage and leakage prevention measures such as a development of manuals for proper waste handling, regular inspection of containers and storage areas;
- 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;
- 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.

10.6.3 Residual Effects

Following the implementation of the mitigation 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 permanent and of minor negative significance.

11 STORMWATER MANAGEMENT AND EROSION CONTROL

11.1 Introduction

Chapter 10 discussed water use and wastewater management for project activities. In this chapter the potential impacts that land use change in the project site will have on natural water streams, soil erosion patterns and flooding risks in the study area are discussed.

The precipitation patterns, topography, soils types and sparse vegetation cover in the study area generate surface run-off and ephemeral streams that erode the soil and can lead to floods. This creates characteristic erosion patterns and has a determinant influence on the topography of the area. It also causes increased siltation in the Mansour Ed Dahbi Reservoir, that has been reported to be a problem.

The project will change the patterns of storm water runoff and divert two channels that run through the site. This can potentially lead to increased erosion and flooding risk downstream.

11.2 Regulatory Requirements

IFC's Guidance Note 4 Community Health, Safety and Security, should be considered for this chapter. The IFC's Guidance Note 4 requires that the exacerbation of impacts caused by natural hazards, such as landslides or floods that could arise from land use changes should be avoided or minimized.

Moroccan Law 10-95 on water and its implementing regulations establish the measures to protect artificial water bodies, the water quality, use of these water systems and protection of the water courses.

- Decree No. 2-97-244, October 24 1997. Establishes the measures for creating artificial water-bodies
- Decree No. 2-97-489, February 4 1998. Identifies publicly accessible water bodies, the procedures to manage these waterways, and their safe extraction.
- Decree No. 2-97-657, February 4 1998. Delineates protected areas, their buffer zones, and identified prohibited activities.

- Decree No. 2-04-553. January 24 2005. Identifies measure to prevent spills, leaks, and discharges and protect surface and ground waters from direct or indirect contamination events.

11.3 Methodology

The assessment has been conducted by identifying the relevant local and international standards and best practice applicable to the environmental conditions at Ouarzazate relating to storm water management and erosion prevention during the construction and operational phases of the proposed facility. Estimates and figures relating to storm water volumes and proposed treatment processes have been based on the data available from hydrological study of the FESIA and the data provided in the bid proposal.

11.4 SESIA Baseline

Storm water is not currently managed on the site, and there are currently no systems in place for its containment or discharge.

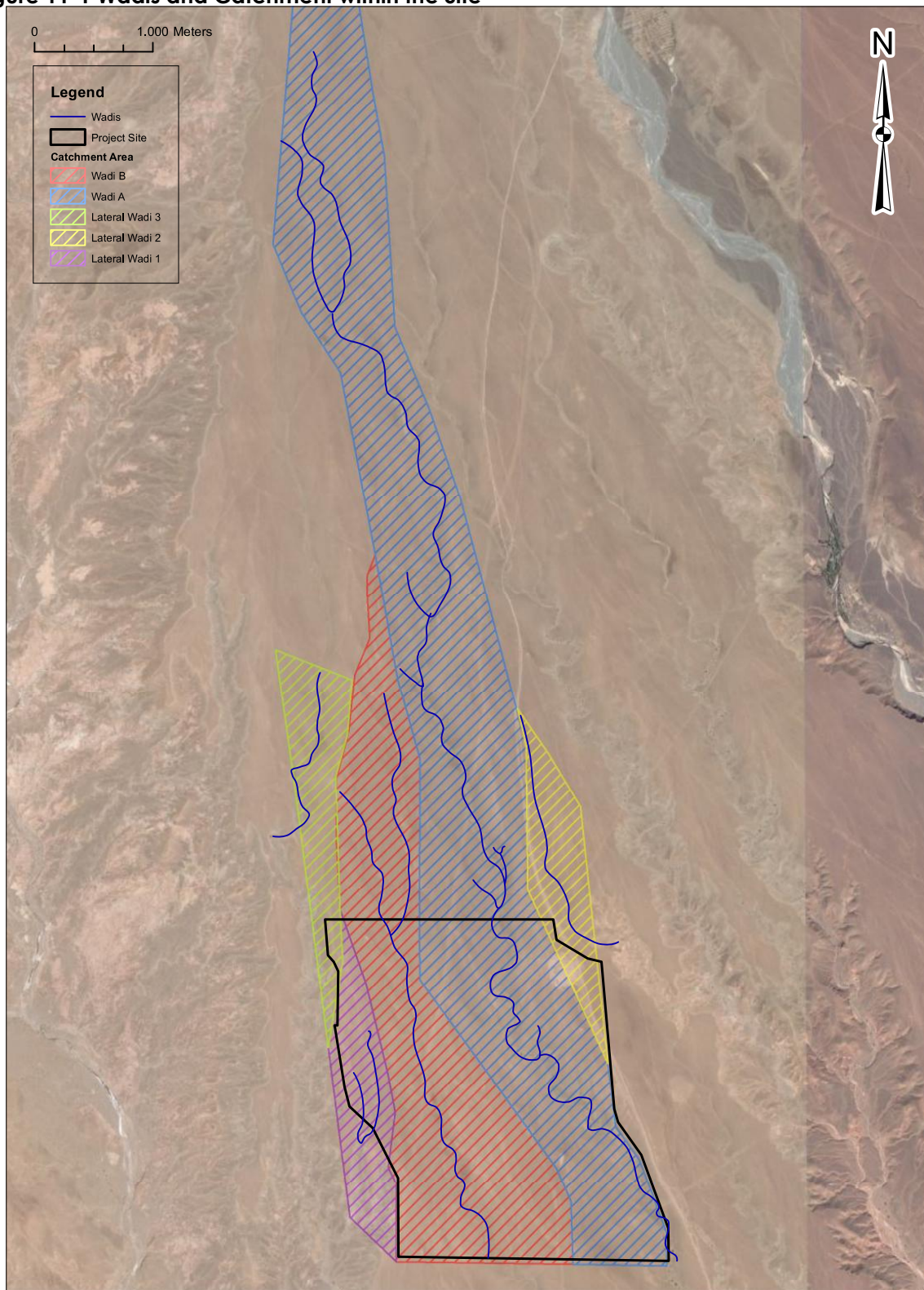
The drainage system onsite consists of two main wadis crossing the site north to south and three lateral wadis, two discharging west and two discharging east. This wadis and their catchment area are mapped in Figure 11-1 below and the catchment area and the maximum discharge for a 50, 100 and 500 year period is specified in Table 11-1 below.

The catchment areas refer to the extent of land where water from precipitation runs to each wadi. The hydrological study undertaken for the FESIA determined that there are currently no flooding risks on site, as all the stormwater that falls on the plateau is channelled through the wadis to the surrounding canyons.

Table 11-1 Onsite water courses catchment area

| Wadis | Catchment area (Ha) | Q ₅₀ (m ³ /s) | Q ₁₀₀ (m ³ /s) | Q ₅₀₀ (m ³ /s) |
|----------------|---------------------|-------------------------------------|--------------------------------------|--------------------------------------|
| Wadi A | 682.5 | 7.96 | 8.88 | 11.01 |
| Wadi B | 296.3 | 5.10 | 5.69 | 7.06 |
| Lateral wadi 1 | 66.2 | 1.51 | 1.65 | 2.09 |
| Lateral Wadi 2 | 56.6 | 3.54 | 3.95 | 4.9 |
| Lateral wadi 3 | 22.6 | 4.43 | 4.94 | 6.13 |

Figure 11-1 Wadis and Catchment within the Site



The project site was characterised in the FESIA as a high risk of erosion. In fact, the risk of erosion in most of the Ouarzazate Solar Complex site has been estimated at levels between 5 and 10 t / ha / year. The strong risk of erosion is caused by several factors:

- Intensity of rainfall;
- The soil type;
- The sparse vegetation cover;
- The topography and the slope.

Upstream erosion causes adverse effects on the Mansour Eddahbi reservoir due to siltation, and also causes problems for irrigation agriculture downstream.

There is no flooding risk in the project site, as it is located in an elevated plateau and the wadis collect and discharge storm water, but flooding risks can increase downstream due to changes in the natural drainage as a result of the land use changes on the project site.

11.5 Construction Assessment

11.5.1 Assessment of Impacts

During construction the main environmental issue relating to storm water relates to its potential contamination by washing of spills or contaminated soils. This impact was already addressed on chapter 10.

The earthworks on site will disturb natural drainage patterns, potentially increasing soil erosion on site and on the canyons where the wadi water will be diverted. Given that the erosion potential onsite is naturally high and that the quality of the vegetation to be removed during the earthworks does not offer a significant protection against soil erosion, the increased erosion risk caused by earthworks during construction can be assessed as being of minor negative impact prior to mitigation.

11.5.2 Mitigation Measures

In order to reduce soil erosion during construction, the following measures will be undertaken:

- The site will be fenced to ensure that no soil disturbance occurs outside of the site area. The areas requiring excavation/filling shall be clearly demarcated to ensure that the soil is no disturbed outside that area;
- The wadis coming from the north of the site will be channelled to the side canyons to avoid intense runoff through the site during the earthworks.
- Define access roads and routes so as to avoid gradients in excess of 15% and adapting existing topography so as to facilitate surface drainage by way of gutters.
- The longitudinal slope of the road must be at least 3% in order to facilitate surface run-off of water and to avoid the build up of sediment in gutters
- Reduce height of embankments and slopes
- Recover vegetation on slopes and embankments
- Perform land cross sections in the most stable areas, taking into consideration the geological conditions of lands.
- Avoid steep gradients on lands susceptible to landslides.
- Construct gabions and concrete barriers for containment, use metal mesh and nets, drains and gutters in slopes for terrain stability
- 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.

11.5.3 Residual Effects

Increased erosion risk caused by earthworks during construction can be assessed as being of minor negative impact.

11.6 Operation Assessment

11.6.1 Project storm water management

The drainage system on site is designed in such a way that the rainfall that falls into the areas where there could be oil or HTF contamination would be collected and treated. As described in chapter 10, waters potentially polluted by hydrocarbons and HTF will be treated and discharged to the evaporation ponds.

The rest of the rainwater falling on the site will be channelled through pipes and concrete ditches to the canyon to the south east of the site.

The water flowing from the north of the site through the wadis will be collected by a concrete channel and discharged to the canyons to the East and the West of the site.

The discharge points of the drainage system will be protected by means of stone rubbles, executed with the appropriate dumping angle. A zone will be protected against erosion at each discharge point, before it comes into contact with the natural water course. The erosion protection design will consist of at least 5 meters of breakwater protection over a gravel bed, separated from natural soil with a geotextile layer. The size of rock and height of gravel will be selected according to water flow energy.

11.6.2 Assessment of Impacts

The potential contamination of rainwater, considering the design of the drainage system and prior to the implementation of further mitigation measures could result with minor negative impacts to the receiving environment.

The levelling of the site, the impermeable concrete areas and the channelling of storm water will lead to increase runoff velocities. The design of the project, including erosion barriers at discharge points, but prior to mitigation measures, could lead to a minor negative impact on erosion rates on the canyons around the site.

11.6.3 Mitigation Measures

- The site needs to be inspected regularly to ensure that no HTF or oil spills (or any other spills that can contaminate rainwater) occur outside the areas designated for storm water collection and treatment.
- Waste management areas have to be designed in such a way that rainwater is not in contact at any point with the waste.
- The effectiveness of erosion prevention mitigation measures at rainwater discharge points needs to be checked after storm events to check that the extent of the protection measures is sufficient, and those would be expanded if necessary.
- A re-vegetation programme on the slopes, embankments and on the canyons where wastewater will be discharged shall be undertaken to reduce soil erosion. Only native species of shrubs and trees adequate to the area shall be used.

11.6.4 Residual Effects

The potential contamination of rainwater after the implementation of adequate mitigation measures could result in negligible to minor negative impacts to the receiving environment.

The impact of land use change on erosion rates after the application of mitigation measures, could lead to a negligible to minor negative impact on erosion rates on the canyons around the site.

11.7 Summary and Recommendations

Provisions for the containment of the first flush of storm water in areas where there is a potential for HTF or oil spills have been considered in the project design, and this water will be adequately treated.

The erosion impact of the storm water discharged from the site drainage system to the canyons has been addressed by erosion prevention measures at the discharge point.

The provision for flood risk management and the impact that it will have downstream (including soil erosion, impact on habitats, and risk to human receptors) must also be considered in the design of the SPC in reference to the wadis and canyons that have been identified on and around the site.

12 ECOLOGY AND BIODIVERSITY

12.1 Introduction

This chapter considers the potential impacts on terrestrial ecology that may occur during both the construction and operational phase of the Project. Where appropriate, mitigation measures are proposed in order to minimise or negate the negative impacts and promote positive impacts, where possible.

Although the Project site is considered to be of relatively low ecological value, due to the sparse vegetation over the open plateau and limited habitat diversity, it is prudent to confirm the habitat types present and species composition.

12.2 Legal Requirements

Law No 11-03 concerning the protection and improvement of the environment provides a framework of legislation under which the Kingdom can meet its obligations as a signatory to the Convention on Biological Diversity (CBD).

In addition, the assessment of potential impacts upon the terrestrial ecology resources represented by the Project site has been undertaken with due consideration to IFC Performance Standard 6 - Biodiversity Conservation and Sustainable Natural Resource Management.

12.3 Methodology

In order to gain an understanding of the terrestrial ecology of the Project Site, a combination of desk studies and field survey was undertaken.

Desk studies for the area included reviewing ecological survey data from the FESIA, literature review of habitats and fauna of the South Atlas Region, and verification on the IUCN Red list of any vulnerable and near threatened species that may have been recorded in the region.

The ecological section of the FESIA report provided the results of detailed 3-day survey campaign, which was carried out by Phénixa in 2010. Although this survey covered an area of 5,376Ha, which consisted of the entire 2020 Concept Solar Power Complex site and a 1Km periphery, the results are representative of the typical and likely fauna, flora and habitats which would be encountered on the Ouarzazate Phase 1 project site.

Consequently, the objective of the second survey undertaken in October 2012 was to review and confirm the ecological conditions of the Phase 1 Project Site with respect to the observations recorded during the 2010 survey. This walkover survey therefore, consisted of a rapid ecological assessment of the 450Ha of the Ouarzazate SPC site. The site was covered by vehicle, and the majority of identified habitats were then more closely investigated on foot. The following methods were utilised to describe and assess the habitats, flora and fauna of the site:

The vegetation of the site was recorded by identifying the main habitat types and their plant communities in areas retaining natural vegetation.

Mammals were recorded when observed, as were their tracks. Reptiles were surveyed by walking over areas representative of the main habitats. An effort was made to search for reptiles under natural shelters such as shrubs and crevices. Bird sightings and incidental observations of invertebrates were recorded. No trapping or specimen collection was undertaken.

12.4 SESIA Baseline

The 2010 survey described three distinct habitat types based on the geomorphology of the site:

- Rocky Plateau: which typically support a low biomass and limited biodiversity.
- Small Wadis within the site and larger wadis on the periphery;
- Escarpments formed between the plateaus and the bases of the wadis.

Within the Rocky Plateau, three ecotypes were identified based on the soil composition and surface water drainage patterns. The rocky and hard substrate sections of the plateau supported the least biomass and biodiversity which was sparsely populated with succulent species of the family *Chenopodiaceae*. Conversely, within the alluvial plains and minor slopes of the drainage patterns, a relatively greater concentration and diversity of flora was observed.

Within the escarpments, the level of biomass and biodiversity was relatively high, particularly in areas where water could temporarily pool or along the edges of the drainage patterns.

Finally, the wadis offered varying degrees of biomass and biodiversity depending on the size of the wadi bed and the frequency and volume of water running through the

system. The larger wadis, which would received flash flows of water from the High Atlas would typically have a lower biomass than the smaller wadis which experienced a more tempered water flow regime.

In general, the small wadis provided the greatest biomass and sustained the greatest diversity of flora. This is not surprising as the soil conditions and water regime would favour the successful and longterm establishment of a diversity of vegetation.

12.4.1 Flora

The main habitat type identified within the survey area, and based on geomorphology and plant communities is Rocky Plateau. This habitat type is characterised by cobble, rock and consolidated fine gravels with sparse vegetation, typically consisting of arid tolerant shrubs, succulents, parasitic plants and occasional grasses.

Overall, 67 species of vegetation were identified across the entire +5,000 ha survey. However, only 4 species were endemic to the rocky plateau of the study region of South Morocco. It must be noted that such a limited endemic diversity is characteristic of the greater subsaharan plains.

None of the observed species are listed as rare or vulnerable regionally or on the IUCN red list.

During the Rapid Ecological Assessment of the Project Site, low-lying halophytic vegetation was identified as the predominant flora across the majority of the proposed site, which indicates a highly saline and arid environment. The vegetation cover at the Project Site was <1% and did not contain any notable species.

A table summarising the species observed during the 2010 survey is provided in Appendix 2.

12.4.2 Fauna

The presence of herptafauna, avifauna and mammals was investigated. Given the local geology and presence of water bodies the diversity of amphibians and reptiles would be high. Historically the region is known to support over 17 species of reptiles and amphibians, four of these being endemic to the Maghreb: the Mauritanian Toad, North African Green Frog, Oudri Gecko and the Saharan Spiny Tailed Lizard, which is listed as Near Threatened on the IUCN red list. No species of reptiles were observed on the plateau or along the wadis during the October 2012 walkover survey.

The presence and diversity of mammals on the other hand is not well supported on the site. Several species have not been recorded in the area since the 1960's and these include: The Dorcas Gazelle, Cuvier's Gazelle, Striped Hyena and Crested Porcupine. The Gazelles were likely hunted to local extinction.

Evidence of the Red Fox (within Wadi Izerki) and unidentified bats were the only observations of mammals on the site.

A summary of the mammals recorded and historically resident is also given in Appendix 2.

The varieties of birds observed during the site visit, comprised of resident and migratory species. Of the 10 resident species observed, the Morning Wheatear is rare and localised in Morocco. Only 9 migratory species were observed at the time of the survey, however it should be noted, that this sector is not considered a major migratory pathway, which is mostly limited to the Southern parts of the High Atlas.

With regards to the typical Saharan resident species not observed, but which would be expected to reside in the surrounding areas, the absence of their sighting is likely due to local foraging movements within more favourable habitats.

A summary of the birds recorded and likely resident is given in Appendix 2.

12.4.3 Protected Areas

Several nationally protected areas have been identified within a 15Km radius of the site. These include:

- Mansour Ed Dhabbi Dam. The dam's lake is part of a RAMSAR site and is located 6Km south of the southern limit of the proposed project.
- The Dorcas Gazelle Reserve of Bouljir. A 30ha reserve is located approximately 13Kmnorth west of the site.
- The Iguenane Reserve was designated in 2005, under the framework of the 'Projet de Conservation de la Biodiversite par la Transhumance' for its high biodiversity of endemic flora and high diversity of fauna. In particular the reserve is home to over 15 Cuvier's Gazelle, which is considered a threatened species in Morocco. The reserve is located approximately 15Km northwest of the site.

- Sbaa Chaab has also been recognised under the framework of the 'Projet de Conservation de la Biodiversite par la Transhumance' as a key biodiversity site as it represents one of the best protected sites in the region.
- A framework plan for the management of the Biosphere Reserve of the South Moroccan Oasis was drawn in 2008. This management plan has allocated 3 degrees of zoning for the Province of Ouarzazate, Er Rachidia and Zagora. The proposed project site is located within Zone B, which is defined as a buffer zone with the objective of only permitting developments that are compatible with conservation principles.

12.5 Construction Assessment

12.5.1 Assessment of Impacts

The baseline survey showed that the site exhibits limited biodiversity, with the main vegetation and supporting fauna restricted to the wadis and escarpments. The requirements for the design and layout of the plant will necessitate site clearance and excavation, which will eliminate any remaining flora on the site and disturb any fauna on or near the site. Due to the resultant loss of habitat, prior to the implementation of mitigation measures, this can be assessed to be a permanent impact of minor negative significance.

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. However, given the low density of flora on the site, construction activities will likely result in a temporary impact of minor negative significance.

Grading of the land will require movement of soils from high areas to low areas of the site. The current landscape of the site includes plateaus, and Wadis. These Wadis vary in size, with the smaller ones located within the property boundaries, and a larger more complex system on the periphery of the site and leading to the canyons. If the excess fill balance is inappropriately disposed at the boundaries of the site, the impacts would be of moderate negative significance prior to the implementation of any mitigation measures.

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 macro-organisms

identified on site, this can be assessed to be a permanent impact of minor negative significance.

12.5.2 Mitigation Measures

In common with WB/IFC Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources and recommendations set out within the Requirements Construction Environmental and Social Management Plan, the loss of native vegetation should be offset through re-vegetation of the site.

None of the plant life in the area of activity and its perimeter is considered to be a rare or threatened species of flora or fauna. However, systematic routes will be covered prior to the entry of machinery onto the site to detect any areas of interest to fauna, such as burrows, nests, sleeping places, resting places, etc. that could be affected by noise emissions. Ditches and site areas where animals could become trapped will also be regularly inspected.

Avoid unnecessary cutting of vegetation, especially in areas around the Wadis.

Assist in facilitating the process of revegetation in places where colonisation is difficult or in the interest of an accelerating the process.

All auxiliary roads will be removed, and any installed platforms will be scarified. Base layers will be removed and waste taken to the appropriate waste landfill facility.

Any foundation holes, effluent channels, wells should be backfilled and covered with soil in order to homogenise the appearance of the area.

Particular effort should be considered in the selection of the vegetation and location of planting in order to successfully achieve 'in-kind' remediation of the Wadis, as these were noted as the key biodiversity habitats.

At the construction stage, the topsoil should be removed and stored safely and spread over the site once construction has been completed.

Any excess cut that will not be used in the cut/fill balance of the site should be disposed at an appropriate location, where no damage to Wadis, or habitats may occur. Therefore disposal of the excess soil, should not be within the Wadis at the periphery of the site. Alternatively, the excess fill may be sold to neighbouring developments, which may have a shortage of soils.

The laydown areas of the site will be minimised in size wherever possible, and preferably located in areas with little or no vegetation, wherever possible. The contractor will ensure that no encroachment to the nearby, adjacent land should occur and that all construction vehicles adhere to clearly defined transportation routes.

Hazardous materials used during the construction stage will be adequately stored and handled, in order to minimise the potential risk of spillage and therefore potential contamination to the soils and negative impact on the ecosystem.

Transportation within and to/from the site should be minimised through efficient transport management in order to minimise noise and vehicle pollution. Transport routes will be identified and strict adherence to designated routes will be enforced, in order to protect the existing vegetation and reduce encroachment on adjacent land.

Machinery will be maintained and stored in designated areas within the construction compound. No plant maintenance will be carried out on open ground, off the main routes or on adjacent undisturbed desert areas. Washing down of vehicles and particularly cement truck washing activities will be carried out over sealed grounds, in designated purpose built areas to capture the run off in settlement tanks.

12.5.3 Residual Effects

Following the implementation of the mitigation measures described above, and considering the relatively limited ecological value of the site, it is considered that the residual impacts upon the terrestrial ecology of the site will be of minor negative significance. This is due to the fact that despite recommended mitigation measures to encourage re-establishment of wadi vegetation along the perimeter of the Project site, the development will result in the loss of habitat, particularly in relation to reptiles and resident birds that inhabit this region.

12.6 Operation Assessment

12.6.1 Assessment of Impacts

During the operation of the Phase 1 Ouarzazate SPC the activities that could negatively impact the ecology of the site would be through indirect measures, relating to poor management practices.

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. Prior to the implementation of mitigation measure, this has the potential to result in a permanent impact of minor to moderate negative significance.

Inappropriate or insufficient wastewater management and stormwater management could result with contaminated water discharging to the Mansour Ed Dahbi Lake, which is located downstream of the proposed construction area. Prior to the implementation of mitigation measure, this has the potential to result in a permanent impact of minor to moderate negative significance. All other identified protected areas, are not likely to be negatively impacted by the proposed project, as they are located outside of the identified potential impact zone from air, noise and water issues.

Air emissions from the plant will include SO_x, NO_x, CO, CO₂, O₃, and PM₁₀. However the emissions will be minimal and intermittent, therefore the impacts on the flora and fauna are not likely and are considered negligible.

12.6.2 Mitigation Measures

Although the terrestrial ecology on the site is not of high ecological 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 the Solar Plant's operations.

Although, the majority of the site will be built up, there may be some opportunities to promote vegetation within the complex's boundaries. Consequently, the following considerations should be made:

- Landscaping on site will incorporate indigenous plant species to help maintain the ecological diversity of the existing region. 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 that had been used for laydown and storage during construction will be scarified if compacted, in order to facilitate the recolonisation of native species;
- No non-native species to be utilised in the landscaping of the plant, with an integrated pest management scheme being utilised in preference to the use of

- large scale pesticides and detailed within the Operational Environmental Management Plan;
- Transport routes on site and training will emphasise that vehicles and employees should keep to the designated routes in order to prevent unnecessary land encroachment, thus protecting the natural resources and reducing dust emissions;
 - Appropriate storage of hazardous materials, will be designed in accordance with the IFC and World Bank guidelines, preventing any major spillages on the site.

12.6.3 Residual Effects

Following the mitigation and management techniques outlined above, which are further described within the Operational Environmental Management Plan, the residual impacts are generally expected to be of negligible to minor negative significance.

However, the implementation of the landscaping mitigation may result in a permanent minor positive impact upon the biodiversity of the area by providing suitable habitats for birds and other fauna such as reptiles and small mammals.

13 SOCIAL AND ECONOMIC ISSUES

13.1 Introduction

This chapter of the SESIA Report focuses on the social and economic issues, both direct and secondary, associated with the development and subsequent operation of the first phase of the Phase 1 Ouarzazate SPC. Initially this chapter considers the baseline socio-economic environment within which the development will proceed, before examining the potential impact of the development during the various stages of the project lifecycle. For this chapter particular attention was paid to the results of the public consultation. Where necessary and possible, opportunities to pursue measures to minimise and / or mitigate any impacts have been developed and put forward.

Regarding the current land use of the project site, there are no settlements on the site, which is currently owned by MASEN. The assessment of the social and economic impacts of land acquisition for the Solar Power Complex was addressed in the FESIA. Additionally, land acquisition procedures for the site are documented in the Land Acquisition Plan (LAP) finalized in July 2011. The only current use for the land is passage by seasonal pastoralists during certain periods of the year, and to a lesser extent (given the sparse and low quality vegetation) for herd grazing.

13.2 Regulatory Requirements

Moroccan Labour Law no 65-99 concerning the Labour Code, is applicable to this project. Other legislation relating to the social and health sector includes:

- 17-08 (dahir 1-08-153 du 18 février 2009) regarding the Communal Charter
- Dahir 1-60-063 (25 June 1960) for the development of rural communities Order 23 November 1950. Ensures that medicinal products and medical equipment should be provided on-site, where 100 workers are permanently stationed or where projects are located more than 10 km from a supply centre.
- Decree 2-70-510 (8 October 1970) identifies preventive measures that should be implemented on construction sites.

The Kingdom of Morocco has also signed 54 International Labour Organisation (ILO) conventions, including the following:

- Unemployment Convention, 1919 (No. 2)
- Night Work (Women) Convention, 1919 (No. 4)
- Workmen's Compensation (Agriculture) Convention, 1921 (No. 12)
- Holidays with Pay Convention, 1936 (No. 52)
- Labour Inspection Convention, 1947 (No. 81)
- Right to Organise and Collective Bargaining Convention, 1949 (No. 98)
- Equal Remuneration Convention, 1951 (No. 100)
- Abolition of Forced Labour Convention, 1957 (No. 105)
- Discrimination (Employment and Occupation) Convention, 1958 (No. 111)
- Employment Policy Convention, 1964 (No. 122)
- Workers' Representatives Convention, 1971 (No. 135)
- Minimum Age Convention, 1973 (No. 138)
- Minimum age specified: 15 years
- Termination of Employment Convention, 1982 (No. 158)
- Asbestos Convention, 1986 (No. 162)
- Maternity Protection Convention, 2000 (No. 183)

Law no. 57-09 for the creation of the Moroccan Agency for Solar Energy provides the legal framework for the Ouarzazate Solar Power Complex and outlines how it aligns with the national economic and social development strategy.

Even though national policies and strategies do not have the same enforceability as national laws and regulations; the FESIA and the SESIA will ensure the project is in line with national, regional and local strategies. Several policy papers have been taken into consideration in the assessment of social and economic impacts, including the 2012-2016 Country Strategy Paper, which supports the development of green infrastructure (including solar) as one of its focus, and the Strategy for the Social and Economic Development of the Region of Souss Massa Draa 2011-2015.

Several areas of the IFC Performance Standards are relevant for this chapter, in particular:

- Performance Standard 2: Labour and Working Conditions;
- Performance Standard 4: Community Health, Safety and Security;
- Performance Standard 5: Land Acquisition and Involuntary Resettlement;

13.3 Methodology

This chapter looks at key indicators relating to factors such as population, the economy, the labour market and social development at a regional level. Where relevant, professional judgement was drawn upon, including knowledge from site visits and information collected during consultations with interested parties to augment the secondary baseline data.

Once this baseline was established the report considered a more detailed assessment of the impacts of the development. As the development will have different socio-economic impacts throughout the lifecycle of the project, impacts during construction and operation are discussed separately.

In reflection to the requirements of the IFC Performance Standards, core components of this analysis include:

- A review of any local communities within the proposed development site and its immediate environs, incorporating views on settlement, grazing rights and other activities;
- A review of any settlements arising from construction of the facility;
- An assessment of local labour market impacts;
- An outline assessment of any health and safety implications of the facility;
- An assessment of impact upon local services; and
- The suitability of the site in light of the social / development profile of the site environs.

The viewpoints of relevant stakeholders into such a nationally important development and mitigation for the social or economic concerns of these stakeholders had already been incorporated at the strategic level during the FESIA, and the specific input from the local consultation process regarding the first phase is particularly relevant for this social and economic assessment.

13.4 SESIA Baseline

The Phase 1 Ouarzazate Solar Complex is located in the Ghassate commune, in the province of Ouarzazate. Ghassate is a rural, sparsely populated commune. In 2004 the population was 8,815 inhabitants. The commune has shown a population decrease of - 2.4% between 1994 and 2004 due to migration to migration to Ouarzazate, Agadir, Casablanca or international migration. In 2004 the city of Ouarzazate had a population

of 56,616. The official unemployment rate (i.e. population receiving unemployment benefits) is 6.5% in the province of Sous Massa Draa.

The villages that are closer to the project site (i.e. Tasselmant, Tiflite, Igherm Amellal, Tidgheste, Taferghouste) grow crops in the bottom of ephemeral river valleys. The main types of crops include date palm, fruit trees (e.g. olive trees) and annual and forage crops. The crop planting areas have been included as sensitive receptors, as they are essential for the economic well being of these villages and impacts on these areas have to be avoided.

The province has a significant tourist industry, for which the cultural heritage and the landscape are important factors that need to be considered and maintained. The cultural heritage and the landscape are also essential for the film studios located near the city of Ouarzazate. Impact on the heritage and archaeological sites and on the landscape of the area are specifically discussed in chapters 15 and 16 respectively, but the impact on the tourist industry is assessed in this chapter.

The site is owned by MASEN. The acquisition of the Field for the SPC was completed on the 18th of October 2010 Land purchase Agreement between the Ait Oukroun Toundout as Seller and l'Office National de l'Électricité as a buyer. Property of the land was then transferred from l'Office National de l'Électricité to MASEN. The land acquisition process fulfilled all the legal requirements (e.g. the certificate of non-farming the land).

Regarding the current land use of the project site, there are no settlements on the site. The assessment of the social and economic impacts of land acquisition for the Solar Power Complex was addressed on the FESIA. The only current use for the land is passage by seasonal pastoralists during certain periods of the year, and to a lesser extent (given the sparse and low quality vegetation) for herd grazing.

13.5 Construction Assessment

13.5.1 Assessment of Impacts

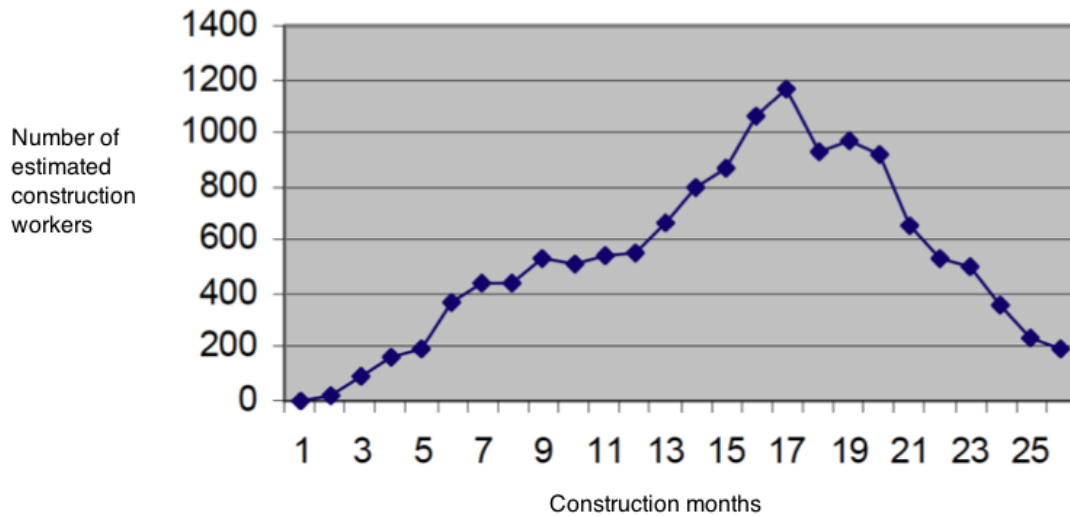
The site was previously used by pastoralists, however under a voluntary agreement and in accordance with the national land acquisition process, MASEN purchased and took ownership of the land in mid 2011. As part of the purchase agreement and in order to ensure that the pastoraists and villagers would not be negatively impacted by the

purchase of the land, MASEN agreed to shoulder the cost for construction of a new road. At the time of this SESIA report preparation, the road construction was still underway.

Our analysis suggests that a primary economic positive impact during construction is likely to result from any local employment creation and the use of local businesses/services during this phase. The workforce that will be employed during the construction phase is given in the figure below. Given the unemployment levels within Morocco and the emigration rates in the rural commune of Ghassate, any creation of jobs is likely to prove welcome. As well as the direct monetary uplift to the families of those employed, money paid to local workers will also stimulate the local economy via the multiplier effect, whereby money earned on the project expended locally will re-circulate within the local economy. Whilst we have no evidence quantifying the multiplier effect within the Kingdom of Morocco, studies undertaken in Europe and the US suggests the impact of expenditure on a local economy prior to leakage to be in the order of 4:1.

Notwithstanding the above, it is likely that the lack of some necessary skills within the immediate local population will require a proportion of work on the site to be undertaken by immigrant population. This could result in the repatriation of wages, with benefits to the local economy potentially being reduced. Within the province of Ouarzazate, particularly in the Ghassate commune and the city of Ouarzazate, this impact is considered to be of moderate positive significance.

Figure 13-1 Expected construction workforce



In addition to the direct monetary impact of employment created during construction, there also exists the potential for the project to promote the dissemination of best practice construction skills into the local labour force. To the extent that the development proves an enabler for further regional development, any skills acquired are likely to prove readily marketable in the aftermath of the project construction. A further secondary impact is likely to arise from spending on local goods during the construction process. These secondary impacts are likely to result in a minor positive impact upon the local economy.

The cultural heritage and the natural landscape are important for the tourist industry at Ouarzazate. As it is explained on Chapter 15 and 16, the impacts on the cultural and natural landscape are not expected to significant, so from an economic perspective the potential negative impact on tourism is assessed as negligible.

However, it should be noted that minor negative impacts to the workers welfare may result during the construction phase, due to health and safety issues related to traffic, noise and air quality. Impacts related to transport and roads are discussed in Chapter 14.

Furthermore, during construction the site will be fenced and access will be restricted, so the seasonal pastoralists will not be able to cross through the site. The site area is, however, insignificant in relation to the large amount of open land that supports a similar or better vegetation for the pastoralist's herds. In densely populated areas where there is

intensive competing land uses the fencing and development of a site can have a significant impacts on the activities of nomadic pastoralists, due to the cumulative nature of the impact. However, the area of the Ouarzazate Solar Complex is sparsely populated, with the vast majority of the land being open for passage and grazing, and there are very few barriers to passage. In addition, the plateau only offers low quality vegetation for grazing. Therefore, it is considered that the impact on the pastoralists will be of minor negative significance.

13.5.2 Mitigation Measures

MASEN have agreed to the upgrading and construction of a new road, to ensure that access by pastoralists and villagers across the plateau is maintained. The construction works are currently ongoing.

The project will seek to employ local workers, as was brought up during the public consultation process, where these are willing and available, and where appropriate will offer training to enhance the development of skills within the local workforce. A Recruitment Policy will be incorporated into the EPC's Construction Environmental and Social Management Plan (CESMP), which will set out the proposed measures to maximise the benefits to the local population and economy. The number of local population employed by the project and the training provided to the workforce will be monitored.

If migrant labour is required, adequate housing will be provided. Available accommodation locally (i.e. at the city of Ouarzazate) will be favoured. The traffic impacts are assessed in the next chapter. If temporary housing was to be provided, it shall be of high quality with appropriate amenities. The environmental and social impact of any temporary accommodation will be adequately assessed. Strict controls over the provision of housing shall prevent any unplanned settlements from developing. Unplanned settlements in the site are unlikely, as it will be monitored by security personnel.

Further mitigation measures are detailed in the framework CESMP, provided in Volume 3.

13.5.3 Residual Effects

The residual impacts as a result of the construction phase are considered to be of minor and moderate positive significance with relation to employment and training

opportunities for the local community and of minor negative significance in relation to the pastoralist's passage through the area.

13.6 Operation Assessment

13.6.1 Assessment of Impacts

At a strategic level the operation of the plant offers potential to support the sustainable growth of the local and national economies, through the ability to provide a renewable source of energy for the Ouarzazate province and the Kingdom of Morocco.

The most significant economic impact upon nearby communities during operation will result from the employment opportunities created by the Project. Sixty workers will be employed in the project during the operational phase.

Even though the direct impact on local employment is not as significant as during the construction phase, the increased time-scales involved offer an opportunity for greater dissemination of skills into the local workforce and via this for the role of local workers to increase over time.

The employment benefits, the dissemination of skills and the economic development that is likely to result from the availability of sustainably produced energy is considered to be an impact of moderate positive significance.

Access to the site will be restricted during the plant operation, so the seasonal pastoralists will not be able to cross through the site. The site area is, however, insignificant in relation to the large amount of open land that supports a similar or better vegetation for the pastoralist's herds. In densely populated areas where there is intensive competing land uses the fencing and development of a site can have a significant impacts on the activities of nomadic pastoralists, due to the cumulative nature of the impact. However, the area of the Ouarzazate Solar Complex is sparsely populated, with the vast majority of the land being open for passage and grazing, and there are very few barriers to passage. In addition, the plateau only offers low quality vegetation for grazing. Therefore, it is considered that the impact on the pastoralists will be of minor negative significance.

The cultural heritage and the natural landscape are important for the tourist industry at Ouarzazate. There are conflicting opinions on the impact that the plant will have on tourism. On the one hand, it can be argued that tourists go to Ouarzazate due to its

natural landscape and the way in which the city and surrounding villages integrate in it. From this perspective any industrial development would have a negative impact on tourism. On the other hand, a study financed by the French Development Agency stated that there is a potential for the SPC to be a tourist asset, as it is a large development that can be impressive and unique, once all the phases are developed, and it is a renewable energy project. In any case, as explained on Chapters 15 and 16, the impacts on the cultural and natural landscape are not expected to be significant (i.e. it will not be visible from the sensitive receptors), so the impact on tourism is assessed as negligible.

13.6.2 Mitigation Measures

The potential impacts beyond the immediate term, in relation to the local community and existing services and facilities has been identified as positive. Mitigation measures to ensure that the concerns of the neighbouring villagers and welfare of the employees and residents is ensured, have been provided in Volume 3.

Furthermore, in order to maximise the benefits, the project will seek to employ local workers where possible and where appropriate will offer training to enhance the development of skills within the local workforce. Additionally, the number of local population employed by the project and the training provided to the workforce will be monitored.

13.6.3 Residual Impact

As a result of the likely contribution to local and regional economic growth, the dissemination of skills and the direct employment opportunities, the operation of the first phase of the Ouarzazate Solar Power Complex is expected to result in a moderate positive impact.

The impact resulting from the nomad pastoralists loss of access to the site is assessed as minor negative significance, while the potential negative impact on the tourist industry is considered negligible.

13.7 Conclusions and Recommendation

The project will have a positive impact on the local economy during construction and operation. During construction a significant workforce will be employed, the multiplier effect implies that there would be a larger positive impact on the local economy and there is a possibility for the dissemination of skills.

The loss of access to the site by the nomadic pastoralists is considered to be a minor negative impact and the potential negative impact on the tourist industry of changes in the landscape and heritage and archaeological sites is considered negligible.

14 TRAFFIC AND TRANSPORT

14.1 Introduction

This chapter of the SESIA focuses on the transportation related impacts associated with the construction and operation of the first phase of the Ouarzazate SPC. 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.

14.2 Regulatory requirements

Due consideration is given in this chapter to the recommendations set out within the IFC General EHS Guidelines Section 3.4 Traffic Safety, within Section 3: Community Health and Safety. In addition, the following national laws have been considered:

- Decree No. 2-03-169 of 22 Muharram 1424 (26 March 2003) on the transport of goods by road;
- Law 52-05 relating to traffic.

A draft law on road transport of dangerous goods has been passed in parliament in the first week of November 2012. According to the legislation, these goods must be transported by vehicles or trailers appropriately equipped. The characteristics of these vehicles must be established by a statutory instrument, which will in turn respect those outlined in the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR).

14.3 Methodology

The baseline analysis of this chapter is principally desk based, drawing from the technical proposal for the project, secondary sources (transportation and local authorities) and the site visit. Once the baseline conditions are established, 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.

14.4 SESIA Baseline

The site will be accessed by road for transport of materials, equipment and machinery and by workers. Ports will be used to bring equipment into the Kingdom of Morocco. Migrant workers may use the airport of Ouarzazate to access the region.

14.4.1 Road Network

The road network in the Province of Ouarzazate is outlined in Table 14-1.

Table 14-1 Road network in the province of Ouarzazate in 2007 (Km)

| National Paved | Regional | | Provincial | | Other routes | |
|-------------------|----------|---------|------------|---------|--------------|---------|
| | Paved | Unpaved | Paved | Unpaved | Paved | Unpaved |
| 428 | 187 | 112 | 214 | 723 | 829 | 835 |

Ouarzazate is linked to Marrakesh by the N9 and to Errachidia by the N10. There is no bypass road to Ouarzazate, so all traffic bringing equipment from the ports will cross the city. A noise baseline has been prepared for this sensitive receptor and is discussed in the noise chapter. The road itineraries connecting Ouarzazate with the ports on the coast are shown below.

The village of Tasselmant is currently linked to the N10 road by the construction track that is being used to build the access road to the site. A tarmacked road is being built to connect Tasselmant with the N10, and the access road to the site will connect to this road.

14.4.2 Port Facilities

The two closest ports to the site are Agadir and Safi. Agadir provides better infrastructure for the transport of containers. The port of Tanger has also been considered as an option for particularly heavy equipment.

14.5 Construction Assessment

Two aspects of transport during construction can potentially generate impacts: The transport of the workforce and the transport of equipment to the site.

The major components for the construction of the plant are equipment that cannot be assembled in-situ, due to the specialised tools and machinery that is required. Therefore it has to be transported to the site. This equipment and materials will be transported in twenty and forty foot containers:

- 20 feet container: 5.9 meter long, 2.35 meter wide, 2.39 meter high
- 40 feet container: 12.32 meter long, 2.35 meter wide, 2.39 meter high
- 40 feet high cube container: 12.32 meter long, 2.35 meter wide, 2.698 meter high

The maximum weight that will be allowed for the containers is 28 tons. The containers will be transported by ships and lorries from the supplier's factories to the site in Ouarzazate. If the goods are imported to Morocco, it will be via sea-transport.

Agadir is the first option since it is relatively close to the project site and it has the required infrastructure.

Three alternative routes (Figure 14-1, Figure 14-2 and Figure 14-3) are envisaged to bring equipment from the ports to the site. The dimension and origin of the containers will determine the route chosen. All of them use the N9, cross Ouarzazate and get to the access road through the N10. Therefore, construction activities are likely to lead to an increase in vehicle numbers and traffic on the N9, N10 and on the road that is being built for Tasselmant, until the access road is reached.

The few parts of equipment that will not fit in the containers will be transported in special platforms. Special permits will be obtained from the Moroccan authorities after an assessment of the routes that will include health, safety and environmental considerations. Similarly, all dangerous goods shall be transported following the current international standards and codes for transport of special merchandise, applying for the relevant permits with the Moroccan authorities and assessing the safety and environmental risks.

Figure 14-1 Safi Harbour/R204/N7/Marrakech/N9/Ouarzazate



Figure 14-2 Agadir Harbour/N10/N9/Ouarzazate

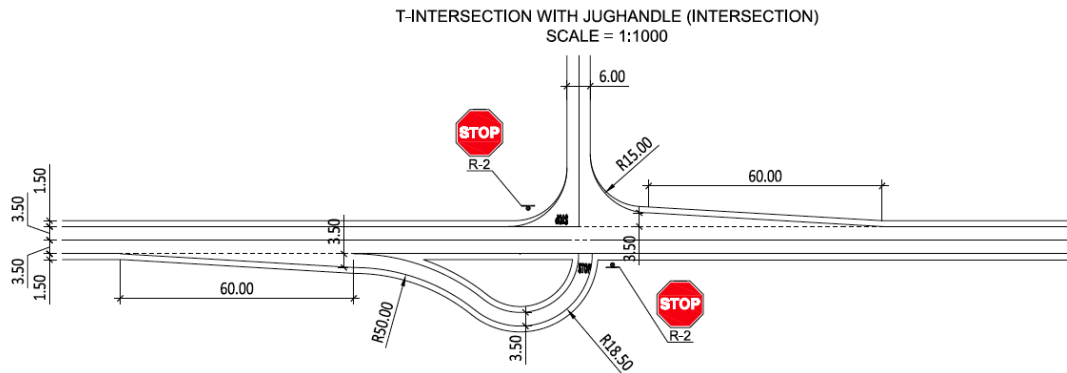


Figure 14-3 Tanger - Med Harbour/N16/A4/A1/Rabat/A3/A5/A7/Marrakech/N9/Ouarzazate



The design outlined in Figure 14-4 was revised (Figure 14-5) to improve road safety in the intersection between access road and the new road that is being built for Tasselmant.

Figure 14-4 Access road intersection



- Wherever possible, heavy vehicle movements will be scheduled outside of peak periods and avoid times when nuisance will be higher.
- The construction vehicles leaving the site will be appropriately cleaned
- All the vehicles used in the site and leaving the site shall be appropriately maintained.
- The design shown in Figure 14-5, that improves road safety in the intersection between the road that will be built to Tasselmant and the access road, shall be the implemented alternative.
- Transport impacts shall be considered in detailed and adequately mitigated in the CESMP.

14.5.2 Residual Effects

Following the implementation of mitigation measures, it is expected that residual impacts will be minor negative on Ouarzazate, the N9 and the N10.

The tarmacked road that will be built for the village of Tasselmant will have a minor positive impact on the transport infrastructure of the region.

14.6 Operation Assessment

14.6.1 Assessment of Impacts

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.

At the operational phase, the access road that is being constructed for Tasselmant will be used primarily by the inhabitants of this village. This impact is considered to be of minor positive significance.

14.6.2 Mitigation Measures

The provision of vans for workers or incentivising car pooling schemes shall be considered during the operational phase.

14.6.3 Residual Effects

The impact of the relatively small workforce and the small amounts of supplies that are expected to be required on the traffic of the N10 and the city of Ouarzazate are expected to be of negligible negative significance.

The impact of the access road that will be built for the village of Tasselmant is considered to be of minor positive significance for the transport infrastructure of the area.

15 CULTURAL HERITAGE AND ARCHAEOLOGY

15.1 Introduction

This chapter considers the potential cultural heritage and archaeology impacts which could potentially result during the construction phase of the proposed First Phase of the Ouarzazate Solar Power Complex.

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 tourist activities in the area.

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 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.

15.2 Regulatory Requirements

The environmental standards and guidelines relating to cultural heritage and archaeology within the Kingdom of Morocco, the World Bank (WB) and IFC have been considered within this assessment.

National

Dahir 1-80-341 of the 17 of Safar 1401 (25th of December 1980) on the promulgation of law 22-80 on the conservation of historical monuments and of historical sites, inscriptions and art objects.

Dahir 1-06-102 of the 18 of Joumada 1 1427 (8^h of June 2006) on the promulgation of law 19-05 modifying law 22-80 on the conservation of historical monuments and of historical sites, inscriptions and art objects.

International

In accordance with the Equator Principles' requirements for projects located in non-OECD countries or countries that are not listed as developed OECD countries (as defined by the World Bank Development Indicators Database), the assessment has referred to applicable International Finance Corporation's (IFC) Performance Standards on Social and Environmental Sustainability, specifically, Performance Standard 8 – Cultural Heritage.

International Conventions

Morocco is one of the signatory parties to the World Heritage Convention. The most significant feature of the Convention is that it links together the concepts of nature conservation and the preservation of cultural properties. It defines the kind of natural or cultural sites that can be considered for inclusion on the World Heritage List. It recognises the way in which people interact with nature, and the fundamental need to preserve the balance between the two.

15.3 Methodology

The assessment in this chapter has been undertaken according to the relevant local and international law, regulations and standards previously listed. The assessment has included a desk-based study that included the review of the available information on the site and a site inspection.

15.3.1 Desk-Based Study

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 study area (including the presence or absence, character and extent, date, integrity, state of preservation and relative quality of the potential archaeological resource). The desk-based study consisted of 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.

The following information and guidance has been gathered and utilised in order to undertake the assessment:

- Data and information gathered for the FESIA;
- International Finance Corporation's Performance Standards on Social and Environmental Sustainability, (January, 2012) specifically Performance Standard 8: Cultural Heritage; and
- World Bank Environmental Safeguard Policies: Physical and Cultural Resources.
- The Equator Principles, July 2006;

15.3.2 Site Walkover

In order to complement the information gathered during the desk-based study, during the site visit evidence of any above ground archaeological structures, deposits and /or antiquities was undertaken. The results and findings are discussed below.

15.4 SESIA Baseline

The investigations from the FESIA concluded that no sites of historical or cultural value were found on the Ghassate commune other than sepulchral or burial sites. In addition, no evidence of sites of archaeological value was detected on the solar complex site during the fieldwork for the FESIA.

During the site visit no artefacts or structures of cultural or archaeological significance were observed onsite. Buildings of potential historical value were identified in Tasselmant (Plate 15-1 and plate 15-2), and a site of potential cultural/historical value was identified in one of the canyons to the northeast of the site (Plate 15-3). This structures/sites are located outside the project site and study area, and will not be affected by the project.

Plate 15-1 Fort in Tasselmant



Plate 15-2 Burial site in Tasselmant



Plate 15-3 Area of potential archaeological interest to the northwest of the study area



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.

Finally, according to the consultations undertaken for the FESIA and the SESIA, no indication was provided suggesting that the proposed project is not located within or adjacent to any areas of archaeological or cultural significance.

15.5 Construction Assessment

15.5.1 Assessment of Impacts

For the reasons outlined in the baseline chapter above, it is considered unlikely that potential impacts on sites of cultural or archaeological value occur during the construction phase.

In the event that earthworks during the construction phase uncover unidentified sources of archaeological or cultural heritage, this will result in an impact of minor negative significance prior to the implementation of mitigation measures.

15.5.2 Mitigation Measures

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 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. In the unlikely event of any artefacts being found/uncovered, the construction work would be ceased immediately and the relevant authorities contacted by the Site Manager.

15.5.3 Residual Effects

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. Consequently, the significance of the residual impact on cultural heritage and archaeology at the first phase of the Ouarzazate SPC is considered negligible.

15.6 Operation Assessment

15.6.1 Assessment of Impacts

It is not considered that any significant impacts upon archaeological or cultural resources will occur during the operational phase.

15.6.2 Mitigation Measures

Will further excavation on the site be required, the mitigation measures mentioned previously for the construction phase will be followed.

15.6.3 Residual Effects

It is not considered that any residual impacts will arise during the operational phase and therefore the residual impact is likely to be neutral in terms of archaeology and cultural heritage.

16 LANDSCAPE AND VISUAL IMPACT

16.1 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, since tourism is a relevant economic activity in the area and the quality of the natural landscape is one of its assets.

16.2 Regulatory Requirements

While the determination and classification of a landscape and a visual impact is largely a subjective interpretation, the general definition for each can be described as:

- Landscape impacts result with changes in the fabric, character, and quality of the landscape as a result of a development; and
- Visual impacts relate to changes in available views of the landscape, and the effect of those changes on people.

No standards exist with regard to landscape or visual impact in the guidance. In the absence of specific standards with regards to landscape or visual impact, the existing visual characteristics of the Project site have been assessed using professional judgment and experience.

16.3 Methodology

The assessment of the Project upon the landscape and visual amenity of the surrounding area has been informed by the following:

- Desk-based assessment of existing information available, including maps, site plans and viewpoint photographs taken at various locations;

- Site survey undertaken to identify the existing landscape and visual character of the area.

16.4 SESIA Baseline

The proposed Ouarzazate Power Plant site will be located on a rocky plateau, crossed by wadis and surrounded by canyons, which are characteristic of this part of the Atlas Mountains. There are no anthropogenic elements on the site other than a small camp for road construction and the tarmac road that is being built to connect the village of Tasselmant with the N10 and for site access.

In the intersection of the N10 and the road that is being built for Tasselmant there are two telecommunication antennas that impact on the natural character of the landscape.

The nearby villages and the city of Ouarzazate are built following the chromatic pattern of the natural landscape. For this reason, they form a natural-cultural landscape that has a high intrinsic and touristic value.

16.5 The Site and Surrounding Area

This chapter presents a number of photos that have been taken on and surrounding the proposed first phase of the Ouarzazate SPC, to provide an indication of the landscape and visual characteristics.

Plate 16-1 Communication towers at the intersection of N10 and the site access road



Plate 16-2 360 degree view of the site



Plate 16-3 180degree view of the Southwest portion of the site



16.6 Construction Assessment

16.6.1 Assessment of Impacts

During the construction of the first phase of the Ouarzazate SPC, several buildings will be temporarily located on site, including offices and material storage. Equally a variety of construction vehicles will be travelling to and from the project site, these will include trailers, cement trucks, graders, excavators, loaders, water trucks, waste removal trucks...etc. Finally, some construction materials and equipment will be located on site during the entire construction program and these will include cranes, pile drivers and drilling machines.

As noted previously in the site description, the anthropogenic sensitive receptors are the villages of Tasselmant, Tiflité, Igherm Amellal, Tidgheste, Taferghoste to the East and the city of Ouarzazate, that is located 8 km south west of the site.

Both the N10 road, located 4Km south of the project site, and the road that is being built for the village of Tasselmant and for site access may potentially represent a sensitive receptor and the visual amenity to road users.

The view of the first phase of the Ouarzazate SPC from the villages to the east and northeast and from Ouarzazate is blocked by the topography of the area (i.e. the topographic configuration of the plateau and the hills present in the area). Therefore the landscape and visual impact from those sensitive receptors is considered to be neutral.

The site will be visible from a short length (approximately 5Km) of the N10 road and from the access road to Tasselmant. In this area there are already anthropogenic elements, in particular two telecommunication antennas. This is considered to be a minor negative impact.

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.

16.6.2 Mitigation Measures

Construction traffic to the site will be minimised through effective transportation planning, combining loads and utilising non-peak timing where possible.

Any flood lights required during night time construction activities will be directed onto the site, with a maximum position angle of 30° from vertical, therefore minimising any potential light leakage and impacts at night.

16.6.3 Residual Effects

The residual impacts, following the mitigation measures outlined above, are considered to be of negligible to minor negative significance.

16.7 Operation Assessment

16.7.1 Assessment of Impacts

The proposed Project design includes the construction of two 15m high stacks. These will be the highest permanent structures of the first phase of the Ouarzazate SPC. However, given the topography of the area and considering that these structures will be located in the power island, they will be screened from view from the nearby villages and from Ouarzazate. These structures, together with parabolic the mirrors located in the Southeast boundary of the site and the site's fence will be visible from a short length (approximately 5Km) of the N10 road and from the access road to Tasselmant. The ancillary structures (water inlet, power output) will also be visible from these roads. As explained above, near this transect of the N10 road there are already two telecommunications antenna that have an impact on the landscape of the area.

Consequently, the visual impacts during the operational phase are considered negligible to minor negative significance.

16.7.2 Mitigation Measures

No mitigation measures are available to reduce the visual impact of the structures that will be required for the plant. The measures designed for vegetation restoration and compensation include re-vegetation at the bottom of canyons, to provide compensation for the lost habitat and reduce soil erosion, and will therefore not screen the structures built onsite. It is not considered beneficial from an ecological or from a water management perspective to implement a landscaping programme to plant alien species of vegetation in the project boundary that could screen the visual impact from the project.

16.7.3 Residual Effects

Following the mitigation measures discussed above, the significance of impacts to the landscape and visual environment during construction and operation will be negligible to minor negative.

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