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AL MANAKHER SOLAR PV PLANT

ENVIRONMENTAL IMPACT ASSESSMENT

CONFIDENTIAL

JULY 2017

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AES

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Project no: 52001890
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ABBREVIATIONS

ABBREVIATION	DEFINITION
kVA	1000 volt amps
AES	AES Jordan
AQ	Air Quality
AIE	Al Hussein Industrial Estate
Project	Al Manakher Solar PV Plant
AC	Alternating Current
a-Si	Amorphous Silicon
ARC	Anti-reflective coating
BS	British Standard
CdTe	Cadmium Telluride
CRTN	Calculation of Road Traffic Noise
C&D	Construction and Demolition
CEMP	Construction Environmental Management Plan
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species
COD	Commercial Operation Date
dB	Decibel
dB(A)	Decibel (A-weighted)
DoA	Department of Antiquities
DC	Direct Current
CIGS/CIS	Di-Selenide
EASEP	East Amman Society for Environmental Protection
E-waste	Electronic Waste
EPC	Engineering Procurement and Construction
ESAP	Environmental and Social Action Plan
ESMP	Environmental and Social Management Plan

Abbreviation	Definition
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
EP	Equator Principles
EPFI	Equator Principles Financial Institutions
EBRD	European Bank for Reconstruction and Development
Gallium	Copper Indium
GIS	Geographic Information System
GWh	Gigawatts per hour
GRP	Glass Reinforced Plastic
GIIP	Good International Industry Practice
GHG	Greenhouse Gas
GDP	Gross Domestic Product
HFO	Heavy Fuel Oil
HGV	Heavy Goods Vehicle
IPP	Independent Power Plant
IEMA	Institute of Environmental Management and Assessment
IFC	International Finance Corporation
IFI	International Financial Institution
ILO	International Labour Organisation
IUCN	International Union for the Conservation of Nature
JD	Jordanian dinar
km	Kilometre
kW	Kilowatt
LVIA	Landscape and Visual Impact Assessment
IPP4	Levant Power Plant
LCA	Life Cycle Analyses

Abbreviation	Definition
MSDS	Material Safety Data Sheet
MW	Megawatt
MWp	Megawatt Peak
m	Metre
µm	Micrometres
MEGA	Middle Eastern Geodatabase for Antiquities
MCM	Million cubic meters
MoA	Ministry of Agriculture
MEMR	Ministry of Energy and Mineral Resources
MOE	Ministry of Environment
MoH	Ministry of Health
MoW	Ministry of Water
MSW	Municipal Solid Waste
NSMLUP	National Soil Map and Land Use Project
NEXI	Nippon Export and Investment Insurance
NSR	Noise Sensitive Receptor
N/A	Not Applicable
OHS	Occupational Health and Safety
O&M	Operation and Maintenance
OEMP	Operation Environmental Management Plan
OHTL	Overhead Transmission Line
OPIC	Overseas Private Investment Corporation
PM	Particulate Matter
PM_{10}	Particulate Matter <10 microns in diameter
$PM_{2.5}$	Particulate Matter <2.5 microns in diameter
PS	Performance Standards (IFC)
PPE	Personal Protective Equipment

ABBREVIATION	DEFINITION
PV	Photovoltaic
PPA	Power Purchase Agreement
QIZ	Qualifying Industrial Zones
RSS	Royal Scientific Society of Jordan
SoW	Scope of Works
SGHAT	Solar Glare Hazard Analysis Tool
SCA	Special Conservation Area
SEP	Stakeholder Engagement Plan
SMBC	Sumitomo Mitsui Banking Corporation
SWM	Sustainable Waste Management
ToR	Terms of Reference
TAGC	Total Above Ground Carbon
TBGC	Total Below Ground Carbon
TSP	Total Suspended Particulates
UAE	United Arab Emirates
UK	United Kingdom
UN	United Nations
UNCLOS	United Nations Convention on Law of the Sea
UNFCCC	United Nations Framework Convention on Climate Change
VCS	Verified Carbon Standard
VP	Viewpoints
WEE	Waste Electronic and Electrical Equipment
Wp	Wattage (peak)
WHO	World Health Organisation
WWF	World Wildlife Fund
ZTV	Zone of Theoretical Visibility
ZVI	Zone of Visual Influence

APPENDICES

1 الملخص التنفيذي

1-1 نظرة عامة على المشروع

1-1-1 نظرة عامة

تم إعداد تقرير تقييم الأثر البيئي بمعرفة شركة دبليو إس بي | بارسونز برينكرهوف لصالح شركة أيه إي إس ليفانت القابضة الأردن بالتعاون مع الجمعية العلمية الملكية في الأردن بصفتها الجهة الاستشارية البيئية المسجلة محلياً.

وفي إطار السعي للحصول على تصريح بيئي للمشروع المقترح من السلطة التنظيمية في الأردن (وزارة البيئة)، يتعين على شركة أيه إي إس ليفانت القابضة الأردن استكمال تقرير تقييم الأثر البيئي ووضع خطة الإدارة البيئية والاجتماعيةالمناسبة وفقاً للمعايير الأردنية. ويجب أن يراعي تقييم الأثر البيئي مخاطر البيئة والمجتمع ومعايير الأداء الخاصة بمؤسسة التمويل الدولية، بالإضافة إلى المبادئ الإرشادية للمصرف المقرض.

وتعمل حكومة الأردن على دعم توليد الطاقة المتجددة من خلال تبني إستراتيجية الطاقة المتجددة التي تهدف إلى تحقيق 10% من إجمالي قدرة توليد الطاقة في الأردن من خلال مصادر الطاقة المتجددة بحلول عام 2020. ومن خلال قانون الطاقة المتجددة وكفاءة الطاقة، تمكنت وزارة الطاقة والثروة المعدنية من طلب المقترحات الخاصة بتطوير مشروعات الطاقة المتجددة.

2-1-1 موقع المشروع

يقع المشروع في مدينة سحاب بمحافظة عمان على بعد 2.2 كيلومتر تقريباً شمال شرق محطة ليفانت لتوليد الطاقة (المحطة الرابعة المستقلة لتوليد الطاقة)التي تم بناؤها وتشغيلها بمعرفة شركة أيه إي إس ليفانت القابضة الأردن. ويعتبر موقع المشروع ملكاً للحكومة ويضم منطقة تأثير مقترحة تبلغ مساحتها 498.000م^2. وتقع أقرب العقارات السكنية للمشروع في قرية المناخر على بعد 2-3 كم جنوب غرب حدود المشروع.

ولا يوجد أي محطات صناعية أخرى في المنطقة المجاورة لموقع المشروع بخلاف المحطة الأولى والرابعة. وتعتبر معظم الأراضي المحيطة بالمشروع أراضي زراعية (لزراعة محاصيل الحبوب) أو أراضي غير مستغلة.

ولا يحتوي موقع المشروع على أي إنشاءات وقامت وزارة المالية مؤخراً ببعض أعمال التربة.وتملك الحكومة المناطق المحيطة بالحدود الغربية والشمالية للموقع، بينما تعتبر الأرض الموجودة في شرق الموقع ملكاً خاصاً لأفراد من المجتمعات المحيطة. ويوجد بعض النباتات المحلية المتفرقة في الموقع، ولا يحتوي موقع المشروع والمنطقة المحيطة على أي من النباتات أو الحيوانات الحساسة.

وفي جنوب وشرق موقع المشروع، يوجد عدد محدود من المساكن الزراعية المملوكة لعائلات بدوية، وورد في التقرير أن هذه المجموعات كانت تستخدم الأرض لرعي الماشية.

3-1-1 المشروع التطويري المقترح

تسعى شركة أيه إي إس ليفانت القابضة بالتعاون مع شركة ميتسوي وشركاه المحدودة إلى الحصول على تصريح لإنشاء وتشغيل محطة للطاقة الشمسية الكهروضوئية بقدرة تصل إلى 50 ميجاوات في موقع يبعد حوالي 2-3 كم شرق محطة المناخر لتوليد الطاقة التي تعمل بثلاثة أنواع من الوقود في الأردن (المحطة الرابعة المستقلة لتوليد الطاقة). ووفقاً للتصميم، من المتوقع تركيب 497.000 لوح كهروضوئي كجزء من المشروع. ويتم تصميم محطة الطاقة الشمسية الكهروضوئية المقترحة لإمداد شبكة شركة الكهرباء الوطنية بطاقة تصل قدرتها إلى51.9 ميجاوات من التيار المستمر (إجمالي الألواح الكهروضوئية المركبة) و40 ميجاوات من التيار المتردد. وسيتم تأكيد القدرة النهائية لمحطة الطاقة الشمسية الكهروضوئية خلال مرحلة التصميم التفصيلية رغم وجود كامل المحطة داخل حدود موقع المشروع المحددة. وسيتم نشر الوحدات الكهروضوئية في جميع أنحاء موقع المشروع وترتيبها بطريقة تحقق أقصى قدر من الطاقة الشمسية. وسيتم استخدام 22 عاكس شمسي تقريباً في الموقع لتحويل الطاقة الكهربائية من التيار المستمر إلى التيار المتردد.

وسيتم إحاطة موقع المشروع بالكامل بسياج وإنشاء طرق داخلية لإتاحة الوصول أثناء مرحلة التشغيل لإجراء أعمال التنظيف والصيانة للوحدات. وإضافة إلى ذلك، لم يتم اقتراح تخزين الطاقة الكهربائية في موقع المشروع، ولذلك سيتم نقل الكهرباء المولدة إلى المحطة الفرعية المجاورة للمحطة الرابعة لغرض استخدامها و/أو توزيعها على شبكة الكهرباء.

وسيتم شراء الطاقة الناتجة عن المشروع بموجب عقد شراء الطاقة المبرم مع شركة الكهرباء الوطنية التي ستتولى المسؤولية عن إنشاء خطوط النقل العلوية بين موقع المناخر المقترح والمحطة الفرعية الحالية في المحطة الرابعة. ويبلغ طول خطوط النقل العلوية الممتدة على الأرض المملوكة للحكومة حوالي 2 كم على طول الجهة الشمالية للطريق, ومن المتوقع أن تبلغ مدة عقد شراء الطاقة 20 عاماً تقريباً وبعدها يتم اتخاذ القرار بشأن إيقاف المشروع أو تمديده حسب الاقتضاء. ويجب تنظيف ألواح الطاقة الشمسية بانتظام طوال فترة العمليات التشغيلية. ورغم أن الطريقة الدقيقة للتنظيف سيتم تحديدها عند إعداد تقييم الأثر البيئي، إلا أن الشركة القائمة بالمشروع أكدت أن التنظيف سيتم بالطريقة الجافة (أي التنظيف بدون استخدام مياه) وسيتطلب الاستعانة بعدد قليل (<50 تقريباً) من الأشخاص على أساس قصير الأجل، وخاصةً خلال الشهور الجافة/ الترابية.وكما هو الحال بالنسبة للقوى العاملة في مرحلة الإنشاء (انظر القسم التالي)، من المتوقع أن يقوم مقاول النظافة بتعيين المقيمين/ المقاولين المحليين لأداء هذه المهام، ومن المتوقع على المدى المتوسط والطويل إسناد الأدوار الأكثر مهارة إلى عمال من داخل المجتمعات، سواء من العمال الماهرين، إن وجد، أو من خلال برنامج التدريب المهني والمنح المطبق في المحطتين الأولى والرابعة.

4-1-1 الجدول الزمني لمرحلة الإنشاء

من المتوقع أن يتم إنشاء المشروع المقترح في غضون 10 أشهر تقريباً رغم عدم تحديد تاريخ بدء الأعمال (المقرر بين عامي 2017 و2018). وسيتم إدارة مرحلة الإنشاء بمعرفة شركة وارتسيلا، مقاول أعمال المشتريات والإنشاءات الهندسية.وتتطلب مرحلة الإنشاء 465 عامل تقريباً في وقت الذروة يشارك معظمهم في إعداد أطر عمل الألواح الكهروضوئية وتركيبها.

ومن المتوقع أن يستعين مقاول أعمال المشتريات والإنشاءات الهندسية ومقاولي الباطن بالمقاولين المحليين والمقيمين (في منطقة المناخر ومدينة سحاب) بناءً على المهارة والتوفر التي سيتم تحديدها من خلال المناقشة المستمرة بشان الأدوار مع مختاري القرى ومكاتب العمل المحلية.

وفيما يلي الأنشطة الإنشائية الرئيسية ذات الصلة بالمشروع:

- التصنيف الدقيق للانتهاء من أعمال تجهيز الموقع الجارية.
- إنشاء الطرق الداخلية.
- وضع ركائز صلب بعمق من 1 إلى 2 متر لهياكل الألواح الكهروضوئية.
- الحفر السطحي لتركيب الكابلات الكهربائية الأرضية بعمق يصل إلى متر واحد.
- تجميع الرفوف وتركيب الألواح.
- تركيب المعدات الكهربائية والمحطة الفرعية وتشغيلها.

وسيتم تحديد مناطق التخزين،ومرافق راحة العمال، ومناطق تخزين المخلفات داخل موقع المشروع. وسيتم نقل الألواح الشمسية من ميناء العقبة إلى الموقع.

2-1 خط الأساس البيئي والتأثيرات المحتملة

1-2-1 جودة الهواء

من المحتمل ان تؤثر اعمال الانشاء الخاصة بالمشروع المقترح على جودة الهواء نتيجة للغبار الناشئ عن أعمال وضع الأساس وانبعاثات المركبات/ المحطة. ولا يتوقع ان يكون للغبار تأثيراً كبيراً نتيجة للمسافة الواقعة بين الموقع وأقرب جهه استقبال

ونظراً لخلو الموقع بالفعل، ستكون تأثيرات مرحلة الإنشاء مرتبطة بشكل أساسي بانبعاثات العوادم والغبار/ الجسيمات الناتجة عن حركة المرور داخل الموقع، وأعمال الحفر والتسوية، وخلط المواد الخام، والتخزين المفتوح للمواد الخام، وانبعاثات المصادر الثابتة. وفي حال تطاير بعض الغبار والحطام أثناء مرحلة الإنشاء وتنظيف الألواح (في حال استخدام الهواء المضغوط)، سيتم تحديد مكان هذا الغبار بدقة ليكون تأثيره ضئيلاً على جودة الهواء المحيط.

ولا توجد مصادر كبيرة أخرى لتلوث الهواء داخل المنطقة العامة لموقع المشروع. ولذلك من المتوقع أن تقتصر جودة الهواء في الموقع على البيئة المحلية والدولية المحيطة. وأثناء مرحلة التشغيل، لا يتوقع وجود تأثيرات كبيرة على جودة الهواء نظراً لعدم إطلاق الألواح الكهروضوئية لأي انبعاثات أو ملوثات.

2-2-1 الضوضاء

تم تقييم مشروع الألواح الكهروضوئية المقترح وفقاً لحدود الضوضاء المعمول بها في فترتي النهار والليل بموجب الإرشادات الأردنية لمنع الضوضاء (2003) وحدود الضوضاء الواردة في الإرشادات العامة بشأن البيئة والصحة والسلامة الصادرة عن البنك الدولي/ مؤسسة التمويل الدولية (2007).

وتم إجراء عملية مسح الضوضاء في الفترة بين 16 و17 يناير 2017 في سبعة (7) مواقع قريبة من موقع المشروع، حيث أشارت النتائج إلى احتمالية توافق مستويات الضوضاء عند أقرب المستقبلات مع الإرشادات الأردنية.

ومن المتوقع خلال المرحلة الإنشائية أن يصل تأثير الضوضاء إلى ذروته خلال أعمال تجهيز الموقع.وتم إجراء تقييم حول تأثير الضوضاء في الأوضاع النموذجية(وفي أسوأ الأوضاع) خلال هذه المرحلة، وذلك باستخدام الجدول الزمني للمرحلة الإنشائية.

ومن المتوقع أن تتوافق مستويات الضوضاء خلال المرحلة الإنشائية، في ظل الأوضاع النموذجية، مع حدود الضوضاء في النهار والليل وفقاً للإرشادات الأردنية. وفي اسوأ الاوضاع ، من المتوقع أن تتوافق مستويات الضوضاء مع حدود الضوضاء في النهار فقط وليس مع حدود الضوضاء في الليل وفقاً للإرشادات الأردنية.

ومن المتوقع أن تتراوح شدة تأثيرات الضوضاء من طفيفة إلى متوسطة أثناء النهار ومن متوسطة إلى كبيرة أثناء الليل.

وأثناء المرحلة التشغيلية، من المتوقع أن تكون مراوح التبريد المثبتة في العاكس الكهربائي هي المصدر الوحيد للضوضاء خلال أعمال التشغيل. وتم إجراء تقييم حول تأثير الضوضاء خلال هذه المرحلة بناءً على التصميم المخطط للعواكس الكهربائية في جميع أنحاء موقع المشروع.

ومن المتوقع أن تتوافق مستويات الضوضاء خلال المرحلة التشغيلية مع حدود الضوضاء في فترتي النهار والليل المنصوص عليها في الإرشادات الأردنية والحدود الواردة في إرشادات البنك الدولي ومؤسسة التمويل الدولية.

ومن المتوقع أيضاً أن تتراوح شدة تأثيرات الضوضاء أثناء أعمال التشغيل بين طفيفة نهاراً وضئيلة ليلاً.

وبناءً على توقعات الضوضاء، من الأفضل أن تقتصر المرحلة الإنشائية على فترة النهار فقط لتجنب وجود أي تأثيرات كبيرة وعدم الامتثال لحدود الضوضاء الأردنية في أقرب المستقبلات. وعلاوة على ذلك، يجب على المقاول اتباع التدابير الواردة في إطار خطة الإدارة البيئية للعمليات الإنشائية للحد من الضوضاء الناجمة عن أعمال الإنشاء.

ومن خلال تنفيذ تدابير التخفيف، من المتوقع أن تتراوح شدة تأثيرات الضوضاء المتبقية أثناء المرحلة الإنشائية من ضئيلة إلى طفيفة نهاراً ومن طفيفة إلى متوسطة ليلاً. وفي حال اقتصار أعمال الإنشاء على فترة النهار فقط، من المتوقع أن تكون شدة تأثير الضوضاء المتبقية خلال هذه المرحلة ضئيلة أثناء الليل.

3-2-1 إدارة المخلفات والمخلفات الخطرة

تتولد المخلفات الصلبة من المشروع بشكل كبير خلال مراحل الإنشاء والتركيب وإيقاف التشغيل. ومن المتوقع عدم تولد أي مخلفات أثناء المرحلة التشغيلية للمشروع. وقد تتولد كميات قليلة من المخلفات خلال مرحلة التركيب نتيجة لتعبئة وحدات الخلايا الكهروضوئية لنقلها ومناولتها، بجانب الألواح التالفة أثناء النقل والتركيب. وتتولد المخلفات خلال مراحل الإنشاء والتشغيل وإيقاف التشغيل، سواء كانت مخلفات خطرة أو غير خطرة أو مخلفات إلكترونية (مثل الألواح الشمسية المكسورة). وورد في التقرير وجود منشأة واحدة فقط للمخلفات الخطرة في الأردن وتقع على بعد 300كم تقريباً من الموقع.

وسيتم إعادة استخدام المخلفات التي تتولد في الموقع خلال المرحلة الإنشائية (من المرجح أن تكون محدودة نظراً لأعمال إخلاء وتحسين الأرض التي يتم إجراؤها) كمواد ردم في أعمال الحفر في الموقع (مثل الردميات وأعمال تصميم الموقع). وسيتم إزالة أي مواد غير لازمة والتخلص منها خارج الموقع لإعادة استخدامها في المرافق المناسبة أو التخلص منها بمعرفة متعهد مخلفات مرخص.

وتعتمد خيارات إدارة المخلفات، بما في ذلك إعادة استخدامها وتدويرها والتخلص منها خارج الموقع، على البنية التحتية المتوفرة محلياً. وتم تحديد مكب الغباوي باعتباره مكب المخلفات الأقرب للموقع، حيث يقع على بعد 7كم تقريباً من المشروع ويمتد على مساحة 50 فداناً.

وتوجد معلومات محدودة للغاية حول خيارات معالجة المخلفات الإلكترونية وإعادة تدويرها والتخلص النهائي منها، ولكن يتم حالياً التخلص من هذه المخلفات في حاويات المخلفات الصلبة البلدية وتجميعها بشكل غير رسمي بمعرفة تجار الخردة المتنقلين لاستعادة المواد البلاستيكية والمعدنية.

وخلال مرحلة التصميم التفصيلية التي يتم إجراؤها بمعرفة مقاول أعمال المشتريات والإنشاءات الهندسية المقترح ، سيتم تقدير كميات ومكونات المخلفات المتولدة أثناء مرحلتي الإنشاء والتشغيل بالمشروع المقترح. وسيتم توضيح ذلك بالتفصيل أثناء وضع خطط إدارة المخلفات بمعرفة شركة وارتسيلا، مقاول أعمال المشتريات والإنشاءات الهندسية ، كجزء من خطة الإدارة البيئية للعمليات الإنشائية المرفقة، وبمعرفة المشغل كجزء من خطة الإدارة البيئية للعمليات التشغيلية.

ويوصي تقرير تقييم الأثر البيئي بعقد مناقشات مع موردي الألواح لتحديد مدى إمكانية إزالة الألواح المكسورة لإعادة استخدامها/ تدويرها بدلاً من إرسالها إلى مكب المخلفات الخطرة المحلي. وبدلاً من ذلك ونظراً لأن هذه المحطة هي إحدى محطات الطاقة الشمسية الكهروضوئية قيد التطوير في الأردن، أشار تقرير تقييم الأثر البيئي إلى أهمية التواصل مع مطوري المشروع الآخرين حيثما أمكن لتحديد مدى إمكانية الاستعانة بمنشأة مشتركة لإعادة استخدام/ تدوير المخلفات. ولذلك تم التوصية بعقد مناقشات حول هذا الجانب قبل انتهاء عقد توريد الألواح.

4-2-1 البيئة الأرضية

تعد الأردن دولة غنية بالتنوع النباتي حيث يوجد بها ما يقرب من 2500 نوع من النباتات الوعائية تنتمي الى 152 عائلة تشكل 1% تقريباً من إجمالي النباتات الموجودة في العالم. وهناك مائة نوع من النباتات المستوطنة تشكل 2.5% تقريباً من إجمالي النباتات الموجودة في الأردن.

ويقع المشروع في منطقة جغرافية حيوية بمنطقة البحر الأبيض المتوسط وسط المرتفعات. ولا توجد مناطق محمية على مقربة من موقع المشروع، وتتمثل أقرب المواقع في محمية الطيور الموجودة عند محطة خربة السمراء لمعالجة مياه الصرف الصحي والتي تقع على بعد 30 كم شمالاً، ومحمية الأزرق التي تقع على بعد 70 كم شرق المشروع.

وتم إجراء زيارة بيئية ميدانية لموقع المشروع في 8 يناير 2017 لتحديد الموائل القائمة وحالتها،وتصنيف أنواع النباتات الموجودة،وتحديد الحيوانات. وأثناء الزيارة الميدانية، تم التجول في جميع أنحاء الموقع وإجراء المسوحات الشاملة. ويبدو الموقع في حالة شديدة الاضطراب والتغير بسبب أعمال التسوية التي قامت بها وزارة المالية عام 2010. وتوجد بعض النباتات المتناثرة داخل الموقع ومعظمها نباتات محلية ويهيمن عليها نبات العجرم وهو من أكثر الأنواع انتشاراً على الصعيد الوطني.

ولا يتم ملاحظة أي علامات على وجود الحيوانات أثناء الزيارة الميدانية. وتم مشاهدة نوع واحد من طائر الذعرة الأبيض داخل موقع المشروع،وهو أحد أنواع الطيور المهاجرة إلى الأردن خلال أشهر الشتاء في أوروبا.

ونظراً لغياب الموائل الطبيعية والنباتات والحيوانات المختلفة، من المتوقع أن تكون التأثيرات الأرضية الناشئة في مرحلتي الإنشاء والتشغيل محدودة. ويوصي تقرير تقييم الأثر البيئي باتخاذ عدد من التدابير أثناء مرحلة الإنشاء لتقليل التأثيرات داخل الموقع مثل اصطدامات حركة المرور مع الحيوانات البرية العابرة وتقليل التأثيرات على الأراضي المحيطة الصالحة للزراعة.

5-2-1 التربة والهيدرولوجيا وجودة المياه

تم القيام بجولة ميدانية لموقع المشروع في المرحلة الأولى ولم يتم العثور على أي دليل بشأن تلوث التربة أو أي مخاطر مرتبطة بمصادر التلوث المحتمل في الموقع رغم وجود عدد من أكوام المخلفات في محيط الموقع نتيجة للقلب العشوائي للمخلفات والتي يبدو أنها تشكل معظم مخلفات الإنشاء أو نتيجة لمخلفات رعاة الأغنام. وأثناء أعمال تجهيز الموقع، سيتحمل مقاول أعمال المشتريات والإنشاءات الهندسية المسؤولية عن ضمان إدارة عمليات إزالة المخلفات من الموقع بشكل مناسب والتخلص منها في المرافق المعتمدة. وتم إجراء فحص جيوتقني في يونيو 2016 مما سمح بمعاينة أوضاع الموقع من خلال 13 بئراً تم حفر كل منها بعمق 30 متراً. ولم يصادف وجود مياه جوفية في أي بئر من الآبار.

وتم تقييم التأثيرات المرتبطة بالتربة والمياه الجوفية على أنها تأثيرات سلبية تتراوح شدتها بين طفيفة ومتوسطة، ويرتبط التخفيف المقترح في تقييم الأثر البيئي بتنفيذ تدابير الإدارة والمراقبة المناسبة. ونظراً لأن موقع المشروع عبارة عن أرض واسعة يحدها

من الجانبين أرض زراعية والطريق المتجه إلى الجنوب، يوصي تقييم الأثر البيئي بضمان مراعاة وضع نظام تصريف مياه الأمطار في الموقع للحد من مخاطر التآكل والفيضانات التي قد تحدث في الموقع أو بالقرب منه. ومن الضروري أيضاً مراعاة نقاط تصريف مياه الأمطار كجزء من التصميم لضمان عدم تأثر مستخدمي الأراضي المجاورة بشكل سلبي.

6-2-1 المناظر الطبيعية والتأثيرات المرئية

يشير نقص النباتات والطبيعة الجرداء لموقع المشروع إلى أن المناظر الطبيعية ذات قيمة منخفضة نسبياً وبالتالي أكثر قدرة على استيعاب المشروع. وهناك العديد من الأراضي غير المطورة التي تحيط بموقع المشروع، وتتكون المناظر الطبيعية القاحلة في الغالب من الرمال والأراضي الزراعية رديئة الجودة. وخلال الفترات العاصفة، تساهم البيئة القاحلة في زيادة الضباب المليء بالغبار.

وبناءً على منطقة الرؤية الإرشادية والتي تراعي تصميم المشروع طبقاً لتضاريس المنطقة المجاورة، تم تحديد تسعة مواقع للمستقبلات حول الموقع. وتم تقييم حساسية المشاهد،ويعتبر المشهد السادس من المستقبلات ذات الحساسية العالية. وتم العثور على ستة مشاهد ذات حساسية متوسطة ومشهدين ذو حساسية منخفضة.

وبناءً على منطقة الرؤية الإرشادية، وقع الاختيار على المشاهد العشرة المستخدمة في التقييم باعتبارها أكثر عرضة للتأثر بالمشروع. وتم تقييم حساسية المشاهد بناءً على المعايير المحددة في القسم رقم 12-3 وعلى النحو الوارد في الجدول رقم 12-9 من التقرير الرئيسي.

وبالنظر إلى جميع المشاهد، تعد المناظر الطبيعية ذات حساسية منخفضة حيث لا تحتوي على أي خصائص مميزة، وتعتبر المنطقة، التي أزالتها وزارة المالية بالفعل مع خطوط النقل العلوية الخاصة بشركة الكهرباء الوطنية، مكاناً ملائماً لاستيعاب مشروع الطاقة الشمسية المقترح دون التأثير البالغ على ملامح المنطقة.

7-2-1 التأثيرات الاجتماعية والاقتصادية

تم إجراء مشاورات مع المجتمعات المحلية والجهات المعنية في شهر ديسمبر 2015 وشهري فبراير ومارس 2017. وتم تحديد النتائج والتعقيبات من هذه الجلسات وإدراجها في منهج التقييم، وتحتوي ملاحق تقييم الأثر البيئي على قائمة مفصلة بالتعقيبات والحاضرين في الجلسات. ويبدو أن التعقيبات العامة كانت إيجابية بشأن تطور المشروع، حيث أقرت المجتمعات المحلية بمزاياالألواح الشمسية الكهروضوئية مقارنةً بمحطات الطاقة الحرارية رغم تركيز المناقشات على حرص المجتمعات المحلية أن تكون المصدر الرئيسي للموظفين خلال مرحلتي الإنشاء والتشغيل. ووردت تعقيبات سلبية بشأن التأثيرات المحتملة التي قد تؤدي إلى تقليل قيمة الأراضي المجاورة،ولاسيما فيما يتعلق بخطوط النقل العلوية ذات الصلة بالمشروع رغم أن المقيمين في مناطق أخرى قد أشاروا إلى عكس ذلك حيث يعتقدون أن قيمة الأراضي قد تزداد مع تطور المشروع.

ولا يتناول المشروع إعادة توطين الشعوب الأصلية أو نقل/ شراء الأراضي الخاصة.

وأثناء مرحلة الإنشاء، قد يحقق المشروع ازدهاراً في الأعمال التجارية بقرية المناخر والمجتمعات المحيطة وذلك من خلال زيادة فرص العمل والعقود المحلية. وسيتم تشجيع مقاول أعمال المشتريات والإنشاءات الهندسية ومقاولو الباطن للاستعانة بالسكان المحليين (من منطقة المناخر وسحاب) حيث يتمتعون بمهارات أفضل من العمال من مناطق أخرى. وبالمثل، سيتم تشجيع المقاولين للاستعانة بمقاولين/ موردين محليين مع إعطاء الأولوية لمقدمي الخدمات المحليين. ومن المتوقع أن يقدم مقاول أعمال المشتريات والإنشاءات الهندسية ومقاولو الباطن تقريراً إلى شركة المشروع (شركة أيه إي إس ليفانت القابضة) والمؤسسات المالية الداعمة حول عدد السكان المحليين الذين تم توظيفهم خلال مرحلة الإنشاء والموردين المحليين الذين تم الاستعانة بهم. وحيثما أمكن، سيقوم مقاول أعمال المشتريات والإنشاءات الهندسية بتنفيذ مخططات التدريب المهني والدورات التدريبية للتركيز على السكان المحليين من أجل تحسين آفاق العمل المستقبلية والمهارات المحلية.

وخلال مرحلة التشغيل ونظراً لقلة فرص العمل المتوقعة، قد تكون هناك حاجة إلى الاستعانة بالموظفين الأقل مهارة (لتنظيف الألواح الكهروضوئية) والموظفين الفنيين، مع إعطاء الأولوية للسكان المحليين إن أمكن.

ويتوقع من جميع المقاولين العاملين بالموقع الالتزام بقوانين ومتطلبات العمل الأردنية والدولية، وتشمل إبرام العقود الواضحة والشفافة ودفع الرواتب في الوقت المحدد وتمكين الموظفين من تقديم شكواهم دون الخوف من الانتقام. وستتابع شركة المشروع امتثال مقاولو الباطن لخطة الإدارة البيئية للعمليات التشغيلية.

وتعتبر عملية توليد الكهرباء الإضافية وتوريد الطاقة إلى الدولة بأكملها، باستثناء الانبعاثات الناتجة، ذات تأثير إيجابي على الأوضاع الاجتماعية والاقتصادية للأردن.

وتمتلك شركة أيه إي إس ليفانت القابضة إستراتيجية استثمارية مجتمعية بشأن المحطة الأولى والمحطة الرابعة،وتم الاستفادة من هذه الإستراتيجية في عدد من المجالات بالمدارس والمجتمعات المحلية باستخدام الأصول المادية (مثل السخانات الشمسية)، بالإضافة إلى توفير الرعاية التعليمية للطلاب المتفوقين. ومن المتوقع أن يشارك مشروع الطاقة الشمسية في المبادرات المجتمعية الجارية بدلاً من إطلاق مبادرات منفصلة للمشروع، وذلك باستثناء إطلاق دورات تدريبية بشأن صيانة ألواح الطاقة الشمسية إذا أمكن تطبيق ذلك عملياً.

وتم وضع خطة عمل تكميلية لإشراك الجهات المعنية وآلية تظلم مع مراعاة تطبيق مسارات التواصل القائمة في المحطة الأولى والمحطة الرابعة.ومن المتوقع أن يشكل الحوار الجاري مع الجهات المعنية عنصراً هاماً لضمان تحديد القضايا المجتمعية في الموقع وتحقيق أقصى قدر من المنافع الإيجابية من المشروع.

8-2-1 المعالم الثقافية والتراثية والأثرية

تم تقييم التراث الثقافي وقيمة الاكتشافات الأثرية في موقع المشروع والمناطق المحيطة به، وذلك من خلال الجولة الميدانية للموقع والتي ضمت خبراء أردنيين في مجال الآثار والبحوث المكتبية. وتم الإشارة إلى المعلومات المتوفرة في قاعدة البيانات الجغرافية للآثار في الشرق الأوسط والتي تحتفظ بها وزارة الآثار باعتبارها السلطة الحاكمة المحلية في الأردن. وعلى الرغم من تحديد العديد من المواقع المهمة داخل المنطقة الواسعة إلا أنه لم يتم تحديد أي اكتشافات أو آثار ذات أهمية داخل حدود الموقع. وأشار ممثل الآثار من الجمعية العلمية الملكية إلى عدم وجود أي علامات لاكتشاف المواقع أو العناصر الأثرية أثناء مرحلة إنشاء المشروع. ويبدو الموقع في حالة اضطراب شديدة نظراً لأعمال التسوية والإخلاء التي قامت بها وزارة المالية قبل بدء المشروع في عام 2010.

وتوصي نتائج التقييم بإعداد ملخص لمراقبة الآثار كجزء من خطة الإدارة البيئية للعمليات الإنشائية والتي ستضم تفاصيل الاتصال في حال اكتشاف الآثار وستقدم التوجيه للمقاولين بشأن أي متطلبات لتدريب للموظفين.

9-2-1 الاستنتاجات

سيتم تطوير مشروع محطة الطاقة الشمسية المقترح في المنطقة التي قامت وزارة المالية بإخلائها عام 2010. وباعتبارها منطقة معزولة نسبياً وذات مستقبلات حساسة قليلة وتشمل السكان المحليين أو الموائل، تعد التأثيرات السلبية المحتملة للمشروع ضئيلة نسبياً ويمكن تخفيفها بشكل كبير. ونظراً لأن هذه المحطة هي إحدى محطات منطقة المناخر المملوكة لشركة أيه أي إس ليفانت القابضة، من المسلم به أن المشكلات التي قد تنشأ من محطة واحدة ستكون ذات صلة بالمحطات الأخرى، ولاسيما فيما يتعلق بضمان تحقيق أقصى قدر من المنافع الإيجابية. وقد أقرت شركة المشروع بهذا التعاون وستسعى إلى دمج مشروع الطاقة الشمسية في خطة المبادرة المجتمعية الحالية.

وتم وضع خطة أولية للإدارة البيئية للعمليات الإنشائية لتطبيقها في الموقع وسيقوم مقاول أعمال المشتريات والإنشاءات الهندسية بتطويرها، حيث توفر هذه الخطة إستراتيجيات التخفيف الرئيسية التي يجب اتباعها في الموقع. وبعد تطبيق تدابير التخفيف المحددة ومتابعة مقاول أعمال المشتريات والإنشاءات الهندسية وشركة المشروع لفعالية ونجاح هذه التدابير، من المتوقع أن تقل التأثيرات السلبية المحتملة للمشروع، مثل الضوضاء أو الغبار، مع زيادة التأثيرات الإيجابية مثل زيادة فرص العمل إلى أقصى حد ممكن.

1 EXECUTIVE SUMMARY

1.1 OVERVIEW OF THE PROJECT

1.1.1 OVERVIEW

This Environmental Impact Assessment report has been prepared by WSP | Parsons Brinckerhoff for AES Jordan (AES) in association with Royal Scientific Society of Jordan, a locally registered environmental consultant.

In order to obtain environmental authorisation for the proposed project from the regulatory authority in Jordan (Ministry of Environment), AES Jordan is required to complete an EIA and develop an appropriate Environmental and Social Management Plan (ESMP) in accordance with Jordanian standards. The EIA is also required to consider the Equator Principles and International Finance Corporation (IFC) Performance Standards (PS) in addition to specific lender-bank guidelines.

The Government of Jordan is promoting the generation of renewable energy by adopting a renewable energy strategy. The renewable energy strategy has set a target of achieving 10% of total generation capacity within Jordan being through renewable sources by 2020. The Renewable Energy and Energy Efficiency Law permits the Ministry of Energy and Mineral Resources (MEMR) to request proposals for the development of renewable energy projects.

1.1.2 THE PROJECT SITE AND LOCATION

The Project site is located within the Sahab District in the Amman Governorate, approximately 2..2km northeast of the Levant Power Plant (IPP4) which was built, and is operated by, AES. The Project site is government-owned and has a proposed footprint of 498,000m^2. The nearest residential properties are in Al Manakher village, located approximately 2-3km to the south west of the Project boundary.

With the exception of the existing IPP1 and IPP4 there are no other industrial plants in the immediate vicinity of the Power Project site. The majority of the surrounding land is either farmed (for cereal crops) or unused.

The site is clear of structures and has been subject to recent earthworks by the Ministry of Finance. The areas surrounding the western and northern boundaries is owned by the government, with the land to the east being privately owned by nearby members of surrounding communities. There is very sparse indigenous vegetation on-site and the Project site and surrounding area are not known to contain any sensitive flora or fauna.

To the south and east of the Project site, there are a limited number of agricultural dwellings belonging to Bedouin families. These groups reportedly use the land primarily for grazing livestock.

1.1.3 THE PROPOSED DEVELOPMENT

AES, in consortium with Mitsui and Company Ltd, is seeking permission to construct and operate a solar photovoltaic (PV) farm of up to 50MW at a site approximately 2-3km east of the existing IPP4 Al Manakher tri-fuel power plant in Jordan. It is anticipated that, as per the design, 497,000 PV panels will be installed as part of the Project. The proposed PV solar plant is designed to have a capacity of up to 51.9 MW DC (total of installed PV panels) and 40 MW AC delivered to the NEPCO grid. The final capacity of the solar PV plant will be confirmed during the detailed design stage although all sizes of the plant will be contained within the defined Project site boundaries. The PV modules will be located throughout the Project site and will be arranged to maximise solar gain. Approximately 22 inverters will be utilised at the site in order to convert the electricity from direct current (DC) to alternating current (AC).

The entire Project site will be fenced and internal access roads will be constructed to allow access during operation for washing and maintenance of modules. In addition, there is no onsite storage of electricity proposed at the Project site; all electricity generated will be transmitted to the substation adjacent to the IPP4 power plant site for use and/or distribution to the electricity network.

The power produced by the Project will be purchased under a power purchase agreement (PPA) with the National Electric Power Company (NEPCO) who will also be responsible for the construction of an overhead transmission line between the proposed Al Manakher site and the existing substation at IPP4 (approximately 2km along the northern edge of the roadway on government-owned land). The PPA is expected to have a duration of approximately 20 years, at which point it will be determined whether to decommission the Project or extend the life as appropriate. During operations, the solar panels will be required to be regularly cleaned. While the exact method of cleaning is still to be determined at the time of this EIA, the Project Company has confirmed it will be a dry method (eg cleaning without water) and will necessitate the use of a small number (c.<50) people on a short-term basis, particularly during dry/dusty months. As with the construction workforce (see following section), the cleaning contractor will be expected to preferentially hire local residents/contractors for these roles, with the expectation in the medium to long-term that more skilled roles can be filled by personnel within the communities either from existing skilled personnel if present or through apprenticeship/training or the scholarship programme already in place within IPP1/IPP4.

1.1.4 CONSTRUCTION SCHEDULE

The proposed project is expected to be constructed within a period of approximately 10 months, although the date of commencement of works is still to be determined (expected within 2017-2018). The construction will be managed by the Engineering Procurement and Construction (EPC) Contractor, Wärtsilä, which was also the EPC Contractor for the IPP4 development. During construction, a peak workforce of approximately 465 workers will be required, the vast majority of whom will primarily be involved in the setting up of panel frameworks and placement of the PV panels.

The EPC Contractor and subcontractors will be expected to utilise local contractors and residents (Manakher and wider Sahab District) preferentially subject to skills and availability via ongoing discussion of roles with village Mukhtars and local labour offices.

The key construction activities associated with the Project include:

- Minimal grading to finalise the site preparation which has already been undertaken;
- Internal road construction;
- Driving of steel piles 1-2 meters deep for the PV structures;
- Open cut excavation for the installation of underground electrical cables up to 1 meter deep;
- Assembly of racks and installation of panels;
- Installation of electrical equipment and substation, commissioning.

The construction lay down areas, worker welfare facilities and waste storage areas will all be located within the Project site. The solar panels will be transported to the site from Aqaba Port.

1.2 ENVIRONMENTAL BASELINE AND POTENTIAL IMPACTS

1.2.1 AIR QUALITY

The construction impacts on air quality expected for the proposed Project will potentially comprise dust raised by groundworks and vehicle/plant emissions. Due to the distance from the Project site to the nearest receptor, dust impacts are not expected to be a significant issue.

As an already cleared site, construction phase impacts will primarily be associated with exhaust emissions and dust/particulate matter associated with construction traffic, excavations, levelling, mixing of raw materials, open storage of raw materials and stationary source emissions. While there may be some fugitive dust and debris during construction and panel cleaning (if compressed air is used), these will be highly localised, having a negligible impact on the surrounding air quality.

There are no other known major sources of air pollution within the general area of the Project site; therefore, air quality at the Project site is expected to be within national and international ambient limits. During operation, no significant air quality impacts are anticipated, as the PV panels will not emit any emissions or pollutants.

1.2.2 NOISE

The proposed PV Project has been assessed in accordance with the daytime and night-time noise limits applicable under the Jordanian Guidelines for Prevention of Noise (2003) and the World Bank Group/IFC General EHS Guidelines Noise Limits (2007).

A noise survey was conducted from 16 - 17 January 2017 at seven (7) locations in the vicinity of the Project area, with the results indicating that existing noise levels at the nearest receptor are predicted to be currently in compliance with the Jordanian guidelines.

During the construction phase, it is expected that the site preparation works will be the stage with the greatest noise impact. An assessment of both the typical and “worst case” noise impact during this phase was conducted, using a typical construction schedule.

The construction noise levels, under typical conditions, were predicted to comply with both the daytime and night-time noise limits in the Jordanian guidelines. Under “worst case” conditions, noise levels were predicted to comply with the daytime noise limit but may not comply with the night-time noise limit in the Jordanian guidelines.

The significance of the noise impacts during construction were predicted to be minor to moderate during daytime and moderate to major during night-time.

During the operational phase, it is expected that cooling fans attached to power inverters will be the only source of significant noise during operations. An assessment of the noise impact during this phase was conducted, based on the planned layout of power inverters across the Project site.

The operational noise levels were predicted to comply with both the daytime and night-time noise limits in the Jordanian guidelines and those in the World Bank Group and IFC guidelines.

The significance of the noise impacts during operations were predicted to be minor during daytime and negligible during night-time.

On the basis of the noise predictions, it has been recommended that construction is limited to daytime only to prevent noise impacts of major significance and non-compliance with the Jordanian noise limits at the nearest receptor. Furthermore, it has been recommended that the contractor follow measures outlined within the accompanying framework Construction Environmental Management Plan (CEMP) to minimise disruption caused.

Following the implementation of mitigation measures, the residual noise impact significance during construction is expected to be negligible to minor during daytime and minor to moderate during night-time. If the recommendation that construction be limited to daytime only is implemented, the residual noise impact significance during this phase is expected to be negligible during night-time.

1.2.3 WASTE AND HAZARDOUS WASTE MANAGEMENT

Generation of solid waste as a result of the Project will effectively only occur during the construction, installation and decommissioning stages. No significant waste generation is expected during the operation of the Project. Small quantities of waste materials will be produced at the installation stage as the PV cell modules are packaged for transportation and handling, together with damaged panels from of transit or installation. The construction, operational and decommissioning phases of the Project will generate waste streams either classified as non-hazardous, hazardous or E-waste (e.g. broken solar panels). There is reportedly only one hazardous waste facility within Jordan, located approximately 300km from the site.

During construction, any spoil generated onsite (likely to be relatively limited as land clearance and improvement works have already been undertaken) will be reused as fill material for earthworks on site (e.g. bank construction and landscaping). Any material not required will be removed and disposed of offsite to appropriate facilities ideally for reuse or disposal by a licensed waste contractor.

The options for waste management including the reuse of waste, recycling and offsite disposal will depend upon the locally available infrastructure. The closest landfill to the Project has been identified to be Gabawi landfill, positioned approximately 7km west from the Project and extending over an area estimated to be 50 acres.

Very limited information associated with E-waste streams processing and final disposal or recycling options exist at the present time, but at present e-waste streams are typically disposed of in municipal solid waste containers and collected informally by mobile scrap dealers for recovery of plastics and metal components.

The quantity and composition of the waste streams generated during construction and operational phases of the proposed Project will be estimated during the detailed design stage by the proposed EPC Contractor. It is anticipated that this process will be considered further through the development of waste management plans by the EPC Contractor Wärtsilä within the accompanying detailed Construction Environmental Management Plan (CEMP) and the operator within the Operational Environmental Management Plan (OEMP).

The EIA has also recommended that discussions with the panel supplier are undertaken to establish whether they are able to remove broken panels for reuse/recycling rather than send to local hazardous waste landfill. Alternatively, as one of a number of solar PV plants which are in the process of being developed within Jordan, it has also been suggested within the EIA that the other Project Developers be liaised with where possible in order to establish whether a shared reuse/recycling facility may be an option. Discussions on this aspect have been recommended prior to the finalisation of the panel supplier agreement.

1.2.4 TERRESTRIAL ECOLOGY

Jordan is rich and highly diverse country with approximately 2,500 recorded species of vascular plants, belonging to 152 families, representing about 1% of the total flora of the world. One hundred species are endemic, forming about 2.5% of the total flora of Jordan. More than 434 bird species, 69 breeding species and 21 migrant species belonging to 58 families have been recorded in Jordan (Source: *State of Jordan's Birds*, 2013, RSCN and Birdlife International).

The Project site is located within the Mediterranean biogeographic zone, within a highland ecosystem (Source: Al–Eisawi, D. (1996). *Vegetation of Jordan*, UNESCO – Cairo Office). There are no conservation areas in close proximity to the Project site; the closest sites are the As-Samra Wastewater Treatment Plant Important Bird Area, 30km north, and the Azraq Wetland, 70km to the east of the Project respectively.

An ecological site visit was conducted at the Project site on 8 January 2017, in order to identify any habitats present and their condition, catalogue flora species present, and identify fauna. During the site visit, a site-wide walkover was completed and transect surveys were undertaken. The site was observed to be in a highly disturbed and modified state, due to the grading works which were undertaken by the Ministry of Finance in 2010. Vegetation was sparse within the site, and was highly localised solely dominated by 'ajram (*Anabasis syriaca)*, which is a nationally common and widespread species.

No field signs for fauna were identified during the site visit. A single specimen of white wagtail (*Motacilla alba*) was seen within the Project site. White wagtail are a migratory visitor to Jordan during the winter months of Europe.

Due to the absence of natural habitats, diverse flora, and fauna, it is considered that potential terrestrial impacts from the construction and operation of the Project will be minimal. The EIA recommends a number of measures be implemented during the construction phase in order to minimise impacts within the site, such as road traffic collisions with transient wildlife, and minimise impacts upon the surrounding arable farmland.

1.2.5 SOIL, HYDROLOGY AND WATER QUALITY

A Phase 1 site walkover was undertaken for the Project and no evidence of soil contamination was identified, nor any risk associated potential contamination sources at the site, although there are a number of waste piles on the periphery of the site as a result of fly-tipping- largely appearing to comprise of construction waste or waste from sheep herders. During the site preparation works, the EPC Contractor will be responsible for ensuring that any waste clearance at the site is appropriately managed and disposed of at approved facilities. A geotechnical investigation had been undertaken in June 2016, which allowed investigation of the site conditions through 13 boreholes, each drilled to a depth of 30m. No groundwater was encountered in any boreholes.

Impacts associated with soil and groundwater have been assessed as of minor to moderate negative significance and mitigation suggested within the EIA is associated with the implementation of appropriate management and control measures. As a large area of land surrounded on two sides by agricultural land and the roadway to the south, it has been recommended in the EIA to ensure that storm water drainage on the site is appropriately considered in order reduce the risk of erosion and flooding on and immediately adjacent to the site. Consideration of the discharge points of storm water will also be necessary within the design to ensure that neighbouring land users are not negatively impacted upon.

1.2.6 LANDSCAPE AND VISUAL

A lack of vegetation and the cleared nature of the Project site means that the landscape is considered to be of relatively low value and so more able to accommodate the development.

There are numerous undeveloped plots surrounding the Project's site and the barren landscape is composed mostly of sand and poor quality arable land. During windy periods, the arid environment contributes to a dusty haze which can result.

Based on the indicative zone of theoretical visibility, which considers the design of the project with the topography in the nearby area, nine receptor locations were selected around the site. The sensitivity of the views has been assessed with only View 6 being considered of high sensitivity, with six views having medium sensitivity and two views of low sensitivity.

Based on the indicative zone of theoretical visibility, the 10 viewpoints used for the assessment have been selected as having potential to be impacted by the development. The sensitivity of the view has been assessed based on the criteria described in Section 12.3 and is shown Table 12 9 of the main report.

For all views, the landscape sensitivity is considered low as there are no unique characteristics and it is considered that the area, having already been cleared by Ministry of Finance together with existing NEPCO overhead transmission lines, is well placed to accommodate the proposed solar development without significant character change.

1.2.7 SOCIO-ECONOMIC

Consultations with local communities and stakeholders have been undertaken in December 2015, February 2017 and March 2017. The outcomes and feedback from these sessions have been have been identified and incorporated within the assessment approach, with detailed feedback and attendees provided in the appendices of the EIA. General feedback appeared to be positive on the Project's development with the local communities recognising the advantages of solar PV in comparison to thermal power plants, although it was highlighted during discussions that the local communities are keen on ensuring that employees during the construction and operational periods are primarily sourced from local communities. Negative feedback was received on the potential impacts on reduced land values of neighbouring land, particularly with respect to the overhead transmission lines associated with the Project, although conversely residents in other areas also indicated they believed land values may increase with the Project's development.

The Project does not involve the resettlement of indigenous peoples or the transfer/purchase of private land.

During the construction period, there is the potential that the Project will enhance business prosperity in Al Manakher Village and surrounding communities, through increased employment opportunities and potential for local contracts. The EPC Contractor and subcontractors will be encouraged to utilise local residents (Manakher and Sahab district) where skills allow in preference to workers from areas outside the area. Similarly, the contractors will also be encouraged to utilise local contractors/suppliers with a priority given to local providers. The EPC Contractor and subcontractors will be expected to report to the Project Company (AES) and the supporting finance institutions the number of local residents employed during the construction phase and local suppliers used. Where feasible, apprenticeship schemes and training will also be actively encouraged by the EPC Contractor to focus on local residents in order to improve future job prospects and the local skills.

During operation, while there are expected to be fewer employment opportunities, there will still be a requirement for both low skilled (PV cleaning) and technical staff, with a preference for th use of local residents where possible.

All contractors at the site will be expected to adhere to Jordanian and international labour law and requirements, including clear and transparent contracts are in place, salary payments are timely and staff are provided a mechanism to make complaints without fear of reprisal. The Project Company will monitor the compliance of subcontractors with

It is considered that the provision of additional electricity generation and supply of power to the country as a whole, without associated emissions, is an overall positive impact on the socio-economic conditions of Jordan.

AES have an established community investment strategy with IPP1 and IPP4 which has invested in local schools and communities in a number of areas, both with physical assets (e.g. solar heaters) in addition to providing education sponsorship for promising students. It is anticipated that the solar project will similarly be involved in the ongoing community initiatives rather than separate initiatives just for the solar project- with the exception of potential solar maintenance training-type schemes if these are practicable to implement.

A complementary stakeholder engagement plan and grievance mechanism have been developed, with consideration of existing communication pathways implemented on IPP1/IPP4 and it is expected that ongoing dialogue with stakeholders will be an important component of ensuring that community-related issues are identified at the site and maximising the positive benefits realised from the Project'

1.2.8 CULTURAL, HERITAGE AND ARCHAEOLOGY

The cultural heritage and archaeological value of findings on and near the Project site were assessed through a combination of a site walkover, which included Jordanian experts in antiquities, and desktop research. Reference was made to information available through the Middle Eastern Geodatabase for Antiquities (MEGA) maintained by the Department of Antiquities, being the local governing authority in Jordan. Although several sites of interest were identified within the wider area, no finds or findings of significance were identified immediately within the site boundaries. The archaeological representative from RSS indicated that there were no signs on site, which would lead to sites or items being located during the construction of the Project. The site is severely disturbed due to the clearing works undertaken by the Ministry of Finance prior to the initiation of the Project in 2010.

As an outcome of the assessment, it has been recommended to implement an archaeological watching brief as part of the CEMP. The CEMP will also include contact details in case of chance finds and provide guidance to contractors on any requirements for training of their staff.

1.2.9 CONCLUSION

The proposed solar Project is to be developed within an area already cleared by the Ministry of Finance in 2010. As a relatively isolated area with minimal sensitive receptors in the area including local residents or habitats, the potential negative impacts of the Projects are considered relatively few and can be largely mitigated. As one of several plants in the Manakher area owned by the same Company, AES, it is recognised that issues raised for one plant may also be relevant to other plants, particularly with respect to ensuring positive benefits are maximised. The Project Company has recognised this synergy and will seek to incorporate the solar project within their existing community initiative scheme.

An initial construction environmental management plan has been developed for implementation at the site (and will be developed further by the EPC Contractor), which provides the key mitigation strategies to be followed on site. Following the implementation of the mitigation measures identified – the effectiveness and success of which will be regularly monitored by the EPC Contractor and Project Company during the construction phase- it is anticipated that the potential negative impacts of the project- such as noise or dust- can be minimised and positive impacts- such as increased employment- can be maximised.

2 INTRODUCTION

2.1 PROJECT BACKGROUND

This Environmental Impact Assessment (EIA) report has been prepared by WSP | Parsons Brinkerhoff for AES Jordan (AES), in co-ordination with Royal Scientific Society (RSS) of Jordan, a locally registered environmental consultant.

AES, in a consortium with Mitsui and Company Ltd ('Mitsui'), is seeking permission to construct and operate a solar photovoltaic (PV) farm (herein referred to as the Project) of up to 50MW at a site approximately 2-3km from the existing IPP4 Al Manakher tri-fuel power plant in Jordan.

An initial Scoping report and Terms of Reference (ToR) Report was developed by WSP | Parsons Brinckerhoff in 2015 although they were not admissible for submission to the Ministry of Environment (MoE) until the Project had cabinet approval, which occurred in December 2016. The Scoping and ToR were subsequently resubmitted in December 2016 for MoE review and comment (Appendix A and Appendix B). The Scoping and ToR were approved by the MoE in January 2017, the approval has been included in Appendix C.

2.2 THE PROJECT PROPONENT

The Project proponent is AES in consortium with Mitsui and Company Ltd.

AES Netherlands Holding BV

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Designation: Project Manager

2.3 PROJECT OVERVIEW

The Government of Jordan is promoting the generation of renewable energy by adopting a renewable energy strategy. The strategy has set a 10% renewable energy target by 2020. The Renewable Energy and Energy Efficiency Law permits the Ministry of Energy and Mineral Resources (MEMR) to request proposals for the development of renewable energy projects.

The power produced by the Project will be purchased under a power purchase agreement (PPA) with NEPCO. The duration of the PPA is anticipated to be over approximately 20years with the land lease agreement also being agreed for 20 years. The Project Company which AES are involved with is AM Solar BV Jordan PSC, with the Project Proponent being Mr. Mohammad Meftaur Rachman (CEO). NEPCO will also be responsible for the construction of the transmission line between the proposed Al Manakher site and the substation at IPP4 (approximately 2km west of the Project site and adjacent to the existing roadway).

2.4 PURPOSE OF THE EIA

As noted within Section 2.1, a Scoping Report was submitted and provided an overview of the Project and identified the key environmental issues that will need to be assessed in accordance with MoE requirements and anticipated international lender requirements. An accompanying Terms of Reference (ToR) was developed in parallel with the Scoping Report, in accordance with the MoE submission requirements, detailing the proposed methodologies which would be undertaken to assess the baseline and potential impacts of the Project.

In order to obtain environmental authorisation for the proposed Project from the regulatory authority in Jordan (Ministry of Environment), AES is required to complete an EIA and develop an appropriate Environmental and Social Management Plan (ESMP) in accordance with Jordanian standards. The EIA also requires approval by the financial institutions and appropriate consideration of the Equator Principles and International Finance Corporation (IFC) Performance Standards (PS) in addition to specific lender-bank guidelines is also necessary.

An EIA is required for the Project in order to ensure that environmental and social issues are appropriately considered within the Project design and management. Furthermore, an EIA is necessary with respect to Jordanian national legislative requirements in order to secure an environmental approval.

It is noted that, typically, international lenders denote these studies as Environmental Social Impact Assessments (ESIAs) for Projects, stressing that social aspects should also be appropriately considered in addition to environmental factors. While this report uses the terminology ‘EIA’ throughout in order to be consistent with Jordanian MoE terminology. However, the assessment has considered the requirements of the financers who are involved in the Project and therefore can be considered an ‘ESIA’ with respect to the lenders.

2.5 EIA PROJECT TEAM

WSP | Parsons Brinckerhoff has been appointed by AES to conduct the EIA and develop an appropriate associated Environmental and Social Management Plan (ESMP) for the Project in accordance with Jordanian EIA requirements and international lender banks.

WSP | Parsons Brinkerhoff has extensive experience working on power and energy projects in the Middle East including the preparation of EIAs in Jordan for the Fujeij Wind Farm and IPP4, the latter of which is only several kilometres from the proposed Project. WSP | Parsons Brinckerhoff has contracted the Royal Scientific Society (RSS), a registered environmental consultant with the Ministry of Environment (MoE), as the local partner for the EIA. The key members of the team involved in producing the EIA are summarised in Table 2-1.

The EIA team comprised of technical specialists from WSP | Parsons Brinkerhoff and RSS in the following disciplines:

Table 2-1 EIA Production Team

Team Member	Position and Technical Specialism
Mark Silverton – WSP | Parsons Brinckerhoff	Project Director - EIA
Daniel Williams – WSP | Parsons Brinckerhoff	Project Manager - EIA
Janos Tsakiris – WSP | Parsons Brinckerhoff	Acoustics
Richard Hunter – WSP | Parsons Brinckerhoff	Landscape and Visual Impact

TEAM MEMBER	POSITION AND TECHNICAL SPECIALISM
Rachael Ford – WSP | Parsons Brinckerhoff	Terrestrial Ecology and EIA Support
Nefertari Egara – WSP | Parsons Brinckerhoff	EIA Support
RSS	Baseline surveys undertaken for: ▪ General site walkover; ▪ Landscape and visual; ▪ Terrestrial Ecology; ▪ Cultural Heritage and Archaeology; and ▪ Soil, Hydrology and Water Quality.

2.6 EIA REPORT STRUCTURE

This EIA includes the findings of the environmental and social assessments undertaken for the proposed Project. This EIA report is required to meet specific national and international best practice guidelines including the following:

- Jordanian EIA Regulation No.37 of 2005, specifically Annexes 1-5; and
- IFC Performance Standards (2012) and Equator Principles (2013) or 'EPIII'.

In line with these requirements, this EIA specifically addresses the issues as identified in the approved Terms of Reference (ToR) and Scoping reports. This EIA comprises the following structure:

- Executive Summary;
- Introduction;
- Overview of the Project;
- Relevant Legislation and Standards;
- Approach to the EIA;
- Description of the Baseline Environment;
- Technical Assessments and Mitigation with each aspect considering:
  - Assessment of Construction Impacts;
  - Assessment of Operational Impacts; and
  - Residual Impacts.
- Framework Construction Environmental Management Plan;
  - Construction Mitigation Measures;
- Framework Operation Environmental Management Plan;
  - Operation Mitigation Measures;
- Conclusions and Recommendations; and
- Technical Appendices.

The relevant IFC Performance Standards, which are considered to apply, include:

- *Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;*
- *Performance Standard 2: Labour and Working Conditions;*
- *Performance Standard 3: Resource Efficiency and Pollution Prevention;*
- *Performance Standard 4: Community Health, Safety and Security;*
- *Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources; and*
- *Performance Standard 8: Cultural Heritage.*

Based on the scope, nature and location of this Project the other IFC performance standards were reviewed and were not deemed applicable for this Project.

3 PROJECT DESCRIPTION

3.1 PROJECT LOCATION AND SITE LAYOUT

The Project consists of the construction and operation of a solar PV farm with a power generation capacity of 51.9 MW DC (total of installed PV panels) and 40 MW AC delivered to the NEPCO grid. It is anticipated that as per the design, 497,000 PV panels will be installed as part of the Project.

The Project site is located within the Sahab District in the Amman Governorate, approximately 2.5km northeast of the Levant Power Plant (IPP4) built and operated by AES. The overall site plot is 498,000m^2 in size of government-owned land (refer to Figure 3-1). The land will be leased to the Project Company by the Ministry of Finance (Department of Land and Survey) under a 20 year tenor i.e. the duration of the power purchase agreement. The nearest residential developments are in Al Manakher village, approximately 3km to the south west of the Project boundary, although two other communities are present (following discussions with AES community liaison personnel at IPP4) within approximately 10km who may also have interests in the Project, particularly with respect to recognition of positive impacts such as employment. As confirmed during a site walkover undertaken by a WSP | Parsons Brinckerhoff environmental consultant on the 16th and 17th January, isolated farm dwellings are also located within several hundred metres of the Project site, with the nearest a sheep farm almost directly opposite the anticipated main site entrance point.

It is understood that the general area is understood to have been designated by the government as a future area for industrial development, with three thermal power plants having been constructed over the past 10 years within a 7km radius. With the exception of the power plants there is no heavy industry in the immediate vicinity of the Project site. The site is clear of structures and has been subject to recent earthworks by the Ministry of Finance. There is very sparse indigenous vegetation on-site and no designated sites or sensitive habitats or species have been identified within the local area as a result of consultations or surveys. The closest designated or sensitive habitat within publicly available databases is considered to be As-Samra Wastewater Treatment Plant, which is located 30km to the north of the Project and unlikely to be impacted upon.

To the south and east of the Project site, there are a limited number of agricultural dwellings belonging to Bedouin families. These groups reportedly use the land primarily for grazing livestock. Approximately 3km to the northeast of the site are lands used for arable crops, such as grasses and date palms, these are reportedly owned by members of the local communities.

Figure 2.2 illustrates the general layout of the proposed Project in relation to the existing power plant facilities within the general area, including IPP1, 3 and 4. The site was selected based on a number of criteria including:

- Solar resource;
- Available area;
- Topography;
- Land use;
- Local regulations, land use policy or zoning;
- Geotechnical conditions;
- Accessibility;

- Proximity to national grid; and
- Module soiling.

Figure 3-1 Site Location and OHTL Interconnection and Cable Routing

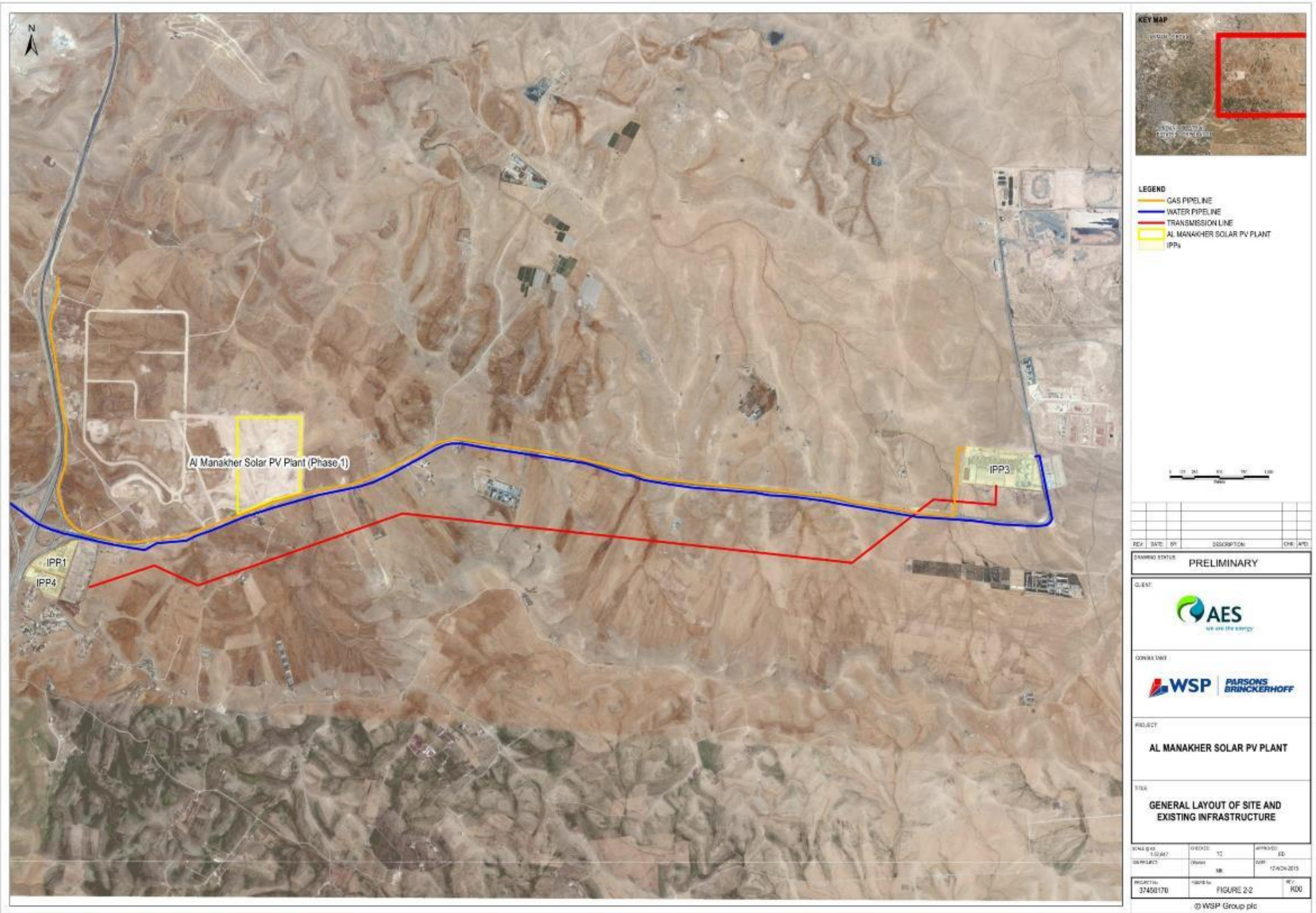


Figure 3-2 General Layout of Site and Existing Infrastructure

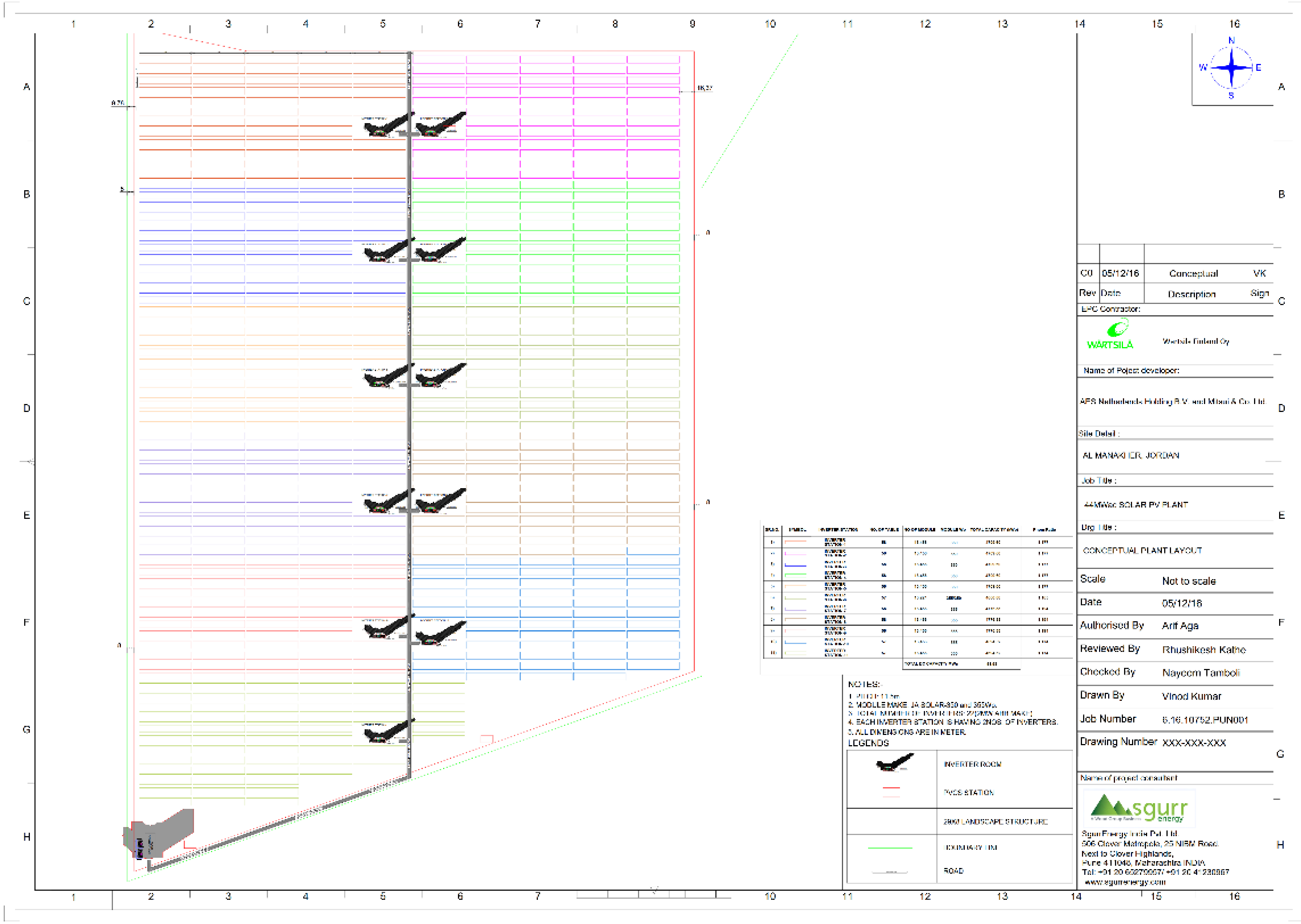


Figure 3-3 Conceptual Plant Layout

3.2 SITE DESCRIPTION AND SURROUNDING LAND USE

A layout plan of the Project site is shown on Figure 3-1. The existing features within and surrounding the Project site are highlighted in this section and are shown on Figure 3-4 with the identified sensitive receptors shown on Figure 3-5. Communities which have been consulted regarding the Project are shown on Figure 3-6.

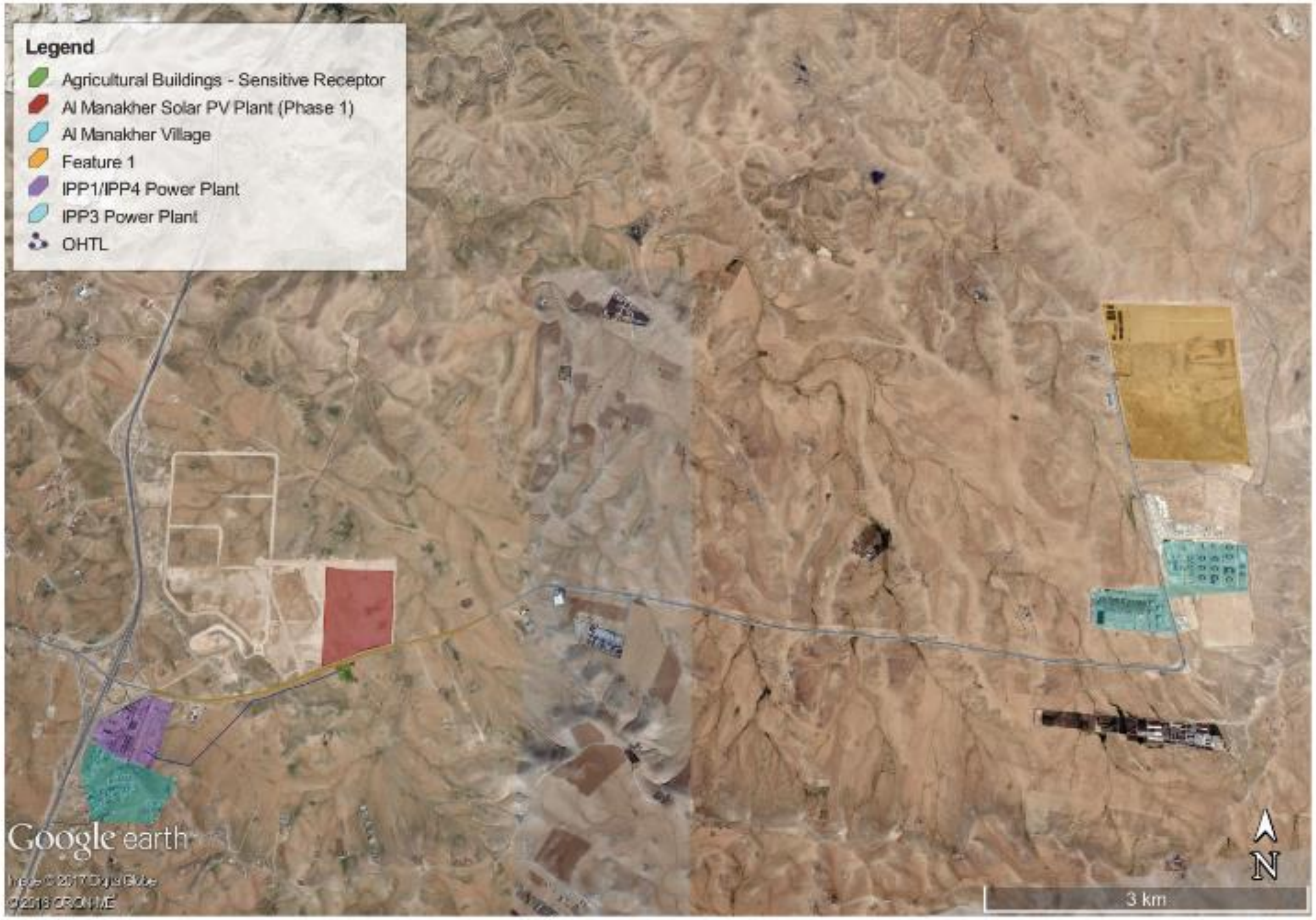


Figure 3-4 Existing Conditions Observed Onsite

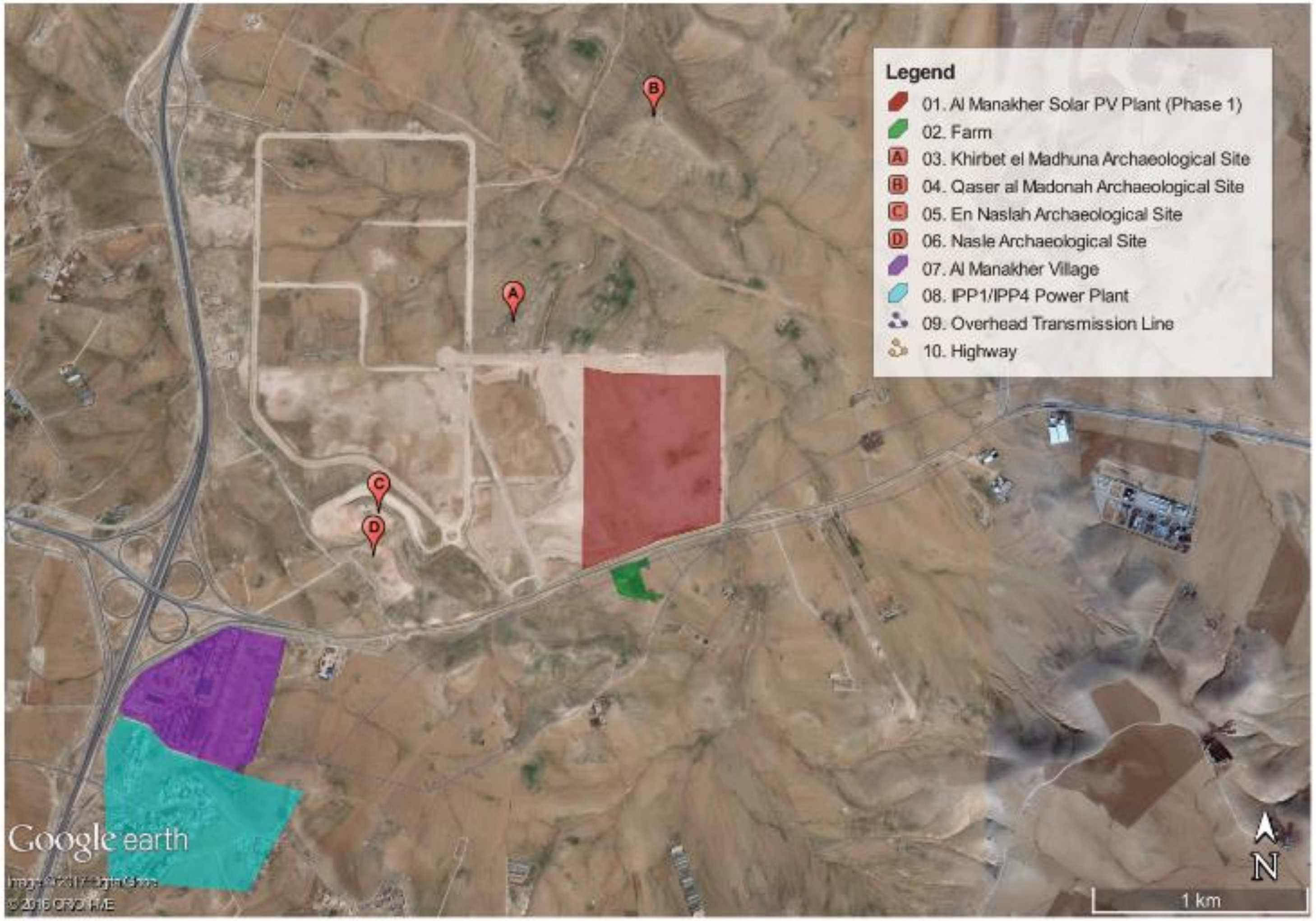


Figure 3-5 Identified Sensitive Receptors

Figure 3-6 Nearest villages to the Project site

A site visit was undertaken by WSP | Parsons Brinckerhoff environmental consultants on 16-17 January 2017 in order to assess the existing conditions of the site.

The Project site is within a relatively undeveloped, rural area of the Sahab District in Greater Amman Governorate, approximately 2.5km northeast of the Levant Power Plant (IPP4) which was developed and is currently operated by AES adjacent to the AES-owned IPP1 power plant. The Project site is government-owned and has a proposed footprint of 498,000m^2. During the site visit it was observed that the Project site has been cleared and re-profiled, with the Project site approximately 2-3m above the adjacent arable lands to the east of the site.

The closest residential properties are in Al Manakher village, located approximately 2-3km to the south-west of the Project boundary. To the south and east of the Project site, isolated dwellings are present which are understood to be used primarily for keeping small numbers of livestock (sheep) (Figure 3-7).

An existing paved municipal road, which connects Zarqa to Sahab, is located along the southern Project boundary, this road has an existing overhead transmission line (OHTL) running in parallel (Figure 3-8).

With the exception of the existing IPP1, 3 and 4 power plants (Figure 3-9), there are no other significant industrial facilities in the immediate vicinity of the Project site. The Project site is clear of structures and has been subject to recent earthworks by the Ministry of Finance (MoF), Department of Land. Figure 3-10 to Figure 3-12 provide an overview of the existing conditions observed onsite.

Figure 3-7 Agricultural buildings located to the south of the site

Figure 3-8 Zarqa to Sahab road along the southern Project boundary

Figure 3-9 IPP3 Power Plant, located approximately 7km east from the Project site

Figure 3-10 Overview of site conditions

Figure 3-11 Grading of the site

Figure 3-12 Minimal vegetation observed on site

No schools are located within or surrounding the Project site, the closest educational facilities comprising the school within the Al Manakher Village approximately 3km from the site.

The Project site is not considered to be near protected natural reserves; the closest reserves are Azraq Wetland Reserve and As-Samra Wastewater Treatment Plant and are located 30km and 70km away respectively. While no sites of significant cultural heritage and/or archaeological value have been determined within the Project site boundary, four sites of archaeological importance, as designated by the Department of Antiquities (DoA), have been identified as being located to the north-west, west and north of the Project site, with the closest identified site being within 340m. None of the identified archaeological designated sites have been developed for tourism, the findings are largely comprised of archaeological fragments.

No sources of hazardous contamination, such as petrol stations or visible signs of contamination, were observed within or surrounding the Project site. Access was available to all areas of the Project site. In a number of areas around the Project site there appeared to be waste piles of construction aggregate or waste associated with sheep farms such as fleeces. While detailed analysis of the infrequent waste piles has not been undertaken such waste is considered likely to be inert and non-hazardous. Notwithstanding this, the wastes should still be removed and disposed of appropriately- whether such disposal comes under the responsibility of the land owner (the Government of Jordan) with respect to providing a ‘clean’ site or the Project Company is unclear at present.

Since the initial site visit, a second site visit was undertaken on 13 March 2017 by WSP | Parsons Brinckerhoff staff. This site visit was initiated by OPIC and NEXI in order for them to undertake a site walkover as part of their investment decision-making.

From the site visit, no additional observations were made relating to sensitive receptors or potential environmental aspects, which be a course of concern in relation to the Project. It was noted that seasonal rains had led to the growth of increased ground vegetation in the land surrounding the Project site. No additional vegetation was noted within the Project site. Figure 3-13 to Figure 3-16 show the conditions observed within and surrounding the Project site during the second site visit.

Figure 3-13 Site conditions with the Project site

Figure 3-14 Site conditions with the Project site

Figure 3-15 Seasonal vegetation growth outside the Project boundary

Figure 3-16 Seasonal vegetation growth outside the Project boundary

3.3 DESCRIPTION OF THE PLANT

The proposed PV solar plant is designed to have a capacity of up to 51.9 MW DC (total of installed PV panels) and 40 MW AC delivered to the NEPCO grid. The final capacity of the solar PV plant will be confirmed during the detailed design stage although all sizes of the plant will be contained within the defined Project site boundaries. The PV modules will be located throughout the Project site and will be arranged to maximise solar gain. Approximately 22 inverters will be utilised at the site in order to convert the electricity from direct current (DC) to alternating current (AC).

The entire Project site will be fenced and internal access roads will be constructed to allow access during operation for washing and maintenance of modules. In addition, there is no onsite storage of electricity proposed at the Project site; all electricity generated will be transmitted to the substation adjacent to the IPP4 power plant site for use and/or distribution to the electricity network.

3.4 PROJECT COMPONENTS

3.4.1 PHOTOVOLTAIC TECHNOLOGY AND GENERATION OF ELECTRICITY

Solar energy facilities use photovoltaic (PV) technology to convert solar energy to a useful form such as electricity or heat. This technology produces significantly smaller quantities of greenhouse gases over its lifecycle compared to conventional fossil fuel-fired power stations. The operational phase of the solar facility does not produce other pollutants commonly associated with fossil fuel combustion such as carbon dioxide (CO_2), sulphur dioxide (SO_2), nitrogen oxides (NO_x) or particulate matter (PM).

3.4.2 COMPONENTS OF THE PV MODULES

Solar or PV cells are devices comprised of semiconductor materials that convert sunlight directly into electricity. When solar cells absorb sunlight, free electrons are created at positive and negative junctions. If the positive and negative junctions of the solar cell are connected to DC electrical equipment, current is generated for use. It has been provisionally indicated by the Project Company that the PV panels will be monocrystalline modules, sourced from a yet to be confirmed 'Tier 1' supplier (e.g. considered as 'preferred supplier' by international lenders due to quality of panels produced, financial stability and other 'bankability' criteria. The panels will be on a fixed mounting with no trackers, minimising the moving parts to be utilised within the design.

3.4.3 PLANT DESIGN CRITERIA

The design of the proposed Solar PV Plant will be in accordance with internationally recognised engineering standards and practices in order to ensure efficient, high reliability, maintainability and availability of the complete plant. It is anticipated that as per the design, 497,000 PV panels will be installed as part of the Project.

The mounting system has not yet been finalised for the Project, although it has been confirmed that the panels will have a single axis and will not track the sun (e.g. non-moveable panels).

The principal technical characteristics of the plant, based on the design details, are summarised in Table 3-1.

Table 3-1 Plant Design Technical Specifications

COMPONENT	MONO-CRYSTALLINE - SPECIFICATION
Inverter technology	Central Inverter
Installed DC peak capacity (MWp)	51.9
Installed AC capacity (MW)	44.00
Contracted capacity (MW)	40.00
Mounting Structure Type	Fixed

Component	Mono-crystalline - Specification
PV module technology	Mono-crystalline
Mounting Structure	
Mounting structure details (rows x columns)	4 x 30
Orientation of modules	Landscape
Tilt angle range	20°
Pitch	5.8m
PV Modules	
PV module manufacturer	TBC
Model	TBC
Wattage (Wp)	340Wp / 345Wp / 350Wp
Number of modules per string	30
Inverter	
Inverter manufacturer / model	TBC
Inverter nominal AC output	2000kW
Number of inverters	22

The provisional design for the 51.9 MW DC (total of installed PV panels) and 40 MW AC delivered to the NEPCO grid solar PV plant available at this time considers the use 2000kVA inverters; these would then be joined to an inverter duty step-up transformer forming a typical inverter station. The physical inverter station shall comprise of one number of three winding transformers, with each accommodating 2x2000kVA inverters taking the individual inverter station size to 4MWAC. The power at each inverter station would then be stepped up to 33kV using step up transformers. The 33kV output of the envisaged 11 inverter stations will then be combined within the PV plant premises and stepped up to 132kV using two 50MVA transformers. The point of interconnection and metering will remain within the PV plant premises.

3.4.3.1 SELECTION OF SOLAR CELLS

PV cell technologies are broadly categorised as either crystalline or thin-film. Crystalline silicon (c-Si) cells provide high efficiency modules and are sub-divided into mono-crystalline silicon (mono-c-Si) or multi-crystalline silicon (multi-c-Si). Mono-c-Si cells are generally the most efficient, but are also more costly than multi-c-Si. Thin-film cells provide a cheaper alternative, but are less efficient. The Project will utilise monocrystalline panels.

The performance of a PV module will decrease over time due to a process known as degradation. The degradation rate depends on the environmental conditions and the technology of the module.

The Project is anticipated to use JA Solar 350 watt 72 cell mono crystalline PV panels rated for operation, although these aren't confirmed; however a Tier 1 supplier will be used. The initial design for the Project considers that the panels will be installed in a four high landscape orientation on fixed racks oriented south at an inclination of 20 degrees. The total DC capacity will be 51.9MW DCp with an AC contract capacity of 40MW. A total of 22 ABB inverters each rated 2000kVA will be installed outdoors in pairs at 11 power islands. Power will be collected at 33kV via underground cables and stepped up to 132kV at the Project substation to be located at the southwest corner of the Project

3.5 ASSOCIATED FACILITIES

3.5.1 ELECTRICAL INTERCONNECTION

It is understood that the proposed Project will be connected to the existing substation adjacent to the IPP4 site via four (4) AC power circuits operating at 15kV and up to 15MW (AC) each at the point of connection. The transmission line from the Project's substation to the IPP4 substation will be the responsibility of the National Electric Power Company (NEPCO). It is understood that the provisional design for the overhead transmission line (OHTL) from NEPCO indicates that the line will be routed from the Project site to the IPP4 substation along the shoulders of the east-west paved road (refer to Figure 3-2). The transmission line will then be routed underground within IPP4 site into the existing switchgear facility.

At the time of this EIA, limited information is available from NEPCO on the proposed design for the transmission line. Notwithstanding this situation, it has been indicated by the Project Company during the assessment that the OHTL will conform to all applicable regulations, be installed on concrete or steel poles and will be of double circuit configuration with a ground conductor and fibrotic communications. It is expected that NEPCO will be responsible for any assessment and/or compensation for the proposed transmission line. This will be in line with national requirements, although it is noted that, as an associated facility, the Project Company will be expected to liaise with NEPCO to try to ensure that the assessment (including the design and necessary land ownership compensations) follow the general principles considered within the IFC Performance standards.

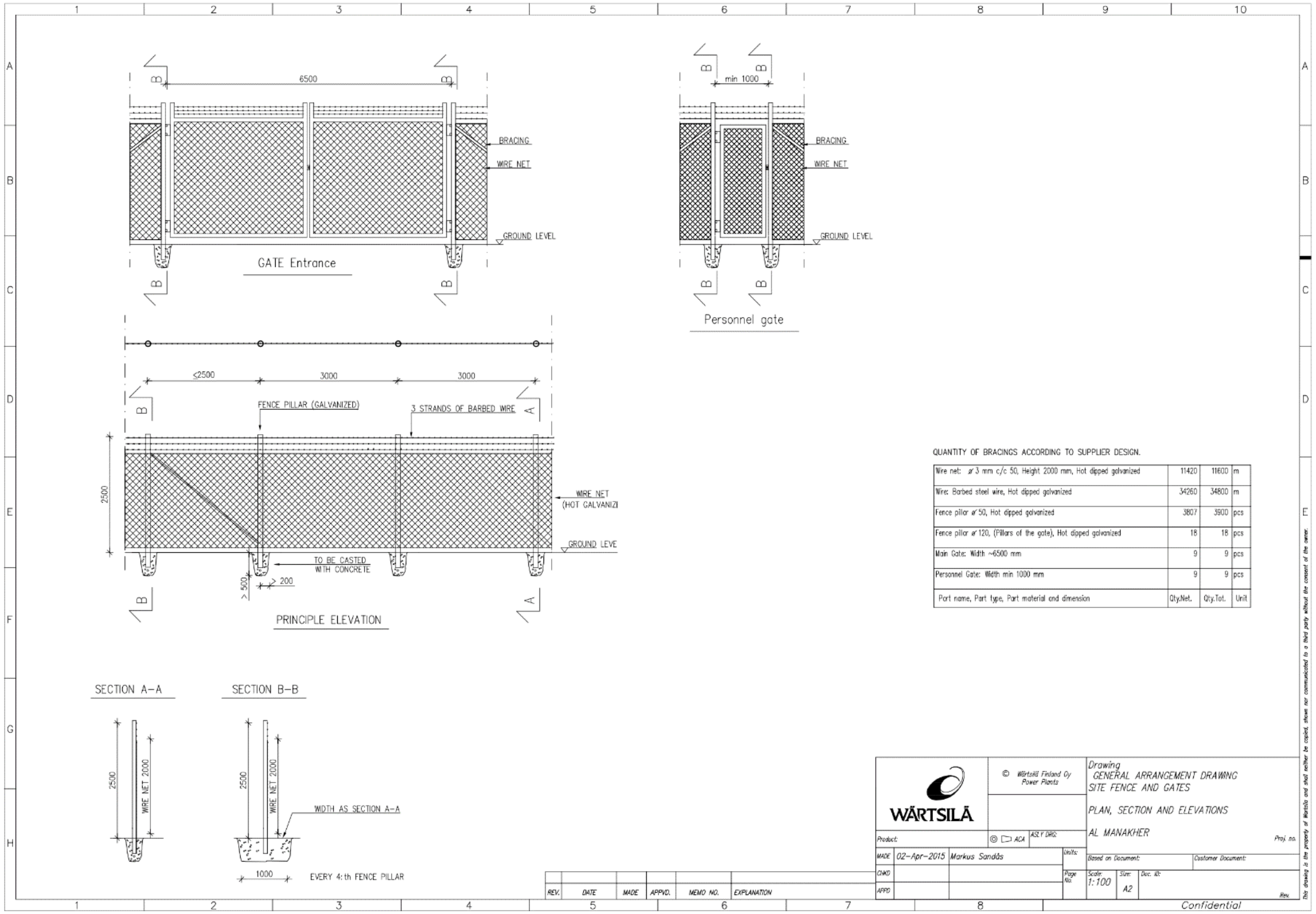
Limited numbers of portable generators are expected to be used during construction but not during operations. It is anticipated that between one and three trailer or skid mounted generators will be used onsite during the construction; these will be used to power the office trailer camp. In addition, up to 12 small portable generators under 5kW will be located around the Project site for power tools and other work. Not all of these would be running at the same time.

3.5.2 SUBSTATION

A small-unmanned building will be installed as part of the Project's substation to house control, protection and communications equipment. The substation will be located within the south west corner of the Project site and have external lighting installed.

3.5.3 FENCING AND SECURITY

The entire Project area will be surrounded by a chain-link fence topped with strands of barbed wire for security. The site fencing will be installed during the first stages of the Project's construction and remain throughout the operational life. The fence will comprise 2.5m high wire mesh as indicated in Figure 3-17. The Project will be controlled and supervised from the existing IPP4 control room approximately 2km from the site, either through fibre optic cable (via NEPCO) or via radio transmitters. AES have indicated that during construction, commissioning and for the first two years of operation the Project site will have 24/7 security guards in place, in addition to the fencing and security cameras. During this period the security of the site shall be monitored with the security arrangements being assessed. Additional security measures would include the installation of motion sensors on the perimeter fence and watch towers with security guards; however it isn't deemed these measures will be necessary.



Wire net: ø 3 mm c/c 50, Height 2000 mm, Hot dipped galvanized	11420	11600	m
Wire: Barbed steel wire, Hot dipped galvanized	34260	34800	m
Fence pillar ø 50, Hot dipped galvanized	3807	3900	pcs
Fence pillar ø 120, (Pillars of the gate), Hot dipped galvanized	18	18	pcs
Main Gate: Width ~6500 mm	9	9	pcs
Personnel Gate: Width min 1000 mm	9	9	pcs
Part name, Part type, Part material and dimension	Qty.Net.	Qty.Tot.	Unit

Figure 3-17 Security Fence Specification

3.6 CLEANING OF THE PANELS

With the Project sited within an arid environment, the panels will be particularly subject to 'soiling', the process by which particles or aerosols within the air deposit on solar panels and reduce the panel efficiencies. As a result, regular cleaning of the panels will be necessary during the operational phase in order to maintain the generating capacity of the power plants within normal limits. A soiling study at the site has been undertaken by the Project Company to determine the anticipated cleaning regime at the site based on the meteorological profile, topography and general substrate in the area. The initially proposed cleaning programme is a preliminary approach that gives the basic principles of the cleaning strategy, and optimisations in the methodology and frequencies are expected to be realised during the Project's operations. As a result of a recognition of the scarcity of water at the selected Project site, dry cleaning methods of module cleaning has been proposed for the Project.

The initially proposed frequency of cleaning based on the soiling study has indicated that modules will need to be cleaned twice every month in dry months. Further to the dry months, cleaning will also be done:

- During periods of heavy soiling to limit soiling losses; and
- During the sunniest periods in order to maximise energy yields.

Dry cleaning technology reduces or eliminates the use of water in the process of PV module cleaning. In order to accomplish the task of cleaning the PV modules efficiently, this method incorporates the use of controlled air flow and microfiber fabric for cleaning of the modules. The air flow removes most of the dust while the brushes help remove the remaining dirt off the panel. Figure 3-18 and Figure 3-19 show typical manual dry cleaning in practice.

Figure 3-18 Manual Dry Cleaning

Figure 3-19 Manual Dry Cleaning

While dry cleaning systems may affect the protective or anti-reflective coating on the PV modules which is applied in order to not reflect the sunlight off the panel (reducing efficiency) improvements in the cleaning microfibers have reduced these impacts. Given the relative infrequent nature of the cleaning (e.g. 2 times per month) the Project Company have indicated that they expect to contract this service to external providers rather than maintaining the staff on a permanent basis.

3.7 KEY SENSITIVE RECEPTORS

As described in previous sections, the proposed Project footprint area has already been cleared and prepared by the Ministry of Finance, and is located within a wider area which has been planned for electricity generation.

The nearest existing anthropogenic receptors, other than personnel employed on the adjacent power plant facilities, include the permanent residents of the farm to the south of the site, residents of Al Manakher village and offices for workers currently employed for IPP1 and 4.

Following a site reconnaissance, desk-based review and scoping exercise, the following key sensitive receptors and potential impacts associated with the construction and operational phases of the proposed Project have been identified (refer to Table 3-2).

Table 3-2 Key Receptors and associated impacts

RECEPTOR	POTENTIAL CONSTRUCTION IMPACTS	POTENTIAL OPERATION IMPACTS
Residents at Al Manakher and other communities	→ Disturbance from construction traffic and staff → Noise and air quality impacts associated with construction activities on the residents of Al Manakher → Increased revenue for local businesses due to retail activities → Increased demand for local services → Potential employment opportunities	→ Social impacts associated with the presence of Plant personnel
Residents of the farm to the south of the Project site,	→ Disturbance from construction traffic and staff → Noise and air quality impacts associated with construction activities on the residents of the farm → Increased revenue for local businesses due to retail activities → Increased demand for local services	→ Social impacts associated with the presence of Plant personnel
Construction workers	→ Health and safety risks → Recruitment and employment opportunities → Worker welfare → Exposure to noise and air pollutant emissions	→ None identified
Al Manakher Plant personnel	N/A	→ Health and safety risks → Worker welfare → Exposure to noise pollutants
Terrestrial habitats and associated flora and fauna	→ Contamination events impacting on the terrestrial ecology → Damage to flora located on the adjacent areas → Dewatering activities (if necessary) may reduce groundwater level outside of the Project footprint area, impacting on the ability of local species to source water from this resource	→ Potential positive impacts associated with landscaping providing suitable terrestrial habitat → Potential bird mortalities for passing migrants if they believe panels are water bodies

RECEPTOR	POTENTIAL CONSTRUCTION IMPACTS	POTENTIAL OPERATION IMPACTS
Soil and groundwater	→ Contamination events impacting on ground and groundwater quality → Storm water events eroding adjacent habitats or arable land	→ Contamination events impacting on ground and groundwater quality → Storm water events eroding adjacent habitats or arable land
Socio-economic	→ Positive socio-economic impacts through employment opportunities for local community members and skills transfer → (Also see impacts to local communities above)	→ Positive socio-economic impacts through employment opportunities for local communities, skills transfer and power supply → (Also see impacts to local communities above)

3.8 CONSTRUCTION AND DECOMMISSIONING

The key construction activities associated with the Project include:

- Minimal grading to finalise the site preparation which has already been undertaken;
- Internal road construction;
- Driving of steel piles 1-2 meters deep for the PV structures;
- Open cut excavation for the installation of underground electrical cables up to 1 meter deep;
- Assembly of racks and installation of panels;
- Installation of electrical equipment and substation, commissioning.

The construction lay down areas, worker welfare facilities and waste storage areas will all be located within the Project site.

3.8.1 WATER CONSUMPTION

Non-potable water will be used for dust control, road and civil construction, and concrete mixing although quantities of water to be used have not been confirmed at present. It is anticipated that this water will be sourced offsite and transported to the Project site via bowsers or tankers. No water will be sourced from onsite or the immediate area given the poor water supply in the area.

No water will be used for operations except potentially for road maintenance. No potable water or wastewater pipelines are expected on site as this will be a largely unmanned site. Ablution facilities will be largely restricted to self-contained units (chemical toilets) with wastewater expected to be removed from site by tanker to appropriate facilities.

Although the exact location, source and quantities of water to be used during the construction and operation phases of the Project, it is anticipated the water will be sourced through either from the AES IPP1 facility waste, local wells the Water Authority of Jordan, which is a government entity.

3.8.2 WASTE GENERATION AND DISPOSAL

SOLID WASTE

The levels of solid waste anticipated to be produced during the construction and decommissioning phase of the Project has not been provided at the time of writing the report. Section 9 assesses the anticipated impact associated with waste management as a result of the Project. Key concepts which will need to be taken into account by the contractors include no waste being disposed onsite; all waste is to be removed from site and taken to a licensed waste facility and appropriate disposal of existing waste within the site. The closest landfill to the Project has been identified as the Gabawi landfill, positioned approximately 7km east from the Project (near IPP3) and extending over an area estimated to be 50 acres. It is understood that the Gabawi landfill only accepts non-hazardous waste and broken solar panels would not be permitted to be disposed of at this facility as they are currently considered as ‘hazardous’ within Jordan. To date, no facility has been approved to recycle or reuse panels within Jordan.

Excavated material and packaging waste have the potential to be the largest sources of waste during the construction phase. However, based on the provisional information provided Wärtsilä, it is anticipated that excavated material (e.g. for panel support or boundary fence) would be incorporated within the limited re-profiling of the site (beyond what has already been undertaken by Ministry of Finance). In addition, the following waste is expected to be produced on site:

- Concrete waste;
- Reusable and recyclable construction waste (e.g. plastics and woods); and
- Hazardous wastes (e.g. paint and solvents containers).

It is expected that wastes on site will be managed through a waste management plan within a CEMP (see Appendix D).

LIQUID WASTE

Although workers are not being housed onsite, Wärtsilä will be expected to provide welfare facilities for members of staff working on the Project. The main source of liquid waste during the construction period will be the wastewater from the toilet facilities for workers. Other forms of liquid waste may come in the form of used oils and chemicals used during construction. The impacts relating to liquid waste generated during the construction phase of the Project are discussed in further detail in Section 9.

3.9 OPERATION

3.9.1 WATER CONSUMPTION

As noted within Section 3.6 a dry cleaning method will be used on site in order to minimise water use. Water may be required for road maintenance but this would be on an ad-hoc basis and is expected to be tankered onto the site should it be necessary.

3.9.2 WASTE GENERATION AND DISPOSAL

SOLID AND LIQUID WASTE

Virtually no solid or liquid waste is anticipated to be generated during the operation phase of the Project (with only minimal domestic-type waste from security personnel expected). Disposal of any kind of liquid wastes will not be allowed on the Power Project site. All wastes will be removed by a Licensed Contractor and disposed of in an appropriate manner.

3.10 TRANSPORT AND ACCESS

The main items required for the construction of the Project are expected to be delivered through the port of Aqaba approximately 300km to the south of the Project site. The specific route has not yet been confirmed although the EPC Contractor (Wärtsilä) having recently worked on the adjacent IPP4 power plant has indicated that the route is adequate for the transportation of heavy loads. The Project site access will be via the paved municipal road adjacent to the southern edge of the site. The details for the site entrance are understood to currently be in the process of being coordinated with the municipal authorities and have not yet been finalised at the time of writing this Report.

3.11 WORKERS AND WELFARE FACILITIES

Workers will be sourced locally from local subcontractors, with the majority of workers comprising Jordanian nationals employed through local subcontractors. In line with the approach taken for the IPP4 power plant, Wärtsilä and subcontractors will be expected to hire employees from local communities should they have the appropriate skills, experience, or identify roles where a level of training may be possible to provide in order to increase the local skill set. Wärtsilä will provide supervisors and managers from countries including Finland, India and Jordan. Where necessary, it is understood that labour camps will be made by local subcontractors for unskilled labour and it is expected that, should such camps be necessary, adherence to relevant Jordan standards in addition to the IFC and EBRD's '*Workers Accommodation: processes and standards guideline'* (2009). Otherwise, it is anticipated the majority of contractors' personnel will live in their own accommodation within Amman and be bussed to and from central locations to the site on a daily basis.

Preliminary estimates by Wärtsilä have indicated that the likely peak workforce will be approximately 465 personnel.

3.12 PROJECT SCHEDULE

It is understood that negotiations with NEPCO are still occurring with respect to when the transmission line from the site substation to the IPP4 substation would be available. As a result a detailed construction schedule is not available at this stage. However, given the size of the plant and land which has already been cleared, it is expected that the Project's construction would be completed within one (1) year. No night work is planned at this time and would only be undertaken if the Project construction schedule has fallen behind. Construction work is expected to start in third quarter of 2018, the timeframe for construction is anticipated to last for 10 months. Based on this the commissioning phase for the Project is expected to start June 1, 2019 and take 4 to 6 weeks to complete.

4 LEGAL FRAMEWORK AND ENVIRONMENTAL AND SOCIAL STANDARDS

4.1 INTRODUCTION

Development projects in Jordan are subject to various national environmental legislation, regulations as well as international regulations and treaties. The Jordanian regulations for environmental protection, pollution control and management are primarily specified in the Environmental Protection Law No. 52 of 2006.

The enactment of Environmental Protection Law No. 52 of 2006 established the MoE as the competent government agency mandated with the responsibility for protection and preservation of the Jordanian environment in addition to environmental affairs at the national, regional and international level. Furthermore, the MoE is responsible for the implementation of environmental laws, regulations and standards.

Article 13 of the Environmental Protection Law No. 52 of 2006 is the main regulation related to the protection and preservation of the environment within Jordan.

Law No. 52 empowers the Ministry of Environment (MoE) to ask any new establishment that may have potential impacts on the environment to prepare an EIA, also known internationally as an ESIA.

As noted previously, the term EIA has been used in preference within this report in order to conform to the terminology typically used within Jordan. However, with respect to the contents of EIAs and ESIAs these are considered comparable, with the term ‘ESIA’ simply highlighting that social aspects are considered a key consideration within the assessment process (and is the acronym often used within lender bank requirements for projects). The MoE has issued the EIA by-law (No. 37, 2005) which includes the procedures for conducting an EIA in Jordan. The law gives the MoE responsibility to review and approve the ToR and EIA study reports. As indicated within Section 2.1, the MoE approval for the Scoping and ToR reports were received in January 2017.

4.2 NATIONAL POLICIES

4.2.1 EIA REQUIREMENT

Projects are initially passed to the EIA Directorate and submitted to a central licensing committee that consists of representatives of the relevant governmental authorities such as the MoE, Ministry of Health (MoH), Ministry of Water (MoW) and Ministry of Agriculture (MoA). An approval from the committee is required for licensing, the approval of which may have conditions attached, prior to the relevant authorities granting permission.

The Project proponent is required to comply with article (3) of the Environmental Protection Law (No. 52, 2006) and with the Jordanian Environmental Impact Assessment (EIA) Regulations (No.37, 2005). The regulation states that all industrial projects should conduct an EIA study and the level and type of the EIA study will be decided by the MoE. A scoping session is required to prepare the ToR. This Regulation also states that the EIA review period for the MoE is 45 calendar days.

The findings of the EIA study should be presented in an EIA Report for submission to the MoE (and, with respect to the proposed Project, also the relevant financial institutions). The EIA Report should consider alternatives to the Project including site location and layout, potential impacts and recommended mitigation measures for the Project.

4.2.2 RELEVANT ENVIRONMENTAL LEGISLATION

Table 4-1 summarises the relevant Jordanian laws and regulations for environmental and social matters that are applicable to the Project.

Table 4-1 Jordanian Laws and Regulations

CATEGORY	LAW AND REGULATION
General	■ Exemption of Renewable Sources of Energy Systems and Apparatus and Energy Efficiency Bylaw (No. 10, 2013) (tax exemptions) ■ Renewable Energy and Energy Efficiency Law (No. 13, 2012) ■ Environmental Protection Law (No. 52, 2006) ■ Environmental Impact Assessment By-Law (No. 37, 2005) ■ General Electricity Law (No. 64, 2002) ■ Regulation of the Organisation and Administration of the Ministry of Energy and Mineral Resources (No. 26.1985)
Terrestrial Ecology and Ornithology	■ Nature Protection Regulations (No. 52, 2006) ■ Natural Reserves and Parks Bylaw (No. 29, 2005) ■ Jordanian Agricultural Law (No. 44, 2002)
Geology, Soils and Groundwater	■ Water Resource Protection By-Law (No. 85, 2011) ■ Drinking Water Resources Protection Guidelines (2006) ■ Soil Protection Regulations (No. 25, 2005) ■ Underground Water Monitoring By-Law (No. 85, 2002) ■ Water Authority Law (No. 18, 1988)
Noise and Vibration	■ Guidelines for Prevention of Noise (2003)
Air Quality	■ Ambient Air Quality (No. 1140, 2006) ■ Air Protection By-law (No. 28, 2005)
Waste	■ Management of Solid Waste Regulations (No. 27, 2005) ■ Management, Transport and Handling of Harmful and Hazardous Substances Regulations (No. 24, 2005)

Category	Law and Regulation
	■ Instructions for Hazardous Waste Management and Handling (2003) ■ Instructions for Management and Handling of Consumed Oil (2003)
Cultural Heritage and Archaeology	■ Archaeology Law (No. 21, 1988)
Transportation	■ Traffic Law (No. 49, 2008) ■ Management, Transport and Handling of Harmful and Hazardous Substances Regulations (No. 24, 2005)
Socio-economics	■ Labour Law (No. 14, 2004)
Health and Safety	■ Public Health Law (No. 47, 2008) ■ Civil Defence Law (No. 18, 1999)

4.3 LAWS AND STANDARDS RELATED TO LABOUR AND WORKING CONDITIONS

4.3.1 LABOUR LAW NO.14 OF 2004

The legal framework with respect to labour issues is mainly comprised of the Jordanian Labour Law of the year 1996 and its amendments. This Code repeals the Labour Code of 1960, and all amendments made thereto and governs labour affairs in Jordan.

The provisions of the law apply to all employees and employers as defined by Article 2 of the Law. Based on ratified Conventions, amendments to the labour law were adopted on 28 August 2002. These amendments concern:

- The extension of the coverage of the labour law to some categories of workers in the agriculture sector;
- Establishment of private employment offices organizing the recruitment of foreign domestic workers and control of these offices by labour inspectors. This will extend the control by the Ministry of Labour of the recruitment and working conditions of these workers;
- The protection of workers from dismissal due to economic and technical factors by adoption of detailed regulation;
- The regulation of working hours; and
- The inter-relation between employers and workers' organisations.

The following Acts are also applicable:

- Regulation No. 23 of 1966, as amended, issuing rules governing the public service defines individual labour relations, paid leave, compensation, temporary assignment and termination of service;

- Order of Minister of Labour to establish committees to study the cases of termination or suspension of contracts of employment on the basis of the provisions of section 31 of the Labour Code. This Order establishes committees in each governorate where there is a Directorate for work and employment, in order to study the cases of termination of contracts of employment for undetermined periods or cases of suspending such contracts for economic or technical reasons as provided for in section 31 of the Labour Code;
- Act No. 36 of 1997 concerning work permit fees for non-Jordanian workers, issued under Article 12 of the Labour Code of 1996. This Act provides for the fees to be paid by the employer for the delivery of work permits;
- Act No. 56 of 1996 concerning labour inspection, promulgated under Article 7 of the Labour Code;
- Industrial accidents and occupational diseases instructions of 1993. Instructions issued by the social security authority which prescribe the procedures to be observed in the event of such an accident, and provide for medical assistance to victims and financial compensation for disability resulting from an industrial accident or the contraction of an occupational disease; and
- Act No. 19 of 2001 on Social Security. This law provides for the establishment of the General Social Security Institution, which should provide social insurance for all workers under sixteen with certain exceptions (seafarers, domestic servants, agricultural workers). It deals also with labour injuries and occupational diseases, old age, disability and death benefits.

4.3.2 INTERNATIONAL LABOR ORGANISATION (ILO) CONVENTIONS

In addition, the ILO has a number of fundamental conventions to which Jordan has ratified and will also apply to the Project including:

- Forced Labour Convention, 1930 (No. 29);
- 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);
- Minimum Age Convention, 1973 (No. 138); and
- Worst Forms of Child Labour Convention, 1999 (No. 182).

Jordan has not currently ratified the convention entitled '*Freedom of Association and Protection of the Right to Organise Convention*', 1948 (No. 87).

4.3.3 INTERNATIONAL STANDARDS FOR WORKERS' ACCOMMODATION

There are no specific international regulation in force relating to worker's accommodation; however, there are legal and regulatory instruments and guidance in place such as those developed by the IFC and European Bank for Reconstruction and Development (EBRD). The two institutions developed guidance material in August 2009 on *Workers' Accommodation: Processes and standards.*

The guidance note provides practical guidance on application of the appropriate policies related to provision of housing or accommodation for workers by employers, including minimum standards for accommodation and the issues that arise from the planning, construction and management of such facilities.

The Guidance covers several stages to the process of addressing issues raised by workers' accommodation, including:

- Assessing whether housing is needed for the project and if so, what sort;
- Assessing impacts on local communities and planning mitigation of potential negative impacts; and
- Awareness of the national and local regulatory framework.[1]

ILO Recommendation 115 on Worker's Housing (1961) also provides guidance on what is expected from employers who provide housing to their employees and specified a number of housing standards.

4.4 INTERNATIONAL ENVIRONMENTAL AND SOCIAL PERFORMANCE STANDARDS AND GUIDELINES

Given the involvement of international lenders to the Project the EIA is required to take into consideration International Financial Institution (IFI) Environmental and Social Standards and Good International Industry Practice (GIIP) for the development of the Project with the objective of producing an EIA compliant with both Jordanian and key lender requirements. The standards considered within the EIA are described in further detail below.

4.4.1 EQUATOR PRINCIPLES

The Equator Principles (EP) consist of ten principles relating to environmental and social assessment and management. In addition, they include reporting and monitoring requirements for Equator Principles Financial Institutions (EPFIs). The EP set a financial industry benchmark that have been adopted by financial institutions for determining, assessing and managing environmental and social risk in projects. The Equator Principles were updated in 2013 and are now more colloquially known as EP III.

The EPs apply globally and to all industry sectors. The ten EPs address the following topics:

- EP1 - Review and Categorisation
- EP2 - Environment and Social Assessment
- EP3 - Applicable Environmental and Social Standards
- EP4 - Environmental and Social Management System and Equator Principles Action Plan
- EP5 - Stakeholder Engagement
- EP6 - Grievance Mechanism
- EP7 - Independent Review
- EP8 - Covenants
- EP9 - Independent Monitoring and Reporting
- EP10 - Reporting and Transparency

In the context of this Project, the EIA must address the following relevant impacts and risks:

- Assessment of the baseline environmental and social conditions;

[1] http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:R115

- Requirements under host country laws and regulations, applicable international treaties and agreements;
- Sustainable development and use of renewable natural resources;
- Protection of human health, cultural properties, and biodiversity, including endangered species and sensitive ecosystems;
- Use of dangerous substances;
- Major hazards;
- Occupational health and safety, and other labour-related issues;
- Fire prevention and life safety;
- Socio-economic impacts;
- Land acquisition and land use;
- Involuntary resettlement;
- Impacts on affected communities and vulnerable groups (including indigenous peoples if present);
- Cumulative impacts of existing projects, the proposed project and anticipated future projects;
- Consultation and participation of affected parties in the design, review and implementation of the project;
- Consideration of feasible environmentally and socially preferable alternatives;
- Efficient production, delivery and use of energy; and
- Pollution prevention and waste minimisation, pollution controls (for liquid effluents and air emissions) and solid and chemical waste management.

4.4.2 IFC PERFORMANCE STANDARDS

For non-designated countries, which includes Jordan, the Equator Principles require the implementation of the associated IFC Performance Standards (PS), with the most recent iteration published in 2012[2] in addition to the World Bank Group Environmental, Health and Safety (EHS) Guidelines. The eight PS comprise the following requirements that projects seeking finance from institutions signed onto the Equator Principles should comply with the following:

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

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[2] http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/performance+standards/environmental+and+social+performance+standards+and+guidance+notes

Compliance with the IFC performance standards in the assessment will not only ensure a socially and environmentally sustainable project but it is also envisaged that it will facilitate financing. Of these PS it is considered that PS5 and PS7 would not specifically apply to the Project following the scoping assessment.

4.4.3 WORLD BANK GROUP ENVIRONMENTAL, HEALTH, AND SAFETY GUIDELINES

The General Environmental Health and Safety (EHS) Guidelines, 2012 is a technical reference document containing general and industry-specific examples of good international industry practice. The General EHS Guidelines contain guidance on environmental, health, and safety issues that are applicable across all industry sectors.

World Bank Group EHS Guidelines include provisions for:

1. Environment
   - Section 1.1 Air Emissions and Ambient Air Quality
     - Fugitive Sources
     - Mobile Sources - Land-Based
   - Section 1.3 Wastewater and Ambient Water Quality
   - Section 1.6 Waste Management
   - Section 1.7 Noise
2. Occupational Health and Safety
   - Section 2.1 General Facility Design and Operation
   - Section 2.2 Communication and Training
   - Section 2.3 Physical Hazards
   - Section 2.7 Personal Protective Equipment
   - Section 2.9 Monitoring
3. Community Health and Safety
   - Section 3.2 Structural Safety of Project Infrastructure
   - Section 3.4 Traffic Safety
   - Section 3.7 Emergency Preparedness and Response
4. Construction and Decommissioning
   - Section 4.1 Environment
   - Section 4.2 Occupational Health and Safety
   - Section 4.3 Community Health and Safety

No referenced sector-specific guidance has been published to date by the World Bank Group with respect to solar projects, although consideration will need to be made to relevant ancillary infrastructure guidelines as noted below. Where national and international guidelines differ, the Project will be required to adhere to the most stringent standard.

4.4.4 OTHER LENDER REQUIREMENTS

It is understood that Overseas Private Investment Corporation (OPIC) and Nippon Export and Investment Insurance (NEXI) have been identified as potential lenders to the Project and the EIA therefore takes into account the following requirements in addition to the EPs and IFC PS:

- OPIC Environmental and Social Policy Statement (2010)[3];
- OPIC Environmental Guidance on Renewable Energy – Solar Projects (2012);
- NEXI Environmental Checklist: 15. Other Electric Generation[4]; and
- NEXI Guidelines on Environmental And Social Considerations In Trade Insurance, 2015.

4.4.4.1 OPIC ENVIRONMENTAL AND SOCIAL POLICY STATEMENT 2014

As a development assistance agency of the United States Government, OPIC's policies reflect the five principal goals of the United States development cooperation policy (Section 101 of the Foreign Assistance Act (See Glossary)):

- *The alleviation of the worst physical manifestation of poverty among the world's poor majority.*
- *The promotion of conditions enabling developing countries to achieve self-sustaining economic growth with equitable distribution of benefits.*
- *The encouragement of development processes in which individual civil and economic rights are respected and enhanced.*
- *The integration of developing countries into an open and equitable international economic system.*
- *The promotion of good governance through combating corruption and improving transparency and accountability.*

The Environmental and Social Policy Statement outlines how OPIC will put into practice its commitment to the development goals through its environmental and social review and monitoring processes. Specifically OPIC will ensure through its processes that projects receiving OPIC support:

- Are environmentally and socially sustainable.
- Are compatible with low and no-carbon economic development.
- Respect human rights, including the rights of Workers and the rights of affected communities.
- Avoid negative impacts and if such impacts are unavoidable properly mitigate or compensate for the impacts.
- Provide timely information regarding its activities to Project Affected People.
- Are undertaken in countries that are taking steps to adopt and implement laws that extend Internationally Recognised Worker Rights.

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[3] https://www.opic.gov/sites/default/files/consolidated_esps.pdf

[4] http://nexi.go.jp/en/environment/pdf/ins_kankyou15e.pdf

OPIC categorizes all projects as Category A, B, C or D based on environmental and social factors. OPIC may apply an additional classification of ‘Special Consideration’ to projects based on labour-related factors. Categories A to C are described further below:

- Category A projects are likely to have significant adverse environmental and/or social impacts that are irreversible, sensitive, diverse, or unprecedented. In the absence of adequate mitigation measures, Category A projects are considered higher risk.
  - Category A projects include large-scale industrial plants, major greenhouse gas emitting projects (more than 91,000 metric tonnes of CO_2eq per year), large scale power transmission, and projects within sensitive locations of national or regional importance.
- Category B projects are likely to have limited adverse environmental and/or social impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures. Category B projects are considered medium risk. For these reasons, the scope of OPIC’s environmental and social assessment for Category B projects is narrower than that required for Category A projects. Examples of Category B projects include, but are not limited to, small to medium scale housing developments in urban areas, restaurants, and light manufacturing.
- Category C projects are likely to have minimal adverse environmental or social impacts. Examples of Category C projects include but are not limited to financial services, telecommunications projects not involving new physical infrastructure, bid bonds and data processing.

In categorising projects, OPIC considers direct, indirect, induced, regional, trans-boundary and cumulative environmental and social impacts. Risks are assessed at key stages in the project life cycle including pre-construction, construction, operations, decommissioning and closure.

In categorizing investments in existing projects, including privatizations, OPIC assesses environmental and social impacts and risks associated with (1) current operations and (2) any risks and impacts from planned expansions or modifications.

It is considered that the Project is likely classed as a Category B Project due to the location and the absence of cumulative effects.

The OPIC Guidelines for Solar PV projects, 2012, and the categorisation of the Project are discussed in the following Section 4.4.4.2.

4.4.4.2 OPIC ENVIRONMENTAL GUIDELINES RENEWABLE ENERGY – SOLAR PROJECTS, 2012

The guidelines present potential environmental and social issues associated with solar PV energy projects, and outlines how OPIC may consider each of these issues when screening projects, the applicable guidelines and standards, recommends measures to mitigate impacts, information needed to review a project and monitoring recommendations.

These guidelines discuss the evaluation features that, in general, are most significant with respect to solar energy projects and therefore require more emphasis while conducting environmental and social due diligence.

The guidelines consider large-scale utility projects but refer to the IFC General EHS guidelines for common construction-related activities.(refer to Section 44.2).

PROJECT SCREENING

Category A solar PV projects are likely to have significant adverse environmental and social impacts that are irreversible, sensitive, diverse or unprecedented. Category A projects require submission of an Environmental and Social Impact Assessment (ESIA) developed in accordance with IFC P.S. 1, an on-site due-diligence visit by an OPIC environmental analyst or a third-party consultant approved by OPIC and development and implementation of an Environmental and Social Action Plan (ESAP). Within three years of the execution of the contract with OPIC, Category A projects are required to conduct a third party audit.

Issues that require careful consideration in determining whether a project is Category A or B for solar PV projects include the following:

- Potential for significant habitat alteration or wildlife disturbance, including disruption of wildlife migration corridors.
- Potential for significant socio-cultural impacts related to land acquisition, land use, indigenous peoples, and cultural heritage
- Potential for significant environmental and social impacts from ancillary features.
- Potential for significant environmental and social impacts due to cumulative effects.

A solar PV project may be screened as Category B if significant impacts are avoided, adequately mitigated and sufficient information is provided to assess such impacts, and there is no significant opposition to the Project by local stakeholders.

It is considered that the Project is classed as a Category B Project due to the location and the relative absence of cumulative effects.

The guidelines provide advice with regards to the Project screening, as well as a description of key impacts and their required mitigation as follows:

- Socio-cultural Issues;
- Community Issues;
  - Land Acquisition and Land Use.
  - Indigenous Peoples and Cultural Heritage.
- Community Issues;
  - Visual Impacts.
- Panel Disposal;
- Ancillary Facilities; and
- Cumulative Effects.

Section 6.0 of the Guidelines provide recommendations for monitoring during both the construction phase and operation phase.

4.4.4.3 NEXI ENVIRONMENTAL CHECKLIST: 15. OTHER ELECTRIC GENERATION

A checklist provided by NEXI detailing the required steps to be followed at each stage if the EIA or ESIA process. The checklist includes the following categories to conform with:

- Permits and Approvals, Explanations;
  - (1) EIA or ESIA and Environmental Permits.
  - (2) Explanations to the Public.
- Anti-pollution Measures;
  - (1) Air Quality.

  - (2) Water Quality.
  - (3) Waste.
  - (4) Soil Contamination.
  - (5) Noise and Vibration.
  - (6) Subsidence.
  - (7) Odour.
- Natural Environment;
  - (1) Protected Areas.
  - (2) Ecosystem and Biota.
  - (3) Hydrology.
  - (4) Topography and Geology.
- Social Environment;
  - (1) Resettlement.
  - (2) Living and Livelihood.
  - (3) Heritage.
  - (4) Landscape.
  - (5) Ethnic Minorities and Indigenous Peoples.
  - (6) Working Conditions (including occupational safety).
  - (7) Community Health, Safety and Security.
- Other;
  - (1) Impacts during Construction.
  - (2) Accident Prevention Measures.
  - (3) Monitoring.

4.4.4.4 NEXI GUIDELINES ON ENVIRONMENTAL AND SOCIAL CONSIDERATIONS IN TRADE INSURANCE, 2015.

The Guidelines provide Environmental Policy and procedures employed by NEXI to confirm environmental and social considerations in trade insurance. According to the Guidelines, NEXI commits itself, in accordance with the policy of the Japanese Government, to contribute to sound development of Japan's external transactions such as foreign trade by confirming whether the project sponsors and relevant parties have implemented appropriate environmental and social considerations in the projects.

The guidelines follow a set of procedures as follows:

- Screening – the applicant must complete and submit the screening form for the project to enable NEXI to categorise the project.
- Categorisation
  - Category A – large-scale projects likely to have significant and complicated impacts.
  - Category B – projects with potential adverse impacts which are expected to be less than those of Category A.
  - Category C – project is likely to have minimal or no adverse environmental impacts.

- Environmental Reviews – NEXI utilises information from stakeholders, environmental laws and existing benchmarking for each category project in order to examine expected environmental impacts. For Category A projects (and some Category B projects), and EIA or ESIA must be prepared and submitted. Environmental Reviews are not required for Category C projects.

4.4.5 GUIDELINES RELATED TO ANCILLARY FEATURES

Other guidelines relevant to ancillary infrastructure (i.e. access roads, worker camps, transmission lines) include applicable provisions for:

- World Bank Group EHS Guidelines for Electrical Power and Distribution; and
- ILO Recommendation 115 on Workers' Housing (1961).

With respect to worker housing, it is noted that the anticipated construction approach (and as was undertaken for the recent development of IPP4 by the same EPC Contractor Wärtsilä) is that workers typically live in their own accommodation and then are transported to site through company buses. As such, no worker housing is anticipated for the Project.

4.5 ENERGY SECTOR ADMINISTRATIVE FRAMEWORK

The Government of Jordan has established a number of objectives to facilitate the development of the national power sector as follows:

- Provision of a secure electricity supply to meet the country's domestic internal demand;
- Generate sufficient amounts of electricity to allow Jordan to export electricity to other countries in the region;
- Develop the national electricity network to allow for the interchange of energy, internally and to neighbours in the region; and
- Attract private investment (domestic and foreign) to the Jordanian power sector.

The Government of Jordan has passed legislation and is implementing policy initiatives to encourage this investment. The Government of Jordan wants to introduce Independent Power Producers (IPP) to Jordan and is particularly interested in participating in the development of a regional power market.

To support these specific policy objectives, the Government of Jordan has adopted a strategy for the development of the power sector. This strategy envisages greater participation by the private sector. As part of the strategy, the Government of Jordan has decided that all new generation capacity will be installed, owned and operated by the private sector. This new capacity will be procured through an international competitive tendering process. Specifically, the Government of Jordan has taken measures to commercialise the power sector, increase competitiveness within the sector and improve the environment for private sector investment.

The Government of Jordan enacted a new electricity law, the General Electricity Law for the Year 2002 (2002 GEL), which clarifies the role and function of the Electricity Sector Regulatory Commission as an independent agency responsible for regulating the power sector in three areas: generation, transmission and distribution. Although the 2002 GEL will issue licenses for generation of electricity pursuant to applications to the Commission, initial independent power plants (IPPs) will be granted licenses pursuant to the applicable license form and the Electricity Companies Licensing By-Law and the terms of the concession (or implementation) agreement entered into with Ministry of Energy and Mineral Resources (MEMR).

The Developer will construct, own, and operate the Project throughout the term of the Power Purchase Agreement (PPA) and will pay taxes and fees as required. The Developer will mobilise project or other financing sufficient to develop and construct the Project, using both equity and debt resources. Financing for the Project will be provided by the Overseas Private Investment Corporation (OPIC), Nippon Export and Investment Insurance (NEXI) and Sumitomo Mitsui Banking Corporation (SMBC).

4.6 INTERNATIONAL CONVENTIONS

The Government of Jordan is also a signatory to a number of regional and international conventions and protocols concerned with environmental protection as follows:

- The Convention on Wetlands of International Importance, especially as Waterfowl Habitat (RAMSAR Convention) 1971;
- Convention on International Trade in Endangered Species (CITES) 1975;
- Convention on the Prevention of Marine Pollution by Dumping of Wastes 1975;
- United Nations Convention on Law of the Sea (UNCLOS) 1982;
- The Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal 1992;
- United Nations Framework Convention on Climate Change (UNFCCC) 1992;
- Convention on Biological Diversity (CBD) 1993;
- Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa 1996;
- United Nations Framework Convention on Climate Change and the Kyoto Protocol 1997; and
- Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol) 1997.

4.7 APPLICABLE JORDANIAN AND INTERNATIONAL STANDARDS AND GUIDELINES

This section describes the applicable Jordanian and International Standards and Guidelines with respect to noise and ambient air quality. The applicable Jordanian Legislation, IFC and World Bank Group EHS General and Sector Guidelines, IFC PS's and International Conventions are discussed further within Sections 4.4 and 4.8.

4.7.1 AIR QUALITY

The Jordanian Ambient Air Quality Standards (JS: 1140/2006) describe the concentration limits for a range of pollutants in the ambient air. The pollutants relevant from this Project relate to the construction period and comprise particulate matter <10 microns in diameter (PM_{10}), particulate matter <2.5 microns in diameter ($PM_{2.5}$) and total suspended particulates (TSP) and are shown in Table 4-2. No significant operational air quality impacts are anticipated.

Table 4-2 1140/2006 Ambient Air Quality Standards for Pollutants of Concern

POLLUTANT	JORDANIAN AIR QUALITY STANDARDS (JS:1140/2006)			IFC EHS GUIDELINES (WHO GUIDELINES) MG/M³
	AVERAGING PERIOD	NUMBER OF EXCEEDANCES	MAXIMUM LIMIT	
Particulate Matter <10 microns (PM_{10})	24 hours	3 times during any consecutive 30 days in a year	120µg/m³ *	150 (interim target 1) 100 (interim target 2) 75 (interim target 3 50
	Annual	-	70µg/m³	70 (interim target 1) 50 (interim target 2) 30 (interim target 3) 20
Particulate Matter <2.5 microns ($PM_{2.5}$)	24 hours	3 times during any consecutive 30 days in a year	65µg/m³	-
	Annual	-	15µg/m³	-
Total Suspended Particulates (TSP)	24 hours	3 times during any consecutive 30 days in a year	260µg/m³	-
	Annual	-	75µg/m³ (geometric average)	-
NO_2	1-hour	3 times within a given month in one year	0.21mg/kg	200
	24-hour	3 times within a given month in one year	0.08mg/kg	-
	Annual	-	0.05mg/kg	40
SO_2	10-min	-	-	500
	1-hour	3 times within a given month in one year	0.30mg/kg	-
	24-hour	Once a year	0.14mg/kg	125 (interim target 1) 50 (interim target 2) 20
	Annual	-	0.04mg/kg	-

The IFC and World Bank Group EHS General Guidelines for “Air Emissions and Ambient Air Quality (2007)” has adopted the World Health Organisation (WHO) ambient air quality guidelines. The IFC and World Bank Group EHS General Guidelines for “Air Emissions and Ambient Air Quality (2007)” states that WHO guidelines should be implemented in the absence of national standards. Therefore JS: 1140/2006 is the relevant ambient air quality standard for this Project.

4.7.2 NOISE

The Project will be assessed in accordance with the daytime and night-time noise limits applicable under each of the following guidelines;

- Jordanian Guidelines for Prevention of Noise (2003); and,
- IFC and World Bank Group General EHS Guidelines Noise Limits (2007).

For the Project, the nearest noise sensitive receptors to the proposed site of the power plant are farms located adjacent, which contain residential and agriculturally-related buildings.

The category that most closely matches this area's usage under the Jordanian guidelines is "*Residential having Small industries, Offices and Public Buildings*" and the applicable noise limits for these are outlined in Table 4-3.

Table 4-3 Noise Emission Limits - Jordanian Guidelines for Prevention of Noise (2003)

Receptor	Maximum allowable hourly measurements L_{AEQ} (dBA)	
	Day (07:00 - 22:00)	**Night (22:00-07:00)**
Residential having Small industries, Offices and Public Buildings	65	55

The category that most closely matches this area usage under the IFC and World Bank Group General EHS Guidelines, is "*Residential, Institutional, Educational*" and the applicable noise limits for these are outlined in Table 4-4.

Table 4-4 Noise Emission Limits – IFC and World Bank Group General EHS Guidelines Noise Limits (2007)

Receptor	$L_{EQ,1HR}$ (dBA)	
	Day-time (07:00 – 22:00)	**Nigh-time (22:00 – 07:00)**
Residential, Institutional, Educational	55	45

Additionally, the World Bank Group/IFC guidelines for noise stipulate that, for industrial facilities, the noise levels at the nearest off-site receptor should not increase by more than 3 dB(A) as a result of operations.

The Jordanian noise guidelines are general applicable and so the predicted noise levels during both the construction and operational phases will be assessed against these guidelines. The IFC and World Bank Group General EHS Guidelines Noise Limits (2007) are intended for assessing operational noise only.

4.7.3 SOIL AND GROUNDWATER STANDARDS

Soil and groundwater protection and management requirements are provided by the Soil Protection Regulation No. 25, 2005. In the absence of specific soil and groundwater standards, international limits are enforced, primarily the Dutch Ministry of Housing Soil Quality Standards, summarised in Table 4-5.

Table 4-5 Dutch Soil Quality Standards

Parameter	Soil (mg/kg dry matter)	
	Reference Value	Intervention Value
I. Metals		
Cadmium (Cd)	0.8	12
Chromium (Cr)	100.0	380
Copper (Cu)	36.0	190
Nickel (Ni)	35.0	210
Lead (Pb)	85.0	530
Zinc (Zn)	140	720
Mercury (Hg)	0.3	10.0
Arsenic (As)	29.0	55.0
Barium (Ba)	160	625
Cobalt (Co)	9.0	240
Beryllium (Be)	1.1	30
Silver (Ag)	-	15
Selenium (Se)	0.7	100
Tin (Sn)	-	900
Antimony (Sb)	3.0	15
II.Inorganic Compounds		
Bromide	20	-
Chloride	-	-
Fluoride	500	-
III.(Volatile) Aromatic Compounds		
Benzene	0.01	1
Toluene	0.01	130
Ethyl Benzene	0.03	50
Xylene	0.1	25
Phenol	0.05	40
Styrene (vinylbenzene)	0.3	100
IV.Polycyclic Aromatic Hydrocarbons		
PAH (sum of 10)	1	40
V.Chlorinated Hydrocarbons		
Polychlorobiphenyl (sum)	0.02	1

4.7.4 LANDSCAPE AND VISUAL ASSESSMENT

There are no specific standards available within Jordan with respect to consideration of landscape and visual impact. As a result, in their absence the visual impact of the Project will be assessed in accordance with the United Kingdom (UK) Guidelines for Landscape and Visual Impact Assessment (LVIA) Revision 3.

In addition, the EIA will take into consideration the limited guidance provided by World Bank Group General EHS Guidelines to assess the landscape character during siting and evaluation of visual impacts from relevant viewing angles and with respect to the cultural character of an area. Specific assessment from critical viewpoints with renderings is considered appropriate in this respect.

4.7.4.1 GLINT AND GLARE

Typically, glint and glare is considered during the planning and design phase.

The main reference point on this issue is the US Federal Aviation Administration which is implementing a web-based tool, Solar Glare Hazard Analysis Tool (SGHAT), which predicts energy production and the potential for solar glare and ocular impacts from an array of photovoltaic panels.

The use of this tool is required by the Federal Aviation Administration for solar energy installations proposed at federally obligated airports in the United States (Notice 78 FR 63276 in the Federal Register).

4.8 COMPLIANCE WITH JORDANIAN LEGISLATION, IFC AND WORLD BANK GROUP EHS GUIDELINES AND IFC PERFORMANCE STANDARDS AND PRINCIPLES

The Projects compliance with relevant Jordanian and International Laws, Regulations and Standards, Guidelines, Performance Standards and Principles are summarised in Table 4-6 to Table 4-11.

Table 4-6 Compliance with Relevant Jordanian Law, Regulations and Standards

Jordanian Law / Regulation / Standards	Requirements	Compliance Status	Mitigation measure to be implemented for Compliance
Exemption of Renewable Sources of Energy Systems and Apparatus and Energy Efficiency By-law (No. 10, 2013)	Renewable energy source systems, energy rationalising appliances and equipment and its production inputs as well as locally manufactured and imported renewable energy apparatus will be exempt from all customs duties and sales tax	In compliance	N/A
Renewable Energy and Energy Efficiency Law (No. 13, 2012)	Requires Project to comply with the objectives of this Law, including achieving safe and sustainable supply of renewable energy to increase the percentage of renewable energy in the total energy mix of Jordan	In compliance	N/A
Environmental Protection Law (No. 52, 2006)	This Law requires that the Project will not result in unacceptable impacts to the environment and complies with relevant Jordanian legislation	Identified within this EIA (considered compliant)	Mitigation measures included within the CEMP
Environmental Impact Assessment (EIA) Regulations (No 37, 2005)	Require an EIA for the Project and obtain an environmental permit from MoE	This document	N/A
General Electricity Law (No. 64, 2002)	Requires Project to comply through the role of an IPP	In compliance	N/A
Natural Reserves and Parks By-law (No. 29, 2005)	The Project will not undertake any activities within the boundaries of Dana Biosphere Reserve or the Important Bird Areas (IBA)	In compliance	N/A
Jordanian Agricultural Law (No. 44, 2002)	Requires the Project not to harm rangeland and their natural resources	In Compliance	N/A

Jordanian Law / Regulation / Standards	Requirements	Compliance Status	Mitigation measure to be implemented for Compliance
Ambient Air Quality Standards (JS: 1140, 2006)	Requires the Project to comply with Jordanian Ambient Air Quality Standards	In compliance	Mitigation measures included within the CEMP
Water Authority Law (No. 18, 1988)	Requires that water will be provided by WAJ with no water taken from other sources. No water will be released to sensitive surface or groundwater	In compliance (no water used during operations and construction water will be sourced from WAJ sources)	N/A
Underground Water By-law (No. 85, 2002)	Requires that groundwater will not be extracted by the Project	No water will be extracted by the Project. In compliance	N/A
Soil Protection Regulations (No. 25, 2005)	Requires the Project to implement mitigation measures to prevent contamination of soils during construction and operation	Measures identified within this document (considered that Project will be in compliance following implementation of measures)	Mitigation measures included within the CEMP
Jordanian Guidelines for Prevention of Noise (2003)	Requires the Project to comply with the noise classification criteria	Measures identified within this document (considered that Project will be in compliance following implementation of measures)	Mitigation measures included within the CEMP
Management of Solid Waste Regulations (No. 27, 2005)	Requires the Project to ensure proper and appropriate handling of waste materials during construction and operation	Measures identified within this document (considered that Project will be in compliance following implementation of measures)	Mitigation measures included within the CEMP
Instructions for Hazardous Waste Management and Handling (2003)	Requires the Project to ensure proper storage and use of any hazardous substances	Measures identified within this document	Mitigation measures included within the CEMP

JORDANIAN LAW / REGULATION / STANDARDS	REQUIREMENTS	COMPLIANCE STATUS	MITIGATION MEASURE TO BE IMPLEMENTED FOR COMPLIANCE
		(considered that Project will be in compliance following implementation of measures)	
Instruction for Management and Handling of Consumed Oil (2003)	Requires the Project to handle waste oils in accordance with the Instruction	Measures identified within this document (considered that Project will be in compliance following implementation of measures)	Mitigation measures included within the CEMP
Management, Transport and Handling of Harmful and Hazardous Substances Regulations (No. 24, 2005)	Requires the Project to ensure the proper storage and use of any hazardous substances. All hazardous waste will be transported from site by a licensed waste contractor	Measures identified within this document (considered that Project will be in compliance following implementation of measures)	Mitigation measures included within the CEMP
Archaeology Law (No. 21, 1998)	Requires Project site to be free from archaeological artefacts	Measures identified within this document (considered that Project will be in compliance following implementation of measures)	Watching brief to be undertaken during construction. Mitigation measures included within the CEMP
Traffic Law (No. 49, 2008)	Requires Project to comply with the Traffic Law, including not overloading a vehicle, adequately covering exposed loads, and not disposing of solid or liquid waste from vehicles	Measures identified within this document (considered that Project will be in compliance following implementation of measures)	N/A

Jordanian Law / Regulation / Standards	Requirements	Compliance Status	Mitigation measure to be implemented for Compliance
Labour Law (No. 8, 2002)	Requires Project to operate under the requirements of this Law	Measures identified within this document (considered that Project will be in compliance following implementation of measures)	N/A
Civil Defence Law (No. 18, 1999)	Requires that the Project will not pose a safety hazard to the general public	Measures identified within this document (considered that Project will be in compliance following implementation of measures)	N/A
Public Health Law (No. 47, 2008)	Requires that the Project will not pose a health hazard to the general public	Measures identified within this document (considered that Project will be in compliance following implementation of measures)	Mitigation measures included within the CEMP and stakeholder engagement plan

Table 4-7 Compliance with International Conventions

International Convention	Requirements	Compliance	Mitigation measure to be implemented for Compliance
The Convention on Wetlands of International Importance, especially as Waterfowl Habitat (RAMSAR Convention) (1971)	The RAMSAR Convention is an intergovernmental treaty that embodies the commitments of its member countries to maintain the ecological character of their wetlands of international importance and to plan for the "wise use", or sustainable use, of all of the wetlands in their territories	Not applicable as there are no wetlands in the Project site	N/A

International Convention	Requirements	Compliance	Mitigation measure to be implemented for Compliance
Convention on International Trade in Endangered Species (CITES) (1975)	CITES is an international agreement between governments which aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival	Measures identified within this document (considered that Project will be in compliance following implementation of measures)	Mitigation measures included within the CEMP
Convention on the Prevention of Marine Pollution by Dumping of Wastes (1975)	The Convention contributes to the international control and prevention of marine pollution by prohibiting the dumping of certain hazardous materials	Not applicable as the Project is terrestrial	N/A
United Nations Convention on Law of the Sea (UNCLOS) (1982)	The UNCLOS aims to regulate all aspects of the resources of the sea and uses of the ocean including navigational and territorial sea rights, conserving global fish stocks and monitoring marine pollution	Not applicable as the Project is terrestrial	N/A
The Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal (1992)	The main objective of the Basel Convention is to protect human health and the environment against the adverse effects of hazardous wastes	Measures identified within this document (considered that Project will be in compliance following implementation of measures)	Mitigation measures included within the CEMP
United Nations Framework Convention on Climate Change (UNFCCC) (1992)	The UNFCCC is an international treaty formed to limit average global temperature increases and the resulting climate change and to cope with inevitable impacts	Project supporting limitation of CO_2 emissions through installation of PV panels	N/A
Convention on Biological Diversity (CBD) (1993)	The CBD has three main objectives: • Conservation of biological diversity; • The sustainable use of the component s of biological diversity; and • The fair and equitable sharing of the b enefits arising out of the utilization of g enetic resources.	Measures identified within this document (considered that Project will be in compliance following implementation of measures)	N/A
Convention to Combat Desertification in Those Countries Experiencing Serious	The Convention aims to combat desertification and mitigate the effects of	Measures identified within this document (considered	N/A

International Convention	Requirements	Compliance	Mitigation measure to be implemented for Compliance
Drought and/or Desertification, Particularly in Africa (1996)	drought through national action programs incorporating long-term strategies supported by international cooperation and partnership arrangements	that Project will be in compliance following implementation of measures)	
United Nations Framework Convention on Climate Change and the Kyoto Protocol (1997)	The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change, which commits its Parties by setting internationally binding emission reduction targets	Not directly applicable to this Project as no operational emissions expected	Consideration of sustainable construction methods to reduce construction-related emissions
Montreal Protocol on Substances that Deplete the Ozone Layer (1997)	This Protocol is a United Nations international programme for the protection of the Ozone layer	Limited In Compliance	N/A

Table 4-8 Compliance with IFC and World Bank Group EHS General Guidelines

IFC / World Bank Group EHS General Guidelines	Requirements	Compliance	Mitigation measure to be implemented for Compliance
EHS General Guidelines	Requires that the Project contains performance levels and measures which are achievable using existing technology at reasonable costs. The EIA will include these levels and measures and, in the event that the national standards are not as stringent as the IFC / World Bank Group EHS General Guidelines standards, the more stringent will apply (unless a detailed justification is provided and approved by the lenders).	Measures identified within this document (considered in compliance)	N/A

Table 4-9 Compliance with Applicable IFC and World Bank Group EHS Sector Guidelines

IFC and World Bank Group EHS Guidelines	Requirements	Compliance	Mitigation measure to be implemented for Compliance
Electric Power Transmission and Distribution Guidelines (2007)	Requires the Project to be in compliance for power transmission between the Project substation and existing IPP4 substation	NEPCO responsible for the transmission line.	Project Company to liaise with NEPCO on the transmission line assessment and compensation to consider international standards

Table 4-10 Compliance with IFC Performance Standards

IFC Performance Standards 2012	Requirements	Compliance
PS 1: Assessment and Management of Social and Environmental Risks and Impacts	Requires that this EIA includes an ESMP for the Project	ESMP included within this document (considered that Project will be in compliance following implementation of measures)
PS 2: Labour and Working Conditions	Requires that no person will be harmed or unwillingly employed by the Developer	Measures identified within this document (considered that Project will be in compliance following implementation of measures)
PS 3: Resource Efficiency and Pollution Prevention	Requires that the Project has considered technologies and practices (techniques) to reduce adverse impacts on human health and the environment while remaining technically and financially feasible and cost-effective	Measures identified within this document (considered that Project will be in compliance following implementation of measures)

IFC Performance Standards 2012	Requirements	Compliance
PS 4: Community Health, Safety and Security	Requires that preventative measures have been incorporated in the Project design to ensure community, health, safety and security	Measures identified within this document (considered that Project will be in compliance following implementation of measures)
PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	Requires that the Project will not significantly impact on local habitats	Baseline assessments undertaken. Measures identified within this document (considered that Project will be in compliance following implementation of measures)
PS 8: Cultural Heritage	Requires that no historic or culturally significant features were identified on the Project site or temporary facility area	Baseline consideration undertaken. Measures identified within this document (considered that Project will be in compliance following implementation of measures)

Table 4-11 Compliance with Equator Principles

Equator Principle 2013	Requirements	Compliance
Principle 1: Review and Categorisation	When a Project is proposed for financing, it will be categorised according to the magnitude of its potential environmental social risks and impacts	In Compliance

EQUATOR PRINCIPLE 2013	REQUIREMENTS	COMPLIANCE
Principle 2: Environmental and Social Assessment	Requires relevant environmental and social risks as well as impacts of the Project. Measures to minimise, mitigate and offset adverse impacts should also be provided	In Compliance
Principle 3: Applicable Environmental and Social Standards	Requires that Project addresses and complies with host country's (Jordan) laws and regulations pertaining to environmental and social issues	In Compliance
Principle 4: Environmental and Social Management System	Requires that the Project will develop and implement an Environmental and Social Management System (ESMS) and Environmental and Social Management Plan (ESMP)	CEMP included within this document. OEMP framework also provided.
Principle 5: Stakeholder Engagement	Requires the Project to demonstrate effective Stakeholder Engagement as an ongoing process	Measures identified within this document (considered that Project will be in compliance following implementation of measures)
Principle 6: Grievance Mechanism	Requires the Project to establish a grievance mechanism to facilitate resolution of concerns about the Project	Measures identified within this document (considered that Project will be in compliance following implementation of measures)
Principle 7: Independent Review	Requires that an independent review of EIA and associated documentation will be undertaken by an Independent Environmental and Social Consultant	Not applicable to the consultant scope
Principle 8: Covenants	Requires the Project to covenant financial documentation to comply with ESMPs, Equator Principles, to provide periodic reports and to decommission the windfarm in accordance with agreed decommissioning plan	Not applicable to the consultant scope
Principle 9: Independent Monitoring and Reporting	Requires that an Independent Environmental and Social Consultant to verify ongoing monitoring information and compliance with Equator Principles after financial close of Project	Not applicable to the consultant scope
Principle 10: Reporting and Transparency	Requires lender to ensure availability of Project information	Not applicable to the consultant scope

5 PROJECT JUSTIFICATION AND ALTERNATIVES

The Power Project is being constructed to help meet the rising electricity demand in Jordan and further the Government's strategy to increase the share of renewables within the energy sector. The location of the Project site, close to the centre of the electricity demand in Jordan, will help Jordan to generate electricity in a manner that will minimise the transmission losses associated with long transmission lines. The site was offered by the Jordan government for the use by the solar project.

5.1 NO DEVELOPMENT OPTION

Electricity demand in Jordan was 13,534.9 gigawatts per hour (GWh) in 2011 compared to 12,857.4GWh in 2010, with an annual increase of 5.3%. The electricity demand is expected to increase to 53,697GWh by 2030.

Electricity from renewable sources in Jordan is currently at 1%. The Government of Jordan are promoting the generation of renewable energy by adopting a renewable energy strategy. The renewable energy strategy has set a 7% target by 2015 and a 10% target by 2020, equivalent to a generating capacity of approximately 1500MW. The Project will assist in meeting the rising electricity demand in Jordan as well as assisting in the growth of renewable energy in the country.

The "do nothing scenario" will result in continued power failures particularly during peak demand in the summer months which is not only an inconvenience but will also potentially limit future growth of the country. Furthermore, the government's target of 7% of energy generated to be through renewables by 2015 and 10% target by 2020 will be less attainable.

Historically Jordan has also imported the majority (97%) of its energy requirements at a cost of almost 18% of GDP according to figures from the Ministry of Energy and Mineral Resources (MEMR). With no fuel dependency for a Project, the proposed Project will also increase the country's long-term self-sufficiency in energy generation in addition to reducing the operational cost for power generation.

5.2 ALTERNATIVE LOCATIONS

There are a number of advantages of the Project site, which make it suitable for solar power generation as follows:

- An existing transport infrastructure in particular the Zarqa to Sahab road that will readily accommodate construction traffic;
- Availability of sufficient land for the Project;
- Close proximity to the centre of electricity demand in Jordan (Amman) which is located approximately 30km to the west;
- The site is located away from residential and populated areas; and
- Close to existing transmission sources.
- Low incidence of 'horizon shading' which comprises the shading caused by land topography and objects (e.g. mountains, etc.) located in close proximity, blocking the sun-path for a particular period during any given year. Following the desktop study and site visits no major

structures were found in the near vicinity of the Project site which may impact the horizon shading.

- The site does not have any large nearby structures such as buildings that may shade the PV panels and reduce performance

The Project is considered to represent the most appropriate option for generation of the energy required. As such, there were no alternative locations considered for this Project development.

The panel layout was chosen based on fixed tilt mounting structures being proposed. The layout comprises a south-facing orientation, tilted at an angle of 17° in order to maximise the total annual incident of solar irradiation. The modules will be arranged in landscape orientation with four rows and each row shall accommodate 30 modules. Each mounting structure table shall accommodate 120 modules. The tilt and pitch has been chosen to ensure minimum inter-row shading at the maximum sun angle on the winter solstice. Adequate distance for maintenance purposes and additional space in order to reduce the effect of inter-row shading has also been taken into account.

As such, the layout was chosen for optimum energy yield and to capture as much sunlight to ensure efficient use, thus no alternative layout plans has been considered for the Project, although slight changes may be required at the detailed design phase.

5.3 ALTERNATIVE DESIGN AND TECHNOLOGY

5.3.1 MATERIAL OPTIONS

Solar Monocrystalline modules from a Tier 1 supplier and ABB inverters of 2000kW capacity are proposed for the Project. Both the components have 1500V as the maximum system voltage. Tier 1 Solar PV modules such as the JAM6 (K)-72-340-PR (340Wp) / JAM6 (K)-72-345-PR (345Wp) / JAM6 (K)-72-350-PR (350Wp) models and ABB PVS980-58-2000kW-7 (2000kW) inverter have been shortlisted to be used for the Project.

Rather than using manual dry cleaning methods to clean the panels, automated robots attached to the panels were also considered. These systems typically utilise the effect of gravitation to move dust and other soiling factors downward, off the panels, and thus facilitate efficient cleaning of the modules. Dry cleaning systems can also be automated and employ robots to accomplish the job. While this automated method of cleaning is considered effective, highly reliable with minimal maintenance the socioeconomic disadvantage is that it would reduce the employment opportunities for local labour during the operational phase.

No other alternative designs or technologies have been proposed for this Project.

6 EIA METHODOLOGY

6.1 INTRODUCTION

This section sets out the approach and methodology which have been adopted as part of this EIA report. This includes the approach to determine the existing environmental and socio-economic conditions, including identification of sensitive receptors, and the general methodology for the assessment of environmental and social impacts likely to be associated with the proposed Project. Methodologies may differ between disciplines and, where this is the case, the deviation from the standard approach described in Figure 6-1 below is described further.

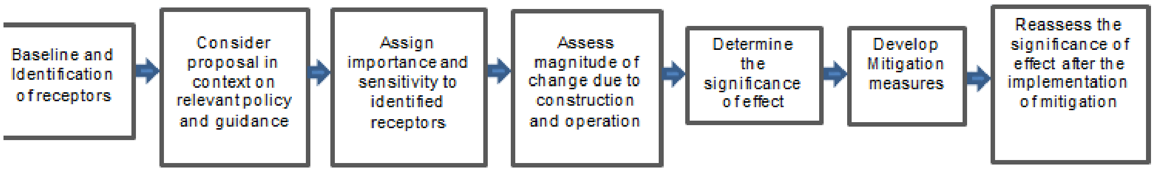

Figure 6-1 EIA process flow chart

The assessment of the potential impacts of both the construction and operational phases of proposed Project has been based on a number of criteria, which are used to determine whether such effects are 'significant'. These significant criteria include:

- Local, national and international legislation, regulations and standards;
- Relationship with national planning policies or drivers;
- Sensitivity of the local environment;
- Reversibility or irreversibility and duration of the impact;
- Inter-relationship, if any, between the impacts, otherwise known as cumulative impacts; and
- Outcomes of consultations with the MoE and other relevant stakeholders.

The significance of impacts reflects judgements as to the importance or sensitivity of the affected receptors and the nature, magnitude and duration of the predicted changes.

6.2 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

6.2.1 SCOPING METHODOLOGY

REQUIREMENTS FOR SCOPING

For a development of this type in Jordan, it is a MoE requirement that an appropriate level of stakeholder engagement is undertaken, involving a range of parties with an interest in the environmental and social impacts associated with the Project. The MoE requires that a developer undertake a scoping session to obtain stakeholder views and concerns regarding the Project during its initial stage. Appropriate stakeholder engagement is also a key element expected by the lender banks.

The objective of this scoping session is to inform stakeholders of the proposed development, outline the potential impacts and benefits associated with the Project's construction and operation, and the approach to be used to manage these impacts. The scoping session provides stakeholders with an opportunity to make comments and/or raise issues of concern.

An official scoping consultation was organised by the Ministry of Environment at the Holiday Inn Hotel, Amman on 5 November 2015 in accordance with MoE EIA Regulations. A list of relevant and potentially relevant stakeholders was prepared by the Company and the MoE. Thirty five (35) stakeholders were invited to the session with 22 subsequently attending, ranging from Ministries to representatives from the nearest (2.5km) local community, Al Manakher.

During the scoping session, the Project Company, with support from RSS, provided a presentation outlining the proposed Project activities, facilities and processes. The attendees were invited to discuss their issues and concerns with the Project, with the comments and attendees recorded and included within the Scoping and ToR report. The attendees and points raised are included within Appendix A and B of the scoping document. The points raised have subsequently been considered in the final Terms of Reference and developed further in this EIA as appropriate.

6.2.2 OBJECTIVES OF SCOPING STAGES

Undertaking consultation at an early stage in the development of a Project is typically of most value particularly with respect to key authorities, statutory bodies, affected communities and other relevant stakeholders[5]. This is valuable in the assessment of Project viability and may guide and increase the efficiency of the development process. Early consultation can also inform the design process to minimise potential environmental and social impacts and maintain overall sustainability of the Project.

The principle objectives of scoping are to agree on the proposed site and:

- Identify the key environmental and socio-economic issues to be included in the EIA;
- Identify the legal requirements and framework for the Project over the course of its lifetime;
- Identify the relevant component studies to establish the relevant baseline for the Power Project;
- Finalise the proposed ToR; and
- Understand the concerns of the local community and stakeholders.

6.2.3 TERMS OF REFERENCE REPORT

A Terms of Reference (ToR) report has previously been prepared by WSP | Parsons Brinckerhoff for the Developer in association with RSS of Jordan, a locally registered environmental consultant.

A comprehensive EIA is required for the proposed Project in order to ensure that environmental and social issues are appropriately considered in the Project design and management. Furthermore, an EIA is necessary with respect to Jordanian national legislative requirements, initiating the environmental permitting process by the MoE in order to secure an environmental approval.

[5] IFC, "Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets," 2007

The ToR Report, which should be considered in accompaniment with the subsequently submitted scoping report, sets out the Terms of Reference for the development of the EIA, which will be completed for Project in Jordan.

The principle objectives of the ToR are to:

- Present the results of the scoping session;
- Identify the key environmental issues to be assessed in the EIA;
- Identify receptors that will be likely affected during construction and operation;
- Identify the legal requirements and framework for the Project during construction and operation; and
- Identify the relevant studies to establish the baseline environment for the Project.

Further to the development of the Scoping and ToR reports, the original scoping session provided an early forum for interested parties to discuss their concerns or issues with the Project with a broad cross-section of parties selected, addressing the national consultation requirements. While the plant sizing is slightly smaller than the original maximum size considered in 2015 (up to 80MW was originally envisaged though the planned size is closer to 50MW) the Project site and general concept remain the same. As a result, it is considered that the findings of the stakeholders' discussion held in 2015 remain relevant. This also corresponds to MoE's acceptance of the Scoping and ToR reports in January 2017 (and Cabinet approval in principle for the Project in December 2016).

The scope of the EIA is summarised in Section 6.

6.2.4 ENVIRONMENTAL IMPACTS ASSESSMENT PROCESS

A comprehensive study of the baseline environmental conditions of the Project location, the potential environmental and social impacts of the Project during construction and operation and appropriate mitigation measures recommended to minimise the impact on the environment are presented in the EIA Report. The EIA process included the following stages:

- Screening process which concluded that a full EIA was required to satisfy the MoE and lender bank requirements;
- Scoping session which allowed interested and affected parties to participate in the EIA process and present their concerns;
- Collection of baseline data to describe the environmental conditions of the Project site;
- Impact assessment to assess the potential environmental and social impact of the Project during construction and operation; and
- Implementation of mitigation measures and monitoring programmes including the preparation of an Environmental and Social Management Plan (ESMP) and Stakeholder Engagement Plan (SEP) for the Project.

6.2.5 ENVIRONMENTAL AND SOCIAL BASELINE

The EIA baseline data were collected through a combination of stakeholder engagement, desktop-based review, field surveys and review of literature. In addition, it also provides a concise description of the Project site and adjacent environment which are vital sources of information to effectively identify and assess the potential environmental and social impacts that may arise during the implementation of the Project.

The baseline data collection has also included specialised surveys and studies and field surveys that ensure impact assessments have been based on current site conditions. The list of specialised studies and field surveys undertaken for the Project is presented in Table 6-1.

Table 6-1 Summary of the EIA Scope from the ToR

ASPECT	BASELINE ASSESSMENT	CONSTRUCTION PHASE	OPERATIONAL PHASE
Air Quality	Desk base study and literature review	Qualitative assessment of the effects of particulate matter according to relevant guidance	Qualitative assessment based on operational and maintenance activities
Noise	Short-term noise monitoring (15 minute periods) at each Project boundary Long-term noise monitoring (24 – 48 hours) at one location on at the southern Project boundary	Noise prediction for based on BS5228-1:2014 Quantitative assessment	Qualitative assessment based on manufacturers specification of plant and equipment
Waste Management and Energy Efficiency	Review of Al Manakher and the Amman Governorate waste management	Production of waste inventory Desk based review of waste strategies for the Project	Production of waste inventory
Soil, Hydrology and Water Quality	Desk based review of existing studies and mapping Phase 1 site walkover	Qualitative assessment of contamination risk	Qualitative assessment of contamination risk
Wastewater and Water Resources	Review of existing water resources, wastewater collection and associated treatment systems	Qualitative review of wastewater generation and disposal options	Qualitative review of wastewater generation and disposal options Review of selected storm water drainage design
Terrestrial Ecology	Ecology survey including quadrat and transect sampling for flora and fauna	Mapping of ecology features and assessment of the Project footprint upon existing ecology	Qualitative to identify enhancement measures
Socio-economic	Stakeholder consultation and review of existing demographic information	Qualitative assessment	Qualitative assessment
Cultural Heritage and Archaeology	Review of Jordan Antiquities Database Site visit with specialist	Mapping of any features and qualitative assessment of activities	Qualitative assessment
Landscape and Visual	Desk based study Prepare Zone of Theoretical Visibility (ZTV) and view point surveys	Review and qualitative assessment of ZTV and viewpoints	Preparation of wireframe Photomontage of 90 degree angles of the Project Qualitative assessment of the ZTV

6.3 RECEIVING ENVIRONMENT

The sensitivity of the receptors or receiving environment to change has been determined using professional judgement and the consideration of existing designations and quantifiable data, where possible. Some examples are as follows:

- IUCN criteria and species listed as Critically Endangered, Endangered or Vulnerable would have to be considered as more sensitive receptors than habitats which are severely modified, damaged or degraded or supporting a generic and common terrestrial habitat;
- Residential areas would generally be considered more sensitive to noise and poorly controlled lighting from a construction site than industrial areas.

When evaluating the severity of environmental impacts, the following factors have been taken into consideration:

- **Impact Magnitude**: The magnitude of the change that is induced (i.e. the percentage of a resource that is lost);
- **Impact Duration**: The time period over which the impact will last;
- **Impact Extent**: The geographical extent of the induced change;
- **Likelihood:** The likelihood that the event will occur during the Project lifecycle; and
- **Regulations, Standards and Guidelines**: The status of the impact in relation to regulations (e.g. discharge limits), standards (e.g. environmental quality criteria) and guidelines.

6.3.1 TWO VARIABLE RISK MATRIX

Table 6-2 and Table 6-3 outline respectively the impact severity and impact likelihood criteria, which would be used within the individual technical assessments.

Table 6-2 Impact Severity Criteria

IMPACT SEVERITY	DEFINITION
Slight	Where the development would cause perceptible improvement or deterioration to the existing environment.
Low	Where the development would cause noticeable improvement or deterioration to the existing environment.
Medium	Where the development would cause moderate improvement or deterioration to the existing environment.
High	Where the development would cause significant improvement (or deterioration) to the existing environment.

Table 6-3 Impact Severity Likelihood

IMPACT LIKELIHOOD	DEFINITION
Extremely unlikely	The event is very unlikely to occur under normal conditions but may occur in exceptional circumstances, e.g. emergency conditions.
Unlikely	The event is unlikely but may occur under normal conditions.
Low likelihood	The event is likely to occur during normal conditions.
Medium likelihood	The event is very likely to occur during normal conditions.
High likelihood	The event will certainly occur during normal conditions.

Table 6-4 and Table 6-5 outline the impact criteria used within the assessment of the proposed Project:

Table 6-4 Definition of impact type

IMPACT TYPE	DEFINITION
Direct Impact	Impacts that result from a direct interaction between a planned Project activity and the receiving environment (e.g. between occupation of a plot of land and the habitats which are lost).
Secondary Impact	Impacts that follow on from the primary interactions between the Project and its environment as a result of subsequent interactions within the environment. (e.g. loss of part of a habitat affects the viability of a species population over a wider area).
Indirect Impacts	Impacts that result from other activities that are encouraged to happen as a consequence of the Project (e.g. presence of Project promotes service industries in the region).
Cumulative impact	Impacts that act together with other impacts to affect the same environmental resource or receptor.
Residual Impact	Impacts that remain after mitigation measures have been designed into the intended activity.

Table 6-5 Impact assessment terminology

IMPACT SEVERITY	DEFINITION
Impact Magnitude	
Magnitude	Estimate the size of the impact (e.g. the size of the area damaged or impacted the % of a resource that is lost or affected etc.)
Impact Nature	
Negative impact	An impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.
Positive impact	An impact that is considered to represent an improvement on the baseline, or introduces a new desirable factor.
Neutral impact	An impact that is considered to represent neither an improvement nor deterioration in baseline conditions.
Impact Duration	
Temporary	Impacts are predicted to be of a short duration and intermittent / occasional in nature.
Short-term	Impacts that are predicted to last only for a limited period but will cease on completion of the activity, or as a result of mitigation / reinstatement measures and natural recovery.
Long-term	Impacts that will continue over an extended period but cease when the Project stops operating. These will include impacts that may be intermittent or repeated rather than continuous of they occur over an extended period of time.
Permanent	Impacts that occur once on development of the Project and cause a permanent change in the affected receptor or resources that endures substantially beyond the Project lifetime.

IMPACT SEVERITY	DEFINITION
Impact Extent	
Local	Impacts are on a local scale (e.g. restricted to the vicinity of the facility etc.).
Regional	Impacts are on a national scale (effects well beyond the immediate vicinity of the Project and affect an entire region).
Global	Impacts are on a global scale (e.g. global warming, depletion of the ozone layer).

6.3.2 SIGNIFICANCE ASSESSMENT

The significance of each impact has subsequently been determined by comparing the impact severity against the sensitivity of the receptor in the impact significance matrix provided by Table 6-6.

Table 6-6 Determining the significance of impacts

		SENSITIVITY OF RECEPTOR				
		LOW	LOW-MEDIUM	MEDIUM	MEDIUM HIGH	HIGH
Impact Severity	No Change	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Major
	High	Minor	Moderate	Moderate	Major	Major
Negligible	Magnitude of change comparable to natural variation.					
Minor	Detectable but not significant.					
Moderate	Significant: amenable to mitigation and should be mitigated where practicable.					
Major	Significant: amenable to mitigation, and shall be mitigated.					

6.3.3 MITIGATION AND ENHANCEMENT MEASURES

Where significant impacts are identified, from moderate levels of significance and above, mitigation and enhancement measures have been identified to prevent, reduce or remedy any potentially significant environmental impacts which cannot be avoided or effectively reduced through changes to the construction or operational methodology. Such measures will need to be implemented during the construction phase or the operational phases or the Project by adopting the control hierarchy principles as illustrated by Figure 6-2.

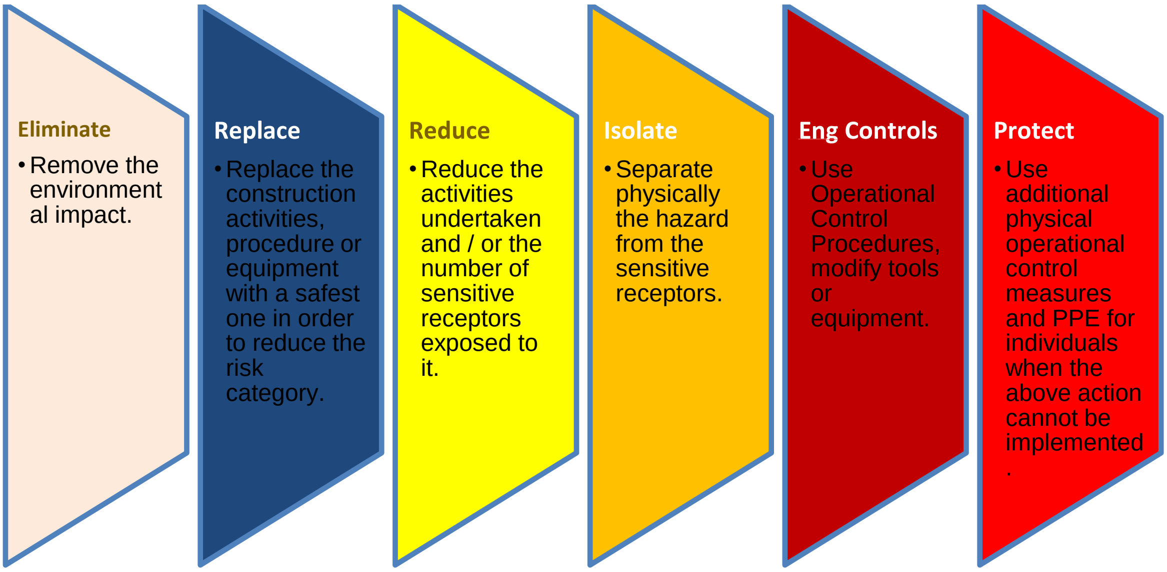

Figure 6-2 Control hierarchy principles

Each technical chapter of the EIA report details the measures recommended to mitigate any identified significant effects and any measures, which may provide positive environmental effects.

6.4 CUMULATIVE IMPACTS

The cumulative impacts of the Project have been considered within the EIA where appropriate. Two types of cumulative impacts have been considered:

- **Type 1 Cumulative Impact**: the combined impacts of different environmental factors from a single development on a particular receptor, e.g. one residential property may experience a degradation in local air quality and an increase in noise levels as a result of a single development; and
- **Type 2 Cumulative Impact**: the combined effects of all developments within the area, e.g. impacts on air quality from one development may not be significant when considered alone, but may be significant in combination with other proposed developments or existing facilities.

6.5 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The accompanying construction environmental management plan (CEMP) (Appendix D) provides the framework by which Wärtsilä (and Project Company) will be expected to manage environmental and social issues on the site. A framework operational environmental management plan has been provided within Section 16.4 , which, it is anticipated that the Project Company will develop closer to the operational phase commencing.

6.6 STAKEHOLDER ENGAGEMENT PLAN (SEP)

The accompanying SEP describes the engagement activities undertaken for the proposed Project, and ongoing approach for engagement with stakeholders including local communities. The proposed developers are key shareholders in the IPP1 and IPP4 power plants, approximately 2km southwest of the Project site. Due to their proximity, these thermal power plants effectively manage community engagement as one entity in order to ensure that, what are often, common issues are resolved together. As a result of the common owners, communities in the local area in particular are likely to consider the proposed Project as part of the overall Project portfolio rather than as an individual Project necessarily. Inputs to the SEP with respect to the Project have therefore considered the existing stakeholder engagement mechanism in place at IPP1 and IPP4 power plants, and have involved the existing community liaison officer at the same sites. It is worth highlighting, however, that with respect to the potential impacts of a solar park on a local community, these differ considerably from thermal power plants, with limited negative impacts associated with the proposed Project particularly during the operational phase.

The following sections assess the proposed Project's impacts on the following aspects:

- Air Quality;
- Noise;
- Waste and Hazardous Waste Management;
- Terrestrial Ecology;
- Soil, Hydrology and Water Quality;
- Landscape and Visual;
- Socio-Economics;
- Cultural Heritage and Archaeology; and
- Health and Safety

The final chapters provide frameworks for the environmental, health and social management on site during construction and operation and the conclusions recommendations.

7 AIR QUALITY

7.1 INTRODUCTION

This Chapter considers the potential impacts of the Project on the air quality within and surrounding the Project site during the construction and operational phases. Where significant impacts are identified, appropriate avoidance and mitigation measures are provided.

The baseline conditions of the Project Site and the surrounding area are presented followed by an assessment of impacts from the Project upon the air quality of the site. Appropriate mitigation options are then examined in addition to potential residual impacts.

7.2 BASELINE

7.2.1 EXISTING CONDITIONS

The type of Project proposed will not result in emissions during the operational phase. Air pollutants associated with the Project will therefore be limited to construction impacts associated with dust creation as a result of earthworks or limited impacts as a result of construction vehicle use on site. As a result, the ToR considered that baseline air monitoring could be scoped out as it would not add value to the assessment. Consideration of the ambient air quality in the area is therefore made on the basis of the most recent monitoring undertaken near the Project area was in 2011 for the IPP4 thermal power plant. While the IPP4 monitoring did not incorporate the emissions from the IPP4 power plant which was yet to be built it is considered that the results provide a general indication of the air quality in the vicinity of the Project site. The monitoring findings indicated that the ambient air quality near the IPP4 power plant does not exceed the more stringent World Bank Group and IFC Guideline for NO_2 or Interim Target 1 for SO_2. One exceedance of Interim Target 1 for PM_{10} was observed during the monitoring period, although it is considered that this is likely a result of high natural particulates given the arid conditions within this region.

A summary of the results of the monitoring compared against the World Bank Group EHS Guidelines are presented in Table 7-1.

Table 7-1 Summary of Ambient Air Quality Results (2011) against World Bank Group EHS Guidelines ((µg/m3)

POLLUTANT	AVERAGING PERIOD	MAXIMUM VALUE	AVERAGE VALUE	WORLD BANK GUIDELINE EXCEEDANCE	INTERIM TARGET EXCEEDANCE
NO_2	1 hour	33.5	6.9	0	-
SO_2	24 hour	111.1	8.2	2	0
PM_{10}	24 hour	975	115	20	3
$PM_{2.5}$	24 hour	18.2	14.5	0	-

A site visit by a WSP | Parsons Brinckerhoff environmental consultant undertaken in January 2017 confirmed that there are no other major sources of air emissions within or adjacent to the study area beyond the IPP1, IPP4 and IPP3 thermal power plants, which are situated approximately 2.5km from the site and 7.5km from the site respectively. It is understood that the IPP1 and 4 power plants are now operating on natural gas following initial operations on diesel. IPP1 initial operation was natural gas then it was switched to Diesel for approximately one year due to limits in natural gas supply, this has since switched back to natural gas. The IPP4 power plants initial operation was on heavy fuel oil (HFO) from the commercial operation date (COD) in July 2014 until September 2015. After this time, the plant was commissioned on natural gas and the plant now operates on natural gas. It is expected that this change of fuel would potentially contribute to a reduction in SO_2 levels in the area potentially in addition to particulate Based on this, it is considered that current air quality conditions in the Project Area are likely consistent with a “moderate” air quality classification according to World Bank Group criteria. Exceedances of the annual mean concentration of Particulate Matter smaller than 10 microns (µ) in aerodynamic diameter (PM_{10}) are considered to be consistent with the arid environment which commonly exhibit such peaks, although the local power plants (if running on diesel) and traffic may also contribute to higher particulate levels.

7.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

7.3.1 ASSESSMENT METHODOLOGY

The closest existing sensitive air quality receptors to the site are considered to primarily consist of the isolated farms. The workers attending the site during the construction phase are also considered to be sensitive receptors with respect to the potential construction impacts of increased dust and exhaust emissions from vehicles. The assessment considers the potential resultant changes to the receptor and assess the overall significance of the impact. Impacts are assessed in the context of the described baseline conditions within the zone of influence during the lifetime of the development. Impacts have been considered in two stages; the construction phase and the operational phase.

ASSESSMENT OF CONSTRUCTION IMPACTS

Construction phase impacts will principally concerned with site clearance and construction activities and will include, but not be limited to:

- Earthworks;
- Building construction; and
- Construction vehicle movement.

These potential impacts have been qualitatively assessed based on the conditions at site and likely mitigation measures.

ASSESSMENT OF OPERATION IMPACTS

Operational phase impacts which will be considered relevant to air quality will include, but not be limited to:

- Maintenance of the PV Panels; and
- Maintenance vehicle movement.

These potential impacts have been qualitatively assessed based on the anticipated methodologies and likely mitigation measures.

7.3.2 SIGNIFICANCE CRITERIA

The significance of impacts to air quality during the construction and operational phases has followed the methodology as outlined in Chapter 6: EIA Methodology.

Air quality impact significance is summarised in Table 7-2

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Table 7-2 Air quality impact significance (importance)

IMPACT	DEFINITION
Positive	The air quality within and surrounding the site is enhanced as a result of the Project
Negligible	Very minor loss or detrimental alteration the air quality within and surrounding the site.
Minor	Some measurable change in the air quality within and surrounding the site; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements
Moderate	Significant impact on the resource, but not adversely affecting the integrity; Partial loss of or damage to key characteristics, features or elements
High / Critical	Loss of resource and/or quality and integrity; severe damage to key characteristics, features or elements

7.4 IMPACT ASSESSMENT

7.4.1 IMPACTS DURING CONSTRUCTION

Construction phase impacts will be largely generic in nature and primarily associated with exhaust emissions and particulate matter and dust raised by construction traffic, excavations, levelling, mixing of raw materials, open storage of raw materials and stationary source emissions (e.g. generators).

While there may be emissions of some fugitive dust during construction, it will be highly localised in nature and for very limited periods without any expected significant impact on the surrounding air quality.

The predominantly sandy and arid environment in Jordan tends to contribute significantly to construction dust and particulate matter emissions. However, as the Project site has already been cleared and levelled by the Ministry of Finance, it is expected that, in this instance there will be less soil movements necessary during the construction period than typical 'greenfield' sites.

Vehicle movements on unpaved roads could also be a cause of fugitive dust emissions where not adequately controlled. In addition, emissions from vehicles, while unlikely to be significant as low numbers of vehicles are expected, may have localised impacts.

The potential construction impacts of the Project on air quality are from key construction activities as follows:

- Earthworks;
- Building construction; and
- Construction vehicle movement.

The amount of dust and air quality emissions generated and their associated impacts will be dependent on the construction techniques used. The main construction activities as a result of the Project anticipated:

- Earthworks:
  - Site levelling;
  - Stockpiling of soils and spoil;

  - Wind blow from exposed soils;
  - Material handling;
  - Stone crushing activities; and
  - Movement of vehicles onsite, particularly on unpaved surfaces.
- Construction
  - Concreting operations;
  - Drainage channel creation;
  - Movement of vehicles onsite, particularly on unpaved surfaces; and
  - Stockpiling of materials.
- Vehicle movements and material handling;
  - Vehicles leaving site carrying friable materials (not expected); and
  - Wind blow from materials transported to site.
- Exhaust emissions from machinery and vehicles.

The above activities may contribute to a localised deterioration in the ambient air quality due to increased exhaust emissions and dust increasing the concentrations of the following pollutants:

- Particulate matter ($PM_{2.5}$ and PM_{10}) – fine particles that can pose the most serious threat to human health as they can penetrate deep into lungs;
- Hydrocarbons (HC) – can irritate the respiratory system, causing coughing, choking, and reduced lung capacity;
- Nitrogen oxides (NO_x) – can cause lung irritation and weaken the body's defences against respiratory infections. In addition, NO_x assists in the formation of ground level ozone and particulate matter;
- Carbon monoxide (CO) – formed by the combustion of fossil fuels such as gasoline and is emitted primarily from cars and trucks. When inhaled, CO blocks oxygen from the brain, heart, and other vital organs. Therefore foetuses, new-born children and people with chronic illnesses are especially susceptible to the effects of CO;
- Sulphur dioxide (SO_2) – can react in the atmosphere to form fine particles and poses a health risk to young children and asthmatics in particular;
- Hazardous air pollutants (toxics) – such as Benzene, acetaldehyde and 1,3-butadiene which have been linked to birth defects, cancer, and other serious illnesses; and
- Greenhouse gases – such as carbon dioxide which contribute to global climate change.

The Project site will not house any workers; however there will need to be facilities in place for worker welfare including toilets, rest areas and places to eat. As such there is the potential for odour impacts to arise during the construction phase should these facilities not be maintained and cleaned appropriately.

As a result of the Project’s location, the main sensitive receptors will comprise the residential property located on the farm to the immediate south of the Project site, other isolated dwellings in the general vicinity of the Project and construction workers. Consideration will also need to be made to transport on the local road with respect to ensuring that dust raised by the Project activities do not result in impeded visibility on the road. Based on the Project location, no impacts are considered likely to impact upon Al Manakher or other community residents.

The dust magnitude of the works resulting from earthworks and construction methods are considered **moderate** due to the dust potential of the material used and the soil material type of the site. The duration of the construction works is expected to be relatively short (<1 year) and therefore any impacts will be temporary. Overall, the risk of dust and construction plant emissions resulting during construction is considered to be **minor** given the size of the development and the timeframe of construction. In the absence of mitigation, the risk of impacts from emissions of dust and other local air quality pollutants from construction activities is considered to be **minor** to **moderate** significance.

The peak number of workers onsite is expected to reach up to approximately 465. An appropriate number of toilet and washroom facilities will need to be maintained during this period with stored wastewater collection facilities for subsequent removal from site for appropriate disposal. The magnitude of impacts relating to odour are therefore considered to be **minor** with a **negligible** significance.

7.4.2 IMPACTS DURING OPERATION

Solar PV systems are passive electric power generation systems. There is no combustion activity that would generate emissions to air. Solar PV systems provide a benefit for the environment as they lead to a reduction of CO_2 emission over the life cycle of the Project when compared to other, more traditional methods of power generation.

The anticipated relatively infrequent panel cleaning (e.g. up to 2 times per month during dry months), will generate small and localised releases of dust considered to be insignificant. During operation, no direct air quality impacts are anticipated from the PV panels, as they do not emit any pollutants.

7.5 MITIGATION

7.5.1 MITIGATION DURING CONSTRUCTION

As the site has already been graded prior to construction, the remaining construction activities which could lead to significant air quality impacts is reduced. However, due to the proximity of the site to the nearby farm (approximately 75m from site boundary) and consideration of the workers on site, construction dust mitigation measures will be required on site. It is anticipated that good construction practices will ensure that any potential impacts are minimised. Mitigation measures to address impacts during construction are included in CEMP.

The measures available to mitigate the air quality impacts from construction activities can be categorised as follows:

- Measures designed to reduce dust and other emissions; and
- Measures designed to monitor dust and other emissions and to provide the triggers for implementing dust reduction measures.

The mitigation measures, included in the CEMP, that are recommended to be included in order to minimise and/or control the impacts on the air quality during construction are as follow:

- Vehicles and vessels carrying loose aggregate shall be appropriately sheeted at all times;
- Vehicles shall not be overloaded while transporting sand, as this may lead to spillage and littering of roads and ensure proper fitting tailgates;
- Minimise offsite movements of material through reuse on site;
- Designated haulage routes around site which will be compacted and dampened;

- Proper signage and control of vehicle speeds (e.g. maximum of 15kph within the site boundary by vehicles moving on un-compacted material and 30kph for routes with compacted material);
- Any remaining activities associated with the grading of material is potentially a source of dust. It is envisaged that such operations will not be undertaken during periods of high wind;
- If stockpiles are used these should be covered or regularly watered, particularly on windy (>15kph wind) days;
- Minimise stock pile heights (circa. 3m). Where stockpiles exceed 3m they should be covered at all times to prevent wind-blown dust;
- Where feasible on large excavations (e.g. substation or inverters) spray water to moisten the area and prevent dust generation;
- Loader operators shall be trained to avoid overfilling their bucket and avoid spilling aggregate during its movement to trucks;
- Loading of materials into the trucks by excavators shall be carried out from minimum height to prevent dust generation;
- During the construction phase, daily visual monitoring of dust arising from the construction activities or construction related transportation activities should be undertaken;
- Ensure appropriate grievance mechanisms are available for workers and outside stakeholders;
- Ensure domestic wastes are appropriately stored in sealed (lids) containers prior to regular disposal at appropriate facilities
- Ensure toilet facilities and septic tanks are regularly emptied before filling;
- Motor vehicles and plant equipment to be fitted with appropriate exhaust equipment to minimise emissions; and
- All vehicles shall be subject to motor vehicle services as specified by the vehicle manufacturer or taken out of service until maintained (at appropriate facilities) should there be significant visible emissions during their operation.

The time of year will greatly affect the potential amount of dust generated as a result of variations in humidity and temperature. Summer winds create increased haze, thus dust suppression measures should be particularly applied during the summer months. Further to this, material movements should be avoided during sand storms or periods of high winds, as these conditions would lead to the greater distribution of fugitive dusts. In the event that dust is visibly being generated during the works, further dampening or mitigation measures would be necessary.

It is important that the control measures identified above are applied during work which generates dust, stockpiling, transportation and disposal operations, both on and off site. Following these procedures will ensure that dust emissions are kept to a minimum.

The CEMP presents a series of mitigation measures specifically designed to address any potential impacts from construction traffic and plant. The implementation of measures through the selected mitigation and monitoring measures, as outlined above, in combination with the construction contractor's CEMP, should be sufficient to reduce construction impacts to minor to negligible significance.

7.5.2 MITIGATION DURING OPERATION

There are no specific mitigation measures proposed for the operation phase given the limited impacts from the Project development. The CEMP presents a number of mitigation measures that will minimise emission from traffic during operations, including:

- Modern, well maintained plant and vehicles to be used for the Project;
- Plant and equipment used on an intermittent basis will be shut or throttled down when not in use to reduce emissions; and
- Avoidance of panel cleaning activities during periods of high wind where possible.

7.6 CUMULATIVE IMPACTS

7.6.1 CONSTRUCTION

There are no expected cumulative impacts with respect to air quality during the construction phase of the Project.

7.6.2 OPERATION

There are no expected cumulative impacts with respect to air quality during the operation phase of the Project.

7.7 RESIDUAL EFFECTS

All predicted air quality impacts can be mitigated for to considerable reduce the impacts, particularly with respect to dust during construction. It is considered that, following the implementation of recommended mitigation measures through the enforcement of a CEMP, the residual impacts upon the air quality and odour of the Project site as a result of dust, fugitive emissions and odour from worker facilities during the construction phase would be **negligible**.

During the operation phase, all residual impacts are considered to be **negligible**.

7.8 SUMMARY OF IMPACTS

A summary of the air quality impacts as a result of the Project are presented in Table 7-3.

Table 7-3 Summary of Air Quality impacts and mitigation measures

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation and Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive or Negative	P/T	D/I	ST/MT/LT		Major, Moderate, Minor, Negligible
Construction							
Dust resulting from earthworks	Moderate	N	-	D	ST	→ Implementation of a CEMP to ensure best practice measures including: ▪ Location of laydowns and stockpiles shall be restricted to within the site boundary; ▪ Dust suppression taking place; ▪ Stockpiles shall be dampened with water or covered in high winds, to reduce fugitive dust; ▪ Minimisation of offsite transport of material through reuse on site; ▪ Haul vehicles shall be sheeted to prevent dust and debris settling on adjacent open desert; ▪ Use of designated transport routes on site which have been compressed or watered down as appropriate; ▪ Restriction of vehicle speeds on site to <15kph on loose sand and <30kph on hard packed ▪ Consideration of initial spraying of water on ground in areas of larger excavations such as substation or inverters. → Motor vehicles shall be fitted with appropriate exhaust equipment to minimise emissions;	Negligible
Dust resulting from other construction methods	Minor	N		D	ST		Negligible
Windblown dust from construction vehicles	Minor	N		D	ST		Negligible
Fugitive emissions from construction vehicle movements	Minor	N		D	ST		Negligible
Odour from workers facilities	Minor	N	-	D	ST		Negligible

DESCRIPTION OF LIKELY SIGNIFICANT IMPACTS	SIGNIFICANCE OF IMPACTS					SUMMARY OF MITIGATION AND ENHANCEMENT AND MONITORING MEASURES	SIGNIFICANCE OF RESIDUAL IMPACTS
	MAJOR, MODERATE, MINOR, NEGLIGIBLE	POSITIVE OR NEGATIVE	P/T	D/I	ST/MT/LT		MAJOR, MODERATE, MINOR, NEGLIGIBLE
						→ All plant and vehicles shall be maintained appropriately and subject to motor vehicle services as specified by the vehicle manufacturer. → Lids on bins at worker facilities. → Regular cleaning of worker facilities and emptying of toilets and septic tanks (before filling). → Positioning of the worker facilities away from sensitive receptors.	

8 NOISE

8.1 INTRODUCTION

This Chapter considers the potential impacts of the Project on the noise within and surrounding the Project site during both the construction and operational phases. Where significant impacts are identified, appropriate avoidance and mitigation measures are provided.

The baseline conditions of the Project site and the surrounding area are presented, followed by an assessment of impacts from the Project upon the noise of the site. Appropriate mitigation options are then examined as well as any potential residual impacts.

8.2 BASELINE

2011 NOISE SURVEY

Baseline noise monitoring was undertaken in 2011 at the IPP4 boundary and for Noise Sensitive Receptors (NSRs) in close proximity to the IPP4 Project. We have summarised the findings of this survey here for background information only.

Short-term noise monitoring was undertaken at the nearest residential sensitive receptor in Al Manakher village, where applicable noise limits were a maximum daytime L_{Aeq} of 55 dB and maximum night time L_{Aeq} of 45 dB.

Additionally, continuous noise measurements were undertaken at Al Manakher village school over a period of 24 hours for 3 days with a measurement period of 60 minutes. The applicable noise limit for Al Manakher Village School was a maximum daytime L_{Aeq} of 45dB. The night-time noise limit was not applicable as this receptor is not in use at night.

Results indicated that noise levels at both receptors within Manakher exceeded ambient regulatory noise limits.

Short-term noise monitoring was undertaken within the boundary of the IPP4 site, where applicable noise limits were a maximum daytime L_{Aeq} of 70dB and maximum night time L_{Aeq} of 65 dB.

The results indicated that noise levels complied with these limits.

2017 NOISE SURVEY

The noise survey for the assessment of the proposed Project was conducted from 16 - 17 January 2017 at seven (7) locations in the vicinity of the Project area. This included six short-term (15 minute) noise measurements within and along the Project boundary and one longer-term (12 hour) noise measurement near the primary source of existing noise in the area; the local highway to the immediate south of the site. Figure 8-1 and Figure 8-2 show the noise monitoring survey being undertaken within the Project site and close to the identified sensitive receptor.

Figure 8-1 Noise monitoring within the Project Site

Figure 8-2 Noise monitoring close to the sensitive receptor

The noise measurement of the road was obtained so that it could be used to assess the existing noise exposure at sensitive receptors in the vicinity of the proposed plant. This establishes a baseline noise level against which noise levels from the activities associated with the proposed power plant can be compared against.

Sound level measurements were conducted using a Rion NL-52 sound level meter. This is a precision “Class 1” integrating sound level meter that records average sound levels over a set period and conforms to British Standard BS EN 61672-2:2013 “*Electroacoustics. Sound level meters. Pattern evaluation tests*”. A ‘Class 1’ Rion NL-74 sound level calibrator was used to calibrate the sound level meter.

The details for this equipment are listed in Table 8-1.

Table 8-1 Equipment used during noise survey

Type	Model	Serial Number	Calibration
Type 1 Sound Level Meter	Rion NL-52	00542883	16/09/2015
Type 1 Acoustic Calibrator	Rion NC-74	34657235	16/09/2015

The measurements were conducted in accordance with International Standard ISO 1996-1:2003 “*Acoustics - Description, measurement and assessment of environmental noise - Part 1: Basic quantities and assessment procedures”*.

In compliance with this standard, the microphone was located in the free field, away from reflecting surfaces and was covered with a wind shield at all times. During the measurement period, adverse weather conditions that may influence the measurements, such as strong winds or precipitation, were noted.

The sound level meter was calibrated before and after measurements and no significant drift (i.e. greater than 0.5 dB(A) from the calibration level of 94 dB(A)) was noted.

Road traffic was the only source of noise identified. The nearest occupied premises is a farm located due south of the proposed plant site, with the most noise sensitive receptor at this farm comprising a residential dwelling located 220m from the southern boundary of the Project site (and 180m from the highway).

Details for each of the noise survey locations and the noise sensitive receptor are provided in Table 8-2 and shown in Figure 8-3.

Table 8-2 Details for noise survey locations and the noise sensitive receptor

ID	LOCATION		MEASUREMENT PERIOD	
	Latitude	Longitude	Start	End
Short-term noise measurements				
NS-1	31°54'16.00"N	36° 6'04.00"E	16 January 2017, 12:14pm	16 January 2017, 12:29pm
NS-2	31°54'25.00"N	36° 5'59.00"E	16 January 2017, 12:36pm	16 January 2017, 12:51pm
NS-3	31°54'33.00"N	36° 6'02.00"E	16 January 2017, 12:57pm	16 January 2017, 1:12pm
NS-4	31°54'35.98"N	36° 6'14.00"E	16 January 2017, 1:21pm	16 January 2017, 1:36pm
NS-5	31°54'38.21"N	36° 6'20.59"E	17 January 2017, 10.06am	17 January 2017, 10:21am
NS-6	31°54'44.00"N	36° 6'08.00"E	17 January 2017, 10:25am	17 January 2017, 10:40am
Longer-term noise measurement				
NS-LT	31°54'18.28"N	36° 6'14.16"E	17 January 2017, 11:15am	17 January 2017, 11:15pm
Noise sensitive receptor				
NSR	31°54'8.75"N	36° 6'6.97"E	N/A	

The results of the noise survey are provided in Table 8-3 and Table 8-4.

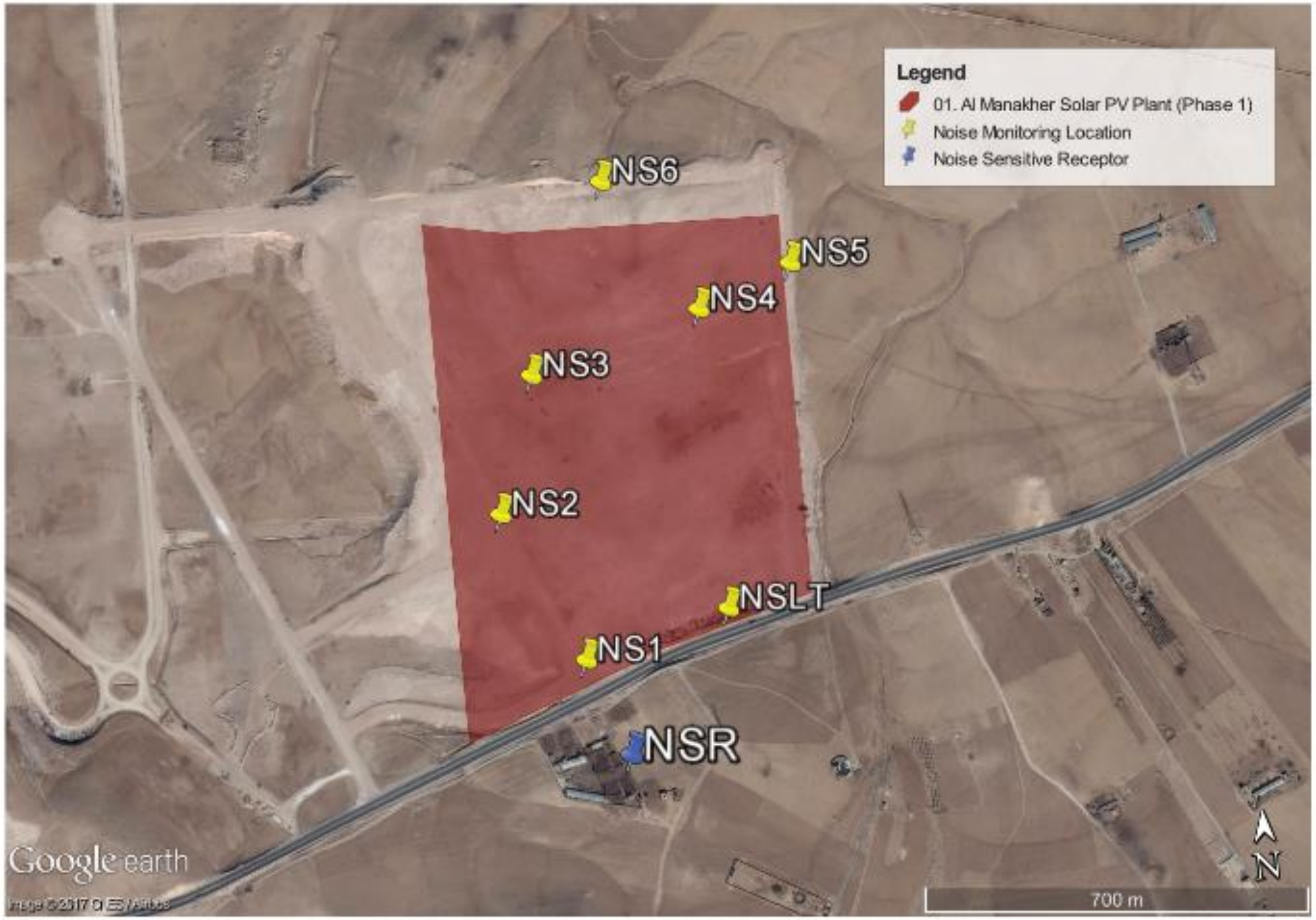


Figure 8-3 Locations of noise monitoring and nearest noise sensitive receptor

Table 8-3 Short term noise measurement results

ID	Average measured sound pressure level, dB(A)			
	L_{Amax}	L_{Aeq}	L_{A10}	L_{A90}
NS-1	87	64	69	42
NS-2	66	48	50	42
NS-3	54	43	45	40
NS-4	53	42	44	39
NS-5	64	51	54	46
NS-6	58	47	50	42

Table 8-4 Longer term noise measurement results

ID	Average measured sound pressure level, dB(A)			
	L_{Amax}	L_{Aeq}	L_{A10}	L_{A90}
NS-LT	Daytime			
	91	69	71	47
	Night-time			
	83	63	61	42

A time history chart of the measured noise levels at NS-LT is provided in Figure 8-4.

To assess the existing noise exposure at NSR (the nearest receptor to the proposed plant) from road traffic along the nearby highway, the UK Department of Transport's "*Calculation of Road Traffic Noise (1988)*" (CRTN) noise prediction methodology has been used.

The L_{Aeq} noise levels at NS-LT, located c.7m from the kerb of the highway, were measured as 68.5 dB(A) during daytime and 62.6 dB(A) during night-time. At a distance of 180m from the highway, CRTN predicts that the noise level should attenuate by a further 12.4 dB(A) due to ground absorption and atmospheric attenuation.

On this basis of the above, noise levels at NSR are predicted to be 56.1 dB(A) during daytime and 50.2 dB(A) during night-time. These results indicate that existing noise levels at NSR are predicted to be currently in compliance with the Jordanian Guidelines for Prevention of Noise (2003) given in Table 4-3. Although these noise levels are predicted to exceed the Performance Standards and Principles and World Bank Group General EHS Guidelines Noise Limits (2007), the IFC and World Bank Group noise limits are considered not to be applicable at this stage as the power plant has yet to be developed though consideration of these elevated levels has been made within the assessment.

8.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

8.3.1 ASSESSMENT METHODOLOGY

CONSTRUCTION PHASE ASSESSMENT

Construction noise guidelines within Jordan are understood to restrict the use of loud construction equipment between 8pm and 6am, except in cases specifically approved by the MoE. It is not currently known whether MoE will provide specific approval for the use of loud construction equipment at night and so this assessment has conservatively assumed that their use will be permitted during this period.

At this stage of the development, exact details of the equipment to be used during construction (i.e. makes & models, quantities and schedules) are yet to be established. Consequently, assumptions have been made regarding equipment usage based on a typical construction methodology.

Noise Level Time History at Noise Measurement Location NS-LT
17 January 2017

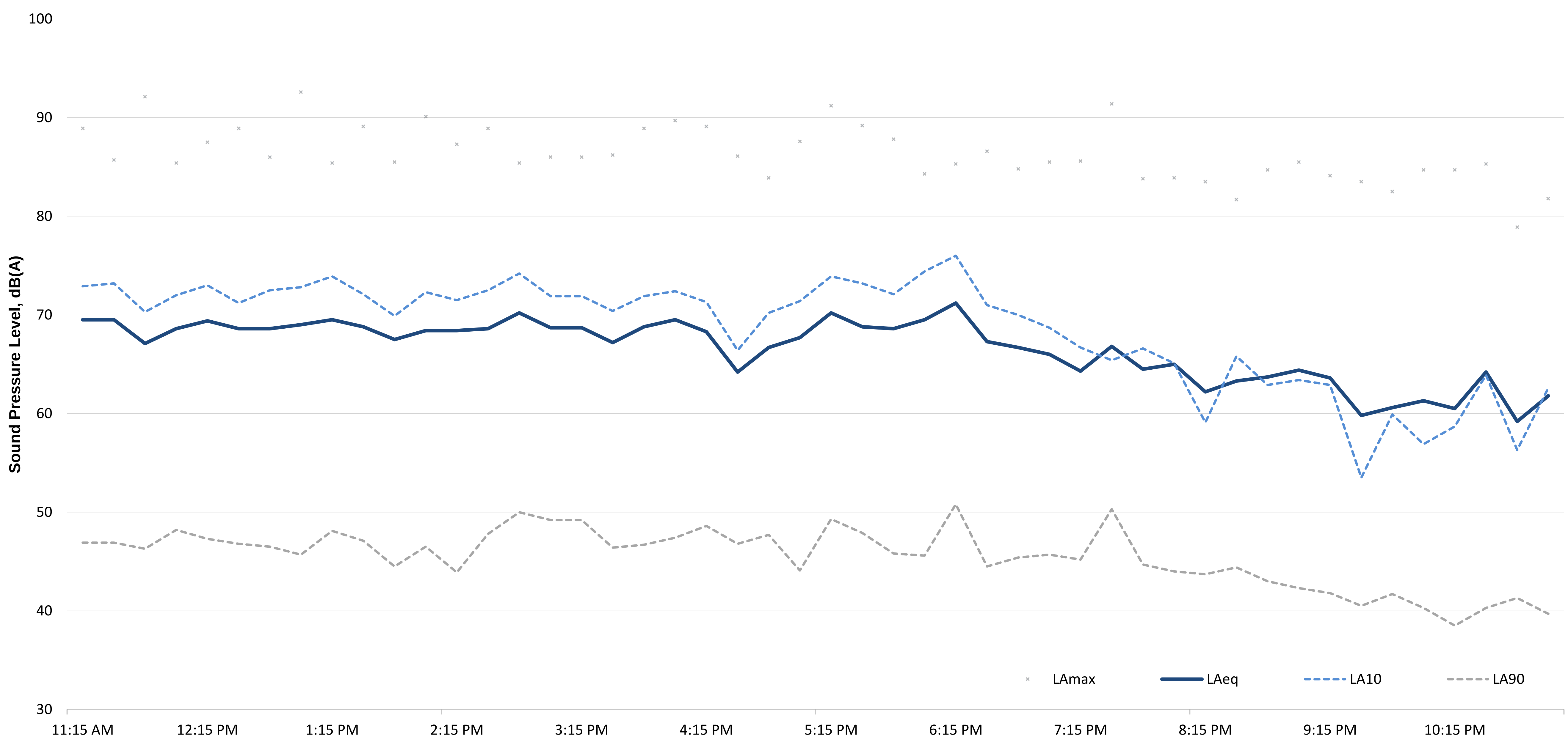


Figure 8-4 Noise Level Time History at Noise Measurement Location NS-LT

It has been assumed that the main construction phases will be as follows:

- Site preparation;
- Civil works;
- Supply and installation of plant and equipment; and
- Mechanical, Electrical and Plumbing ("MEP") works.

The assumed equipment used during each of these phases is presented in Table 8-5, along with the corresponding noise data (i.e. sound power levels) for each item. The noise data has been sourced from BS 5228-1 and references have been provided. Table 8-5 should not be interpreted as a comprehensive list of all equipment likely to be used during these activities; only items that produce significant levels of noise are considered for the noise assessment.

Table 8-5 Assumed equipment usage and sound power levels for construction works

Noise Generating Equipment	Site Preparation	Civil Works	Plant and Equipment	MEP Works	BS 5228-1 2009+A1: 2014, Table Reference	Equivalent Sound Power Level, dB(A) (Per Item)
Dozer	✓	✓			C2. 10	107
Tracked excavator	✓	✓			C2. 14	106
Wheeled loader	✓	✓			C2. 27	107
Articulated dump truck	✓				C2. 33	108
Lorry	✓	✓	✓	✓	C2. 34	107
Vibratory roller	✓	✓			C2. 39	101
Large rotary bored piling rig	✓				C3. 14	111
Cement mixer truck		✓			C4. 18	102
Tower crane		✓	✓	✓	C4. 49	104
Tracked mobile crane		✓	✓		C4. 52	102
Lifting platform			✓	✓	C4. 57	94
Diesel generator	✓	✓	✓	✓	C4. 84	101
Water pump (diesel)	✓	✓			C4. 88	95
Angle Grinder		✓	✓		C4. 93	107

The construction noise assessment has been based on the site preparation phase because (1) this phase of construction is expected to have the greatest noise impact due to the size of the area that will need clearing and levelling and (2) the civil works phase is expected to be of limited duration and scope, by comparison.

To ensure a conservative construction phase assessment, the following assumptions have been made:

- For the equipment listed under "Site Preparation", one of each will be used;
- All equipment will be in use concurrently;
- All items of equipment will be operational for 50% of the assessed time period;
- Noise attenuation provided by any hoarding installed around the site will be negligible (no hoarding is anticipated just chain mesh fence); and,
- Absorption of noise by the ground will be negligible.

Both the typical and “worst case” noise impacts have been assessed. To assess the typical noise impact, noise levels have been predicted for when construction activities will be located near the middle of the Project site, approximately 700m from receptor NSR. For the “worst case”, predictions were made for when construction activities will be localised along the southern property boundary of the Project site, approximately 220m from receptor NSR.

The noise from construction equipment has been predicted using a spreadsheet implementing British Standard BS 5228-:2009+A1: 2014 “*Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*” (BS 5228-1).

OPERATIONAL PHASE ASSESSMENT

Solar PV systems are static generators of electricity and therefore PV modules do not generate any audible sound. However, power inverters used for switching DC to AC sometimes need cooling by fans or air conditioning and these can be a source of noise during operation.

For this development, the power inverters will be located either side of the north-south centre line of the site. Eleven (11) clusters are proposed, with two inverters per cluster, for a total of 22 inverters. The approximate locations of these clusters are shown in Figure 8-5 (adapted from “*Conceptual Plant Layout*”, Wärtsilä, 05/12/16).

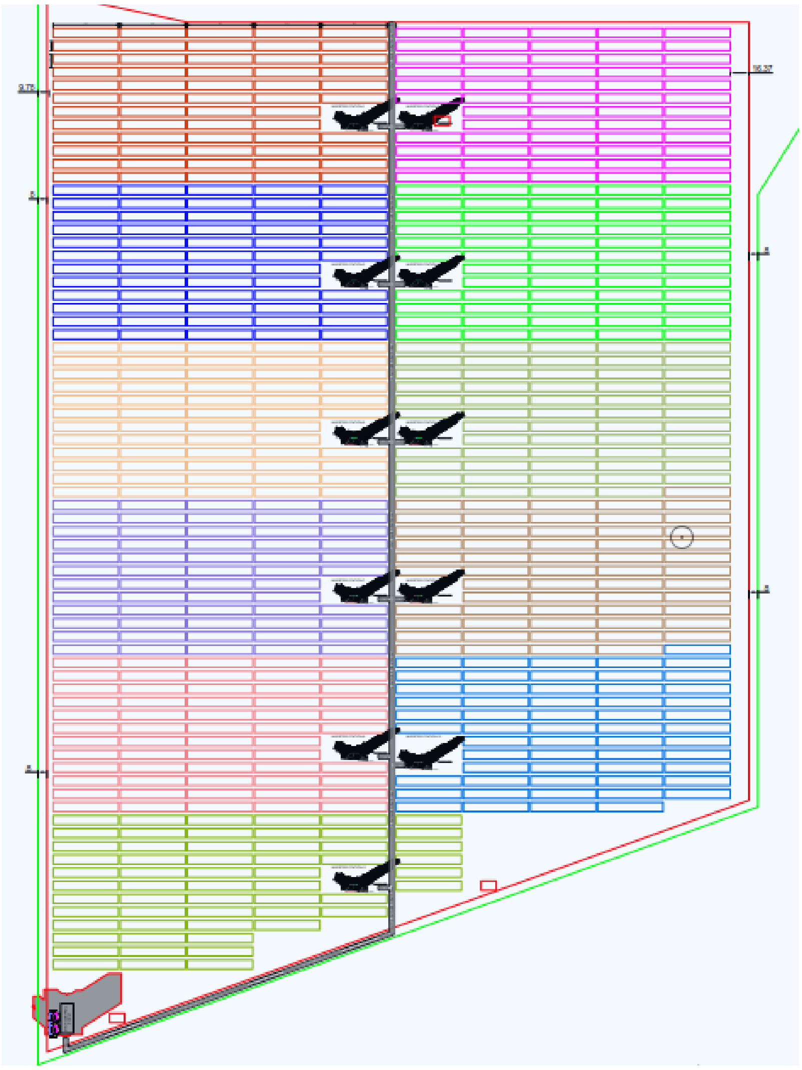


Figure 8-5 Locations of inverter clusters

ABB PVS980-58-2000kW-7 2000kW capacity inverters have been proposed for the Project, although the final inverters haven't been confirmed ("*Al Manakher 50MW Solar PV Project, Document No-DBAD 887764 REV-5, Energy Yield Report*", Wärtsilä, July 2016).

The manufacturers specification for this model lists the maximum noise level as 88 dB(A)[6] ("*Solar inverters: ABB central inverters: PVS980 1818 to 2000kVA*").

The operational noise from the inverters has been predicted using a spreadsheet implementing ISO 9613-2 (1996) "*Acoustics – Attenuation of Sound during Propagation Outdoors – Part 2: General Method of Calculation*" (ISO 9613-2).

[6] This noise level is assumed to be the sound pressure level measured at a distance of 1.0 m.

8.3.2 SIGNIFICANCE CRITERIA

Table 7-14 of the Institute of Environmental Management and Assessment ("IEMA") document "*Guidelines for Environmental Noise Impact Assessments*" (2014) provides typical criteria for classifying the impact magnitude of short-term (e.g. construction phase) and long-term (e.g. operational phase) changes in ambient noise levels. These have been adopted for this assessment and are reproduced in Table 8-6. Note that the nomenclature for the magnitude categories (originally "negligible" to "major") have been modified (to "slight" to "high") to ensure consistency with the nomenclature used by other assessment chapters within this report.

Table 8-6 Impact magnitude criteria for noise and vibration during construction and operation

INCREASE IN NOISE LEVEL, DB(A)		MAGNITUDE OF IMPACT
Construction Phase	**Operational Phase**	
0	0	No Change
0.1 – 0.9	0.1 – 2.9	Slight
1.0 – 2.9	3.0 – 4.9	Low
3.0 – 4.9	5.0 – 9.9	Medium
5.0 or more	10.0 or more	High

The noise impact significance depends upon not only the noise impact magnitude, but also the environmental sensitivity of the receptor affected. Given that the sensitive receptor considered in this assessment (NSR) is a residential dwelling located on a farm, it will have sleeping areas and is therefore considered to be a high sensitivity receptor.

The impact significance criteria for this receptor, adapted from Table 6-6, are given in Table 8-7.

Table 8-7 Determining the significance of impacts

IMPACT SEVERITY / MAGNITUDE	IMPACT SIGNIFICANCE
	HIGH SENSITIVITY RECEPTOR
No Change	Negligible
Slight	Minor
Low	Moderate
Medium	Moderate
High	Major

8.4 IMPACT ASSESSMENT

8.4.1 IMPACTS DURING CONSTRUCTION

The typical increase in ambient noise levels at receptor NSR resulting from construction activities in the middle of the site were predicted and these are given in Table 8-8.

Table 8-8 Typical noise levels predicted due to construction

ID	Predicted L_{AEQ} sound pressure level, dB(A)			
	Existing	**Construction**	**Existing + Construction**	**Increase above existing noise level**
NSR	Daytime			
	56.1	48.2	56.8	0.7
	Night-time			
	50.2	48.2	52.3	2.1

Based on the noise levels given in in Table 8-8, the noise impact magnitudes and significances have been predicted and these are given Table 8-9.

Table 8-9 Typical noise impact magnitudes and significances predicted due to construction

ID	L_{AEQ} increase, dB(A)	Impact magnitude	Impact significance
NSR	Daytime		
	0.7	Slight	Minor
	Night-time		
	2.1	Low	Moderate

The “worst case” increase in ambient noise levels at receptor NSR resulting from construction activities taking place close to the residential boundary were predicted and these are given in Table 8-10.

Table 8-10 “Worst case” noise levels predicted due to construction

ID	Predicted L_{AEQ} sound pressure level, dB(A)			
	Existing	**Construction**	**Existing + Construction**	**Increase above existing noise level**
NSR	Daytime			
	56.1	58.2	60.3	4.2
	Night-time			
	50.2	58.2	58.8	8.6

Based on the noise levels given in in Table 8-10, the noise impact magnitudes and significances were predicted and these are given Table 8-11.

Table 8-11 "Worst case" noise impact magnitudes and significances predicted due to construction

ID	L_{Aeq} INCREASE, DB(A)	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE
NSR	Daytime		
	4.2	Medium	Moderate
	Night-time		
	8.6	High	Major

Based on the results given in Table 8-9 and Table 8-11, the significance of the noise impacts are predicted to be **minor** to **moderate** during daytime and **moderate** to **major** during night-time.

The predicted construction noise level of L_{Aeq} 48.2 dB(A) at receptor NSR, under typical conditions, would **comply** with both the 65 dB(A) day-time and 55 dB(A) night-time noise limits in the Jordanian guidelines.

The predicted construction noise level of L_{Aeq} 58.2 dB(A) at receptor NSR, under "worst case" conditions, would **comply** with the daytime noise limit but would **not comply** with the night-time noise limit in the Jordanian guidelines.

As noted previously, the World Bank Group/IFC noise limits are not directly applicable during the construction phase, as they are intended for assessing noise during operations only.

8.4.2 IMPACTS DURING OPERATION

The maximum increase in noise levels at receptor NSR resulting from operational activities (i.e. noise from the inverter cooling fans) have been predicted and these are given in Table 8-12. As this will be a solar power plant, it is understood that the power inverters (and their fans) will not be operating at night.

Table 8-12 Typical noise levels predicted during operation

ID	PREDICTED L_{AEQ} SOUND PRESSURE LEVEL, DB(A)			
	Existing	**Operation**	**Existing + Operation**	**Increase above existing noise level**
NSR	Daytime			
	56.1	42.9	56.3	0.2
	Night-time			
	50.2	-	50.2	0

Based on the noise levels given in in Table 8-12, the noise impact magnitudes and significances have been predicted and these are given in Table 8-13.

Table 8-13 Typical noise impact magnitudes and significances predicted during operation

ID	L_{AEQ} INCREASE, DB(A)	IMPACT MAGNITUDE	IMPACT SIGNIFICANCE
NSR	Daytime		
	0.2	Slight	Minor
	Night-time		
	0	No change	Negligible

Based on the results given in Table 8-12 and Table 8-13, the significance of the noise impacts are predicted to be **minor** during daytime and **negligible** during night-time.

The predicted maximum operational noise level of L_{Aeq} 42.9 dB(A) at receptor NSR would **comply** with both of the following;

- The 65 dB(A) daytime and 55 dB(A) night-time noise limits in the Jordanian guidelines; and,
- The 55 dB(A) daytime and 45 dB(A) night-time noise limits in the World Bank Group/IFC noise guidelines.

Additionally, the plant is predicted to increase ambient noise levels during operation by no more than 0.2 dB(A) and would therefore **comply** with the IFC and World Bank Group guideline that noise levels at the nearest off-site receptor should not increase by more than 3 dB(A) as a result of operations.

8.5 MITIGATION

8.5.1 CONSTRUCTION

The daytime noise levels at receptor NSR during construction are predicted to **comply** with the Jordanian noise limits under both typical and “worst case” conditions and have a noise impact significance that is **minor** to **moderate**.

The night-time noise levels at receptor NSR during construction are predicted to **comply** with the Jordanian noise limits under typical conditions, but **not comply** under “worst case” conditions, with a noise impact significance that is predicted to be **moderate** to **major.**

On the basis of the findings above, it is recommended that construction activities are limited to daytime only to prevent noise impacts of major significance and non-compliance with the Jordanian noise limits at the nearest receptor.

Furthermore, it is recommended that the contractor implement the attached Construction Environmental Management Plan (CEMP) to minimise the disruption caused. It is recommended that the following general guidelines are integrated into this CEMP where practical:

- If noise exceeds the noise limits the use of acoustic screens or noise attenuation measures shall be implemented;
- Items of plant on site operating intermittently shall be shut down in the intervening periods between use;
- Electrically powered plant should be used, where practicable, rather than mechanically powered alternatives;
- All mechanically powered plant shall be fitted with suitable silencers;

- Proper PPE shall be provided to all personnel working in high noise areas;
- Appropriate breaks shall be provided to personnel working in high noise areas;
- High noise warning sign boards shall be placed in high noise areas such as excavation, cutting, grinding;
- Where noise thresholds are exceeded during construction works it is the responsibility of the Contractor to develop alternative ways of working to reduce noise levels to acceptable levels

A noise grievance register should be established to provide written records of any noise complaints as follows:

- The nature of noise complaints (e.g. shouting, equipment noise, etc.);
- The contact details of the complainant;
- An assessment of the validity of the complaint; and
- The actions taken, if any.

8.5.2 OPERATION

The noise levels at receptor NSR during operations are predicted to **comply** with both the Jordanian and IFC and World Bank Group noise guidelines and have a noise impact significance that is **minor** during daytime and **negligible** at night.

Although a noise impact of minor significance has been predicted during daytime, it represents a noise level increase that is 0.2 dB(A); a change that is well below the threshold of human perception.

On this basis, no noise mitigation measures are considered necessary.

8.6 CUMULATIVE IMPACTS

There are no known developments in operation, or planned, in the immediate vicinity of the Project site and so cumulative noise impacts are not predicted.

8.7 RESIDUAL EFFECTS

The implementation of a Construction Environmental Management Plan (CEMP) has been recommended to minimise the disruption caused. If this is implemented, the residual noise impact significance during construction is expected to be as follows:

- **Negligible** to **minor** during daytime, and;
- **Minor** to **moderate** during night-time.

It is recommended that construction be limited to daytime only. If this is implemented, the residual noise impact significance during construction is expected to be **negligible** at night-time.

Noise mitigation measures have not been recommended for the operational phase and so the residual noise impact significance should remain unchanged during this phase.

8.8 SUMMARY OF IMPACTS

A summary of the noise impacts as a result of the Project are shown in Table 8-14.

Table 8-14 Summary of noise impacts and mitigation measures

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	**Positive or Negative**	**Permanent or Temporary(P/T)**	**Direct or Indirect (D/I)**	**Short Term (ST) Medium Term (MT) Long Term (LT)**		**Major, Moderate, Minor, Negligible**
Construction							
Typical conditions							
Daytime	Minor	Negative	T	D	MT	→ Implementation of Construction Environmental Management Plan (CEMP)	Negligible
Night-time	Moderate	Negative	T	D	MT	→ Implementation of Construction Environmental Management Plan (CEMP)	Minor
"Worst case" conditions							
Daytime	Moderate	Negative	T	D	ST	→ Implementation of Construction Environmental Management Plan (CEMP)	Minor
Night-time	Major	Negative	T	D	ST	→ Restriction of construction to daytime only **(Preferred mitigation option)**	Negligible
						→ Implementation of Construction Environmental Management Plan (CEMP)	Moderate
Operation							
Daytime	Minor	Negative	P	D	LT	→ No mitigation required	Minor

DESCRIPTION OF LIKELY SIGNIFICANT IMPACTS	SIGNIFICANCE OF IMPACTS					SUMMARY OF MITIGATION / ENHANCEMENT AND MONITORING MEASURES	SIGNIFICANCE OF RESIDUAL IMPACTS
	Major, Moderate, Minor, Negligible	**Positive or Negative**	**Permanent or Temporary(P/T)**	**Direct or Indirect (D/I)**	**Short Term (ST) Medium Term (MT) Long Term (LT)**		**Major, Moderate, Minor, Negligible**
Night-time	Negligible	-	P	D	LT	→ No mitigation required	Negligible

9 WASTE AND HAZARDOUS WASTE MANAGEMENT

9.1 INTRODUCTION

The construction, operational and decommissioning phases of the proposed Project will generate a diverse range of waste streams, either classified as non-hazardous, hazardous or electronic waste (E-waste).

This Chapter provides an overview of the types of wastes likely to be produced during the life cycle of the Project and assesses the potential environmental impacts of these waste streams during the construction, operational and decommissioning phases.

This Chapter also introduces opportunities for the implementation of mitigation measures aligned with the Waste Management Hierarchy Principle requirements to be adopted in order to reduce potential impacts arising during each phase of the development.

9.2 BASELINE

9.2.1 EXISTING CONDITIONS

9.2.1.1 WASTE MANAGEMENT IN JORDAN

The growing industrialisation and high population growth rate within Jordan has led to a rapid increase in solid waste generation, which has, in turn, put increasing pressure on limited waste management infrastructure. The below information were extracted from "*The Country report on the Solid Waste Management in Jordan, April 2014, German Cooperation*" (German Cooperation, April 2014).

Approximately 2 million tonnes of municipal solid waste (MSW) is generated in Jordan each year with most of it diverted to unsanitary landfills, leading to public health risks, adverse environmental impacts as well as socio-economic concern of issues (Yamin, 2015).

The predominant fraction in Jordanian MSW is organic matter which makes up as much as 60% of the solid waste stream. Being a relatively modest Middle Eastern country, the per capita waste generation in Jordan is estimated to be 0.9 kg per day.

It is estimated that Jordan generates about 2 million tons of MSW, 45,000 tons of hazardous industrial waste, and 4,000 tons of medical waste. (German Cooperation, April 2014).

MSW collection coverage is estimated at about 90% for urban areas and 70% for and rural areas, with the overall composition consisting of 50% of food waste and 35% of packaging waste. Most of MSW streams are diverted into dumpsites and landfills, whereas only 7% are currently recovered informally in the Kingdom (German Cooperation, April 2014).

To date, there are no up-to-date accurate records associated with the quantity and quality of the hazardous industrial waste streams or waste electronic and electrical equipment (WEE). Nevertheless, it has been estimated that 45,000ton per year of hazardous waste streams was generated in 2012 throughout the country including an estimated 10,000-15,000ton per year of waste oil, which is either:

→ Diverted into the sewer system;

- Directly disposed of on open land;
- Burned directly as a fuel leading to severe environmental and health impacts; and
- Collected for further treatment and processing such as refining.

The total annual construction permits in Jordan is estimated to be approximately 11.8 million m^2 per year resulting in very significant volumes of construction and demolition (C&D) waste, however no adequate strategy or plans have been adopted to date (German Cooperation, April 2014).

Various governmental agencies are involved in waste management, either as policy makers, regulators, or operators, with most typical examples being identified as the Ministry of Environment, by the virtue of Environment Protection Law No. 52/2006 and its executive regulations, and Municipalities, which are directly responsible for MSW service delivery.

Table 9-1 and Table 9-2 introduce key facts and figures on solid waste management in Jordan for the year 2012, and were extracted from the Country Report on The Solid Waste Management – Jordan released by the German Cooperation – Deutsche Zuammenarbeit in 2014.

Table 9-1 Technical Performance – MSW (German Cooperation, April 2014)

Ref. Number	Parameter	Unit	Value
1	Population	No.	6,388,000
2	Municipal Solid Waste Generation	Tonnes per year	2,077,215
	Composition	%	50
	Food Waste	%	34.5
	Dry Recyclables	%	15
	Paper and Cardboard Waste	%	2
	Glass	%	1.5
	Metals	%	16
	Plastics	%	15.5
	Others	%	
3	MSW per Capita		
	Urban	Kg/capita/ day	0.9
	Rural	Kg/capita/ day	0.6
4	Estimated MSW general annual growth	%	3
5	Hazardous industrial waste generation	Tonnes per year	45,000
6	Medical waste generation	Tonnes per year	4 000
7	Agricultural waste generation	Tonnes per year	≥ 4 million
8	Packaging waste generation	Tonnes per year	700 000
9	Construction and demolition waste generation (Amman)	M^3 per year	2.6 million
10	Scrap tyres generation	No. per year	2.5 million
11	Waste oil generation	Tonnes per year	10,000-15,000
12	E-waste generation	Piece per Year	30 000

Table 9-2 Technical Performance – Other Waste Streams (German Cooperation, April 2014)

REF. NUMBER	PARAMETER	UNIT	VALUE
1	Number of hazardous industrial waste treatment centres	No.	1
2	Number of medical waste treatment units	No.	.30
3	Number of manure composting plants	No.	1
4	Number of scrap tires recovery plants	No.	15
5	Number of scrap tires recycling plants	No.	2
6	Medical waste treated in existing facilities per year	%	50
7	Hazardous industrial waste treated and/or stored in Swaqa per year	%	10

POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

→ National Solid Waste Management Policies

Jordan does not have a consolidated solid waste management policy, however the Government of Jordan has adopted a series of regulatory requirements, including but not limited to the Environment Protection Law No. 52/2006 and related regulations:

- Solid waste management regulation No. 27 /2005.
- Waste oil handling and management instructions (2003).
- Hazardous waste handling and management instructions (2003).
- Fee collection for hazardous waste treatment and disposal instructions (2004).
- Organic compost (animal and plant origin) storage, production, trading, and use instructions (2009).
- Nuisance prevention and waste collection fees for Greater Amman Municipality No. 83/2009.
- Buildings and zoning regulation in the City of Amman No. 67/1979 and amendments (latest No. 21/2005).
- Nuisance prevention and waste collection fees for Municipalities No. 1/1978 and amendments (latest No. 72/2009).
- Medical waste management instructions No. 1/2001.
- Industrial and Hazardous Waste Management

The Ministry of Environment regulates, monitors, and enforces hazardous industrial waste management requirements through the Hazardous Waste Handling and Management instructions of year 2003. The Ministry of Environment acts as the operator for Swaqa hazardous waste treatment centre, the only licensed facility for central storage, treatment, and disposal of hazardous waste in Jordan.

→ Packaging Waste

Currently, there is no specific definition for packaging waste stream in regulations. However, packaging waste that is generated from residential, commercial, institutional, and industrial sources is collected, transferred, and disposed of along with municipal solid waste through Municipalities and joint services councils. This is undertaken by the virtue of Municipalities Law No. 13/2011 and amendments (latest No. 7 /2012), and nuisance prevention and waste collection fees for Greater Amman Municipality No. 83/2009, and nuisance prevention and waste collection fees for Municipalities No. 1/1978 and amendments (latest No. 72/2009).

The municipal solid waste management strategic planning study (2012-2022) for Greater Amman Municipality sets the conceptual framework for a phased introduction of waste separation at source in almost 50% of Amman City coupled with a clean material recovery facility - 70,000-100,000 tonnes per annum supported by a 5-10% recovery target. Greater Amman Municipality has developed and operates three pilot separation-at-source projects: Marka, Daheyat Al Hussein, and Um Uthyna.

→ Construction and Demolition (C&D) Wastes

Municipalities regulate, monitor, and enforce C&D waste management, with this mandate stipulated in the Municipalities Law No. 13/2011 and amendments (latest No. 7/2012), and in the nuisance prevention and waste collection fees for Greater Amman Municipality No. 83/2009, and nuisance prevention and waste collection fees for Municipalities No. 1/1978 and amendments (latest No. 72/2009).

Although there is a lack of specific regulations or instructions for Municipalities, Greater Amman Municipality does regulate C&D waste final disposal, by the virtue of the buildings and zoning regulation in the City of Amman No. 67/1979 and amendments (latest No. 21/2005).

For developments within Greater Amman Municipality, whether involving excavation or renovation, a permit is granted against a security for the proper handling and disposal of C&D waste in designated disposal sites. However, considerable quantities of C&D waste streams are still diverted to illegal dumpsites. In some cases, an approval for land owners to dump C&D waste on their land may be granted by the Ministry of Environment, but this approval is limited by time and quantity.

→ Oil and Lubricants

The Ministry of Environment regulates, monitors, and enforces waste oil handling and management, by the virtue of waste oil handling and management instructions of year 2003.

The Water Authority of Jordan prohibits the discharge of any wastes or liquids, including waste oil, into the public sewage system, by the virtue of Sewage system No. 66/1994 and amendments regulation.

→ E-Waste

The Ministry of Environment regulates, monitors, and enforces E-waste handling and management, by the virtue of Environment Protection Law No. 52/2006; however no specific regulations or instructions that regulate E-waste management have been established to date.

There are limited records or studies available which provide breakdowns of E-waste streams processing and final disposal or recycling options. As such, given the lack of separate information it is assumed therefore that E-waste streams are predominantly disposed of in municipal solid waste containers and collected informally by mobile scrap dealers for recovery of plastics and metal components.

In 2010, Greater Amman Municipality opened a drop-off centre for E-waste at al Yarmouk waste transfer station.

→ International financial assistance programs

Greater Amman Municipality obtained a loan from the International Bank for Reconstruction and Development – World Bank Group (USD 25M) toward the cost of the Amman Solid Waste Management Project (USD 40.5M), 2009-2014.

The main objectives of Amman Solid Waste Management (SWM) Project were to strengthen the operational, financial, and environmental performance of municipal solid waste management in Amman and to improve the municipal capacity for better planning and management including enhanced cost effectiveness and efficiency.

The institutional component of the Project included technical assistance and capacity-building activities benefiting municipal departments involved in the planning, development, operation, and evaluation of SWM services. The infrastructure component included extension of the existing landfill and Direct By Owner (“DBO”) contract for landfill gas recovery and power generation.

PROJECT SITE

The proposed Project is located within a 2-3km radius of previously developed power plants (IPP1 and 4) and Al Manakher village. While no specific information is available, based on typical generation from operational plants and the relative small size of the village, it is anticipated that neither the power plants nor the village generate significant amounts of solid waste. It is expected that MSW streams would be predominantly generated by domestic activities undertaken at the residential dwellings and from those of the industrial units, while hazardous waste streams would mainly generated during maintenance activities undertaken at the power plants.

The closest landfill to the Project was identified to be Gabawi landfill, positioned approximately 7km east from the Project and extending over an area estimated to be 50 acres, as illustrated by Figure 9-1. The Greater Amman Municipality has the duty to collect, transport, and dispose the waste to Al Ghabawi landfill site, which is considered to be the largest landfill in Jordan serving Amman and 10 other major cities.

Figure 9-1 Nearest landfill site to the Project site

Ghabawi landfill is the first disposal facility operating in Jordan which has been designed with a gas collection system, where the electricity will delivered to the national grid. It is reported this waste management facility receives approximately 3,000 tons of waste per day (Yamin, 2015).

The Project footprint area supports at the existing time undeveloped graded land, however, C&D waste streams were encountered along the southern and eastern boundary in the course of the site reconnaissance undertaken on the 16-17 January 2017, as illustrated in Figure 9-2 and Figure 9-3.

Figure 9-2 Construction waste along the southern perimeter of the proposed Project.

Figure 9-3 Construction waste along the eastern perimeter of the proposed Project.

9.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

9.3.1 ASSESSMENT METHODOLOGY

This assessment focuses on key waste management issues associated with the Project that could have an impact upon the environment. The assessment also aims to identify opportunities which may reduce the likelihood or severity and subsequently the degree of significance of the environmental impacts. The waste streams anticipated to be generated from the Project are detailed within Table 9-3, and further discussed in the subsequent sections of this Chapter, detailing if they are associated with either tailored to the construction, operational or decommissioning phases of the Project.

Table 9-3 Waste categories

WASTE CATEGORY	DESCRIPTION
Excavated waste	As the Project site has already been cleared and graded, minimal excavations are expected to occur. However, as part of the pre-construction site activities, some further excavation activities may be required across the Project footprint area requiring the disposal of bulk excavated soils. The excavated waste generated as part of this Project will be more likely to be associated with trenching activities for example for drainage channels.
Municipal solid waste	This refers to the general waste that will be generated mainly during both construction and operational phases of the Project by construction workers and future operational employees of the facility.
Inert waste	During the construction phase, an assortment of inert waste streams is likely to be generated. The likely range of waste streams associated with infrastructure, building construction and site preparation would include but not limited to: → packaging made of paper, cardboard, plastic, wood, metal, composite; → concrete and bricks; → mixtures of concrete, bricks, tiles and ceramics (non-hazardous); → wood; → glass; → plastic; → iron and steel; → aluminium; → mixed metals; → cables; → soil and stones; → insulation materials; and → mixed construction and demolition wastes.
Hazardous waste	Hazardous waste is a waste with properties that make it potentially dangerous or harmful to human health or the environment. Hazardous wastes can be liquids, solids, or gases. The likely range of waste associated with infrastructure, building materials in the course of the life cycle of the Project may include: → waste oil; → paints; → oils; → tyres; → acid; → used spill kit materials; → contaminated soils; → coating substances; → batteries → capacitors; → used chemical drums; → hydrocarbon waste.
Demolition Waste	Demolition waste streams are anticipated to be generated as a consequence of temporary structures expected to be erected during the construction phase, and during the decommissioning phase of the Project including but not limited to: → asphalt; → concrete; → wood; → gravel; and → scrap metal.

WASTE CATEGORY	DESCRIPTION
Landscape Waste	Green waste is anticipated to be generated from necessary vegetation clearing activity during pre-construction work and during the operational phase of the Project, however, as the Project footprint area currently supports undeveloped disturbed land, it would anticipated that the associated volume would not be significant.
E-Waste	While E-Waste streams, including PV solar panels, are expected to be generated during the construction (damaged materials) and operation (repair activities) phases, it is envisaged that the main generation of this specific waste stream would occur in the course of the decommissioning phase of the Project.
Wastewater	This refers to used water which will be typically disposed of into sewerage networks (which do not exist on site) or into an underground holding tanks, prior to removal by approved waste management service providers. This also includes effluent from construction activities.

For the purposes of this EIA, the above waste streams have been broadly classified into three different categories as presented in Table 9-4 below. Due to their diverse characteristics, different categories of solid waste streams would require specific storage and handling arrangements and subsequent recycling and disposal arrangements in order to avoid risks to the environment and human health.

Table 9-4 Waste Classification

NATURE OF WASTE	DEFINITION	EXAMPLES
Hazardous Waste	Waste streams which can be dangerous or potentially harmful to human health or the environment. Hazardous waste are characterises according to four factors: toxicity, ignitibility, corrosiveness and reactivity. Hazardous wastes can be liquids, solids, gases, or sludge.	Asbestos, aerosols, fuel, oils, paint, solvents, contaminated soil, asphalt, batteries, treated wood, packaging contaminated by hazardous waste etc.
Non-hazardous and inert waste	Waste streams which can degrade chemically or biologically into the environment without any harm to the environment or human health. Waste streams which cannot breakdown in the environment as it is neither chemically or biologically reactive, but excludes E-Waste.	Food waste, vegetation, wood (non- treated), metals, plastics etc. Cement, sand, glass, excavated soil (not contaminated) etc.
E-Waste	E-Waste describes discarded electrical or electronic devices. Used electronics which are destined for reuse, resale, salvage, recycling, or disposal are also considered e-waste. Informal processing of e-waste can lead to adverse human health effects and environmental pollution.	PV Solar panels, mobile phones, base stations, desktop computers, laptop computers, mobile phones, headsets, switches, CD/DVD media, antenna network systems, keyboards, empty toners, processor, random access memories (RAMs), and radio equipment.

The extent of the study area has been determined through considering the range of sensitive receptors that may be impacted by the proposed Project. In the case of waste management, the sensitive receptors are not solely located within the proposed footprint area but would also include waste management infrastructures operating at a regional level. Sensitive receptors are identified based on the following

- The potential linkages between the generation of specific waste streams;
- Volumes of the waste streams; and
- The impact this may have on the surrounding environment.

As previously noted, the principal aim of this assessment is to consider the key waste management issues associated with the construction, operational and decommissioning phases of the proposed Project with particular reference to identifying opportunities for the reduction of the severity or likelihood of significant environmental impacts. The methodology deployed within this EIA has included a number of distinct tasks:

- A site reconnaissance undertaken on 16-17 January 2017 in order to gain an understanding of issues regarding waste management on the existing Project footprint area and its vicinity;
- A desktop review of publicly information associated with existing waste management infrastructure and regulatory framework in Jordan, and more particularly in the vicinity of Al Manakher, with a primary objective to establish the availability, condition and capacity of the existing waste management infrastructure associated with transportation, recycling, treatment, disposal and recovery operations at local, regional or international level;
- A review of available and accessible waste guidance and policy information.

The following assumptions have been made during the assessment:

- The engineered disposal landfill facility is capable of accommodating the anticipated non-hazardous waste volumes generated during the life cycle of the Project; and
- The Project is at an early design stage and therefore details on waste generation and handling are not yet available. Therefore, the significance of impacts from waste management has been estimated based on the Project's available information and previous experience on similar developments, mainly extracted from literature review.

9.3.2 SIGNIFICANCE CRITERIA

The assessment of potential impacts as a result of the waste management activities of the Project has taken into account the construction, operational and decommissioning phases.

As there are no specific criteria for waste management activities, the measure of assessment is described below and has been based on professional experience and methods used in other similar developments. It evaluates the severity of the waste management operations and the sensitivity of the identified receptors. The waste management impact severity is based on the criteria below:

- Intensity: measure of the degree of change from existing baseline conditions (e.g. increase in organic waste due to vegetation clearance, or introduction of heavy metals associated with E-waste if not managed adequately), and classified as none, minor, low, moderate, high or very high. The categorisation of the impact intensity is based on a set of criteria (e.g. health risk levels, ecological concepts and/or professional judgment). The specialist study quantifies the intensity and outlines the rationale used;
- Duration: refers to the period waste may be generated: i.e. transient (less than one (1) year), short-term (0 to 5 years), medium-term (5 to 15 years), long-term (greater than 15 years with impact ceasing after closure of the Project) or permanent;
- Geographic extent: refers to the area that could interact with waste and is classified as site, local, regional, national, or international. Where by site refers to the Project site, local is within 50km to the Project, regional is >51km-200km, national ≥200km and international refers to trans-boundary movement of waste across international boundaries;

- Waste hierarchy: the internationally recognised waste hierarchy favours waste avoidance, reduction and recycling, with landfill disposal the least desirable option. Management options for all wastes generated will be evaluated against this rank order; and
- Probability: the measure of likelihood of occurrence of a waste type ranked in favour of improbable occurrence. This is classified as improbable (less than 5% chance), low probability (5% to 40% chance), medium probability (40% to 60% chance), highly probable (most likely, 60% to 90% chance) or definite (impact will definitely occur).

The components of all criteria have been ranked and a waste impact severity determined based on the following formula:

Impact Severity of Waste = [Intensity + Duration + Extent + Adherence to Hierarchy] x Probability

The ranking system for each criterion is summarised in Table 9-5.

Table 9-5 Impact Severity Criteria Ranking System

INTENSITY	DURATION OF WASTE GENERATION	GEOGRAPHIC EXTENT	WASTE HIERARCHY	PROBABILITY
10 *(Very high / don't know)*	**5** *(Permanent)*	**5** *(International)*	**0** (Avoid & Reduce)	**5** *(Definite / don't know)*
8 *(High)*	**4** *(Long-term - impact ceases after closure of activity)*	**4** *(National)*	**1** *(Reuse)*	**4** *(Highly probable)*
6 *(Moderate)*	**3** *(Medium-term, 5 to 15 years)*	**3** *(Regional)*	**2** *(Recycle / Compost) assuming 50%*	**3** *(Medium probability)*
4 *(Low)*	**2** *(Short-term. 0 to 5 years)*	**2** *(Local)*	**3** *(Recover)*	**2** *(Low probability)*
2 *(Minor)*	**1** *(Transient)*	**1** *(Site)*	**4** *(Treat)*	**1** *(Improbable)*
1 *(None)*	-	-	**5** *(Dispose)*	**0** *(None)*

The impact severity of waste management has been determined based on the following scores presented in Table 9-6.

Table 9-6 Impact severity criteria

IMPACT SEVERITY SCORE	IMPACT SEVERITY	DEFINITION
<15	Negligible	Development would cause perceptible improvement or deterioration to the existing environment.
15-45	Minor	Development would cause noticeable improvement or deterioration to the existing environment.
45-75	Moderate	Development would cause moderate improvement or deterioration to the existing environment.
>75	Major	Development would cause significant improvement or deterioration to the existing environment.

9.4 IMPACT ASSESSMENT

Sensitive receptors relating directly to the waste impact assessment for the proposed Project are described below:

- Waste infrastructures - the main sensitive receptor relating to hazardous, non-hazardous, inert waste and E-waste generated by the proposed Project will be the waste infrastructures utilised for the treatment, recycling and disposal of the waste streams generated by the Project, both during the construction, operational and decommissioning phases;

- Soil and groundwater - potentially sensitive receptors include soil and groundwater within the proposed Project footprint area which could be adversely impacted by contamination events due to inadequate handling arrangements and storage provisions;
- Construction workers - potentially sensitive receptors that may be exposed to hazardous waste (e.g. solvents, excavated contaminated soil etc.) if adequate procedural and engineering control measures have not been implemented; and
- Operational staff - similar as construction workers, the future operational staff may be exposed to hazardous waste during working hours if the waste management system for the facility is not properly implemented.

Impacts due to contamination on soil, groundwater and proper mitigation measures are discussed in Section 11. Additionally, impacts of hazardous material exposure on construction workers and operational staff as well as proper mitigation measures are discussed within Section 13. The sensitive receptors identified and existing waste infrastructure have been classified based on their type and sensitivity and scaled in Table 9-7.

Table 9-7 Classification of Receptors

Sensitivity of Receptors	Type of Receptors
Waste infrastructure	*Medium*
Soil, groundwater and marine environment	*Medium-high*
Construction workers	*High*
Operational Staff	*High*

9.4.1 IMPACTS DURING CONSTRUCTION

This section illustrates the different impacts during the construction phase of the proposed Project upon the environment and human health associated with waste management practices. No waste quantity estimation at this stage has been provided, however, based on previous experience on similar developments, the construction of the proposed Project is likely to generate relatively significant volume of inert waste (particularly packaging) and various potentially hazardous waste streams, although it is anticipated that the generation of E-waste (e.g. solar panels) would not be significant. Table 9-8 details therefore the waste streams which may be generated during the construction phase of the Project, in addition to introduce potential sustainable waste management options for adoption.

Table 9-8 Construction waste streams

Waste Material	Construction	Recommended Management Option
Asphalt	Generated from the construction of the future plant roads, access roads, parking should they be necessary	Treatment and Reuse
Concrete and cement	Generated from the construction of the temporary buildings and ancillary structures.	Treatment and Reuse
Soil	Generated by the site clearance and excavation works	Treatment and Reuse
Metals	Generated from construction scrap of structural steel (used for PV frames and other framed structures), reinforced bars for reinforced concrete ("RC"), security fence, columns, main	Reuse and/or Recycling

WASTE MATERIAL	CONSTRUCTION	RECOMMENDED MANAGEMENT OPTION
	beams, struts, vertical and horizontal braces, wires, cables, sign board etc.	
Wood/Timber and plasterboard	Generated from packing material and temporary offices.	Reuse and/or Recycling
Chemicals and hazardous waste	Fuels, hydrocarbons & oils, solvents, waste, contaminated soil, sludge, acid, paints, coating substances including elastomeric polyurethane and epoxy type, coal tar and epoxy resin blends, extruded polystyrene board insulation, used chemical drums, used spill kit materials, batteries / capacitors, fluorescent tubes etc.	Appropriate storage and Disposal
Glass and plastics	Generated from the construction administration office, the canteen area which include mostly food packaging, office elements, etc..	Reuse and/or Recycling (and/or treatment and disposal for fibreglass)
PV Solar Panels and E-waste	Generated as a consequence of accidental damage during transportation or mounting stages.	Reuse and/or Recycling (e.g. by panel supplier) E-waste streams would be disposed of in municipal solid waste containers
Electronic	Generated from the operation of the construction administration office, camp which include computers, printers, refrigerators, mobile phones etc.	Reuse and/or Recycling
Cardboard and paper	Generated from the operation of the construction administration office which include office documents, printing, boxes etc.	Recycling
Organic	Landscape waste – generated from site clearance Food waste – generated from daily operations at construction site	Composting

Three main impacts have been identified due to the improper or inadequate management of any waste streams, which have the potential to result in the following:

- Excessive landfill disposal and pressure on the current waste management infrastructures;
- Soil and groundwater ground contamination;
- Health and safety risks for construction workers.

Each category of waste including hazardous, non-hazardous, inert and E-waste, has been assessed below to identify their potential impacts and their potential significance. Please refer to Table 9-9 and Table 9-10, which detail the impact severity and the impact significance on each relevant receptor.

HAZARDOUS WASTE GENERATION

During the construction phase of the proposed Project, it is expected that hazardous waste streams will be generated, with the quantity being dependant on the mode of construction and waste management practices adopted by the construction contractor.

→ Waste Management Infrastructure

Hazardous waste streams could either be treated within dedicated facilities where available or disposed in an engineered landfill depending on the composition. In a 'worst case scenario', hazardous waste streams would be diverted to the Swaqa hazardous waste treatment centre. However taking into consideration that Jordan operates only one hazardous waste treatment centre, the disposal of the hazardous waste streams on this waste management infrastructure is expected to be of **major negative** significance.

→ Soil and Groundwater

It is anticipated that potential impacts associated the generation of hazardous waste streams during the construction phase of the Project are likely to be of moderate to major negative significance due to the potential to cause contamination if not adequately managed or disposed of, dependent up on the type and volumes of the waste.

Additionally, uncontrolled or unlicensed dumping of waste is also common in the region and physical or procedural control measures should be established in order to ensure that this practice is prohibited during the construction phase of the proposed Project.

→ Construction Workers

During the construction phase of the Project, if adequate mitigation measures are not implemented, construction workers could be exposed to occupational health and safety risks, the impact is therefore considered to be of **major negative** significance. The source of the risk may include but not limited to:

- The handling and exposure to contaminated soil – which can directly cause health issues if inhaled or ingested;
- Paint chips, paint scrapings and contaminated blast residue or masonry, metal and boards that have been painted with lead-based or other heavy metal based paint may also be found within the hazardous waste streams;
- The improper handling and storage of hazardous waste streams – which could cause significant chemical reactions (emergency scenarios) such as explosion, fire, production of dangerous gas, corrosion etc.

NON-HAZARDOUS AND INERT WASTE GENERATION

Raw material waste generated during the construction phase, and associated features, may require off-site disposal. Other than construction waste, it is anticipated that there will be a significant number of construction workers at the proposed Project during the construction phase in addition to temporary site offices. Presently, no waste generation calculations are available, however, it can be assumed that significant amounts of MSW may be generated over the course of the construction phase particularly during the peak phase is approximately 465 workers are expected on the site.

→ Waste Management Infrastructure

Inert waste could be treated, reused and recycled in proper waste infrastructure facilities depending on the composition, while MSW would be diverted for landfilling. In a 'worst case scenario', non-hazardous waste streams would be diverted to an engineered landfill for disposal. However, taking into consideration that Jordan operates only one engineered landfill, the disposal of the non-hazardous waste streams on this waste management infrastructure is expected to be of **minor negative significance**.

→ Soil and Groundwater

Slight changes on the environment are expected if the non-hazardous and inert waste streams are not properly handled, stored and overall managed, which may also generate local nuisance, the impact is therefore considered to be of **minor negative significance**.

→ Construction Workers

By their composition, non-hazardous waste and inert waste streams should not directly impact on construction workers, however, if not adequately managed, local nuisances including but not limited to odour and pest infestation may be generated, the impact is therefore considered to be of **minor negative significance**.

E-WASTE

While the volumes of E-waste generated during the construction phase of the Project are not anticipated to be significant, improper handling and storage arrangements associated with specific waste streams may led to a release of contaminants onto the ground, and potentially leach into the groundwater within the Project footprint area or at the location whether they are disposed of (if not disposed of appropriately).

→ Waste Management Infrastructure

In absence of regulatory framework associated with E-Waste in Jordan and a 'worst case scenario', E-waste streams would be disposed of in municipal solid waste containers and collected informally by mobile scrap dealers for recovery of plastics and metal components. Taking in consideration, that the volumes are anticipated not to be significant, the impact is therefore considered to be of **moderate negative significance**.

→ Soil and Groundwater

It is anticipated that potential impacts associated the generation of E-waste streams during the construction phase of the Project may be of **moderate** to **major negative** significance due to the potential to cause contamination by the release of heavy metals and other pollutants (plastic) if not adequately managed or disposed of (subject to the volumes and receptors at the disposal locations).

Additionally, uncontrolled or unlicensed dumping of waste is also common in the region and physical or procedural control measures should be established in order to ensure that this practice is prohibited during the construction phase of the proposed Project.

→ Construction Workers

By their composition, E-waste waste should not directly impact on the construction workers, the impact is therefore considered to be of **negligible negative significance**.

SUMMARY OF CONSTRUCTION IMPACTS

Based on the ranking system presented in Table 9-5, the potential waste impact severity for the categories of waste anticipated to be generated during the construction phase of the proposed

Project are provided in Table 9-9. This assessment is prior to the implementation of any mitigation measures.

Table 9-9 Potential waste impact severity during construction phase

Type of Waste	Intensity	Duration of Waste Generation	Geographic Extent	Adherence to Waste Hierarchy	Probability	Impact Severity
Impact on waste infrastructure						
Hazardous	8 *(High)*	3 *(Medium-term, 5 to 15 years)*	3 *(Regional)*	5 *(Dispose)*	4 *(Highly probable)*	**76 *(Major)***
Non-Hazardous and Inert Waste	4 *(Low)*	2 *(Short-term. 0 to 5 years)*	2 *(Local)*	5 *(Dispose)*	4 *(Highly probable)*	**52 *(Minor)***
E- Waste	8 *(High)*	3 *(Medium-term, 5 to 15 years)*	2 *(Regional)*	5 *(Treat)*	3 *(Medium probability)*	**57 *(Moderate)***
Impact on soil, groundwater and marine environment						
Hazardous	10 *(Very high / don't know)*	4 *(Long-term - impact ceases after closure of activity)*	3 *(Regional)*	5 *(Dispose)*	4 *(Highly probable)*	**88 *(Major)***
Non-Hazardous and Inert Waste	6 *(Moderate)*	2 *(Short-term. 0 to 5 years)*	2 *(Local)*	5 *(Dispose)*	3 *(Medium probability)*	**45 *(Moderate)***
E- Waste	8 *(High)*	4 *(Long-term - impact ceases after closure of activity)*	3 *(Regional)*	5 *(Dispose)*	4 *(Highly probable)*	**80 *(major)***
Impact on construction workers						
Hazardous	10 *(Very high / don't know)*	5 *(Permanent)*	4 *(National)*	5 *(Dispose)*	5 *(Definite / don't know)*	**120 *(Major)***
Non-Hazardous and Inert Waste	2 *(Minor)*	2 *(Short-term. 0 to 5 years)*	2 *(Local)*	5 *(Dispose)*	4 *(Highly probable)*	**44 *(Minor)***
E- Waste	1 *(None)*	2 *(Short-term. 0 to 5 years)*	3 *(Regional)*	5 *(Dispose)*	1 *(Improbable)*	**11 *(Negligible)***

Table 9-10 Potential construction impact significance summary

	Hazardous Waste	Non-Hazardous and Inert Waste	E-Waste
Waste infrastructure	*Major*	*Minor*	*Moderate*
Soil and groundwater	*Major*	*Moderate*	*Minor*
Construction workers	*Major*	*Minor*	*Negligible*

9.4.2 IMPACTS DURING OPERATION

This section illustrates the different impacts during operation of the proposed Project upon the environment and human health associated with waste management practices. No waste quantity estimation has been provided at this stage, however, based on our experience on similar projects, the operational phase of the proposed Project is likely to generate very low volumes of non-hazardous and inert waste, with the potential too for low volumes of hazardous waste. Table 9-11 details the waste streams which may be generated during the operation phase of the Project, in addition to introduce potential sustainable waste management options to be adopted.

Table 9-11 Operational waste streams

WASTE MATERIAL	OPERATION	RECOMMENDED MANAGEMENT OPTION
PV Solar Panels	Repair and maintenance activities associated with damaged PV solar panels	Reuse and/or Recycling
E-waste	Repair and maintenance activities associated with electrical and electronic modules	Reuse and/or Recycling E-waste streams would be disposed of in municipal solid waste containers
Metals	Repair and maintenance activities associated with electrical and electronic modules	Reuse and/or Recycling
Green Waste	From regular clearance of the Project site	Reuse and/or Recycling
Hazardous Waste	Spent solvents, cleaning agents, oils from vehicles or transformers	Treatment and Disposal
Municipal Solid Waste	From amenity buildings from the Project such as security guards.	Disposal

Three main impacts have been identified associated with the improper or inadequate management of waste streams, which have the potential to result in the followings:

- Excessive landfill disposal and pressure on the current waste management infrastructures;
- Soil and groundwater ground contamination; and
- Health and safety risks for employees.

Each category of waste including hazardous, non-hazardous, inert and E-waste, has been assessed below to identify their potential impacts and their potential significance. Please refer to Table 9-9 and

Table 9-10, which details the impact severity and the impact significance on each relevant receptor

HAZARDOUS WASTE STREAMS

During the operational phase of the proposed Project, it is expected that hazardous waste streams will be generated as illustrated by Table 9-11. Hazardous waste streams including but not limited to cleaning agents associated with the PV solar panels, fuel, oil, grease and chemical residues will be generated mainly from maintenance activities and may potentially to be released onto the soil and subsequently leach into the groundwater. Transformer oils will also likely be necessary and containment around the transformers will be required.

The total volumes and specific details of the hazardous waste streams will be dependent upon the nature and frequency of the repair and maintenance activities undertaken and hence cannot be accurately estimated at this stage of the Project though given the nature of the plant are likely to be relatively low volumes.

→ Waste Management Infrastructures

Hazardous wastes likely to be produced will include cleaning agents associated with PV solar panels, hydrocarbons and oils, solvents, contaminated rags, steel and plastic contaminated drums, paints and greases containers. Periodically it may also include contaminated pipe work, metals and plastics generated during maintenance activities associated with the Project. In a 'worst case scenario', hazardous waste streams would need to be diverted to the Swaqa hazardous waste treatment centre. However, taking into consideration that Jordan operates only one hazardous waste treatment centre, the disposal of the hazardous waste streams on this waste management infrastructure is expected to be of **moderate negative significance**.

→ Soil and Groundwater

It is anticipated that potential impacts associated the generation of hazardous waste streams during the operational phase of the proposed Project are likely to be of **moderate** to **major negative** significance due to the potential to cause contamination if not managed or disposed of properly subject to the type, volumes and receptors.

Additionally, uncontrolled or unlicensed dumping of waste is also common in the region and physical or procedural control measures should be established in order to ensure that this practice is prohibited during the operational phase of the Project.

→ Operational Workers

During the operational phase of the Project, if proper waste mitigation measures are not implemented, workers could be exposed to a health and safety risks. The source of the risk will mostly include inadequate handling and storage arrangements storage which may lead to significant chemical reactions such as explosion, fire, production of dangerous gas, corrosion etc. The general impact is therefore considered to be of a **major negative significance** given the human health consequences.

NON-HAZARDOUS AND INERT WASTE STREAMS

In the course of the operational phase, the proposed Project is likely to generate low levels of non-hazardous and inert waste streams, which are mostly expected to be green waste, municipal waste generated by the maintenance and/or the security workforce, and additional inert waste streams from repair and maintenance activities.

→ Waste Management Infrastructures

Inert waste could be treated, reused and recycled in proper waste infrastructure facilities depending on the composition. In a 'worst case scenario', non-hazardous waste streams would be diverted to an engineered landfill for disposal. However, taking into consideration that volumes of non-hazardous waste generated by the operational phase would be minimal, it is expected that the impact on the existing waste management infrastructures would be considered to be of **a minor negative significance**.

→ Soil and Groundwater

Slight changes on the environment are expected if non-hazardous and inert waste streams are not properly handled, stored and managed, which may lead to local nuisance, the impact is therefore considered to initially be of **minor negative significance**.

→ Operational Workers

By their composition, non-hazardous and inert waste streams should not directly impact on the construction workers, however, if not adequately managed, local nuisances including but not limited to odour and pest infestation may be generated, the impact is therefore considered to be of **minor negative significance**.

E-WASTE

The volumes of E-waste generated during the operational phase of the Project may be identified as significant, taking into consideration the lifecycle of the Project over a 25-30 year period. Inadequate handling and storage arrangements associated with specific waste streams may lead to a release of contaminants onto the ground and subsequently into the groundwater within the Project footprint area or location where disposed of.

→ Waste Management Infrastructure

In the absence of a regulatory framework associated with E-Waste in Jordan and a 'worst case scenario', E-waste streams would be disposed of in municipal solid waste containers and collected informally by mobile scrap dealers for recovery of plastics and metal components. Taking in consideration, that the volumes are anticipated to be significant over the lifecycle of the Project, the impact is therefore considered to be of **moderate negative significance**.

→ Soil and Groundwater

It is anticipated that potential impacts associated the generation of E-waste streams during the operational phase of the Project are likely to be of a **major negative significance** due to the potential to cause contamination by the release of heavy metals and other pollutants (plastic) if not adequately managed or disposed of.

→ Workers

By their composition, E-waste waste should not directly impact on the workers during the operational phase of the Project, the impact is therefore considered to be of **negligible negative significance.**

SUMMARY OF OPERATIONAL IMPACTS

Based on the ranking system presented in Table 9-5, the potential waste impact severity for the categories of waste anticipated to be generated during the operational phase of the proposed Project are provided in Table 9-12. This assessment is prior to the implementation of any mitigation measures.

Table 9-12 Potential waste impact severity during operational phase

Type of Waste	Intensity	Duration of Waste Generation	Geographic Extent	Adherence to Waste Hierarchy	Probability	Impact Severity
Impact on waste infrastructure						
Hazardous	4 *(High)*	**4** *(Long-term - impact ceases after closure of activity)*	3 *(Regional)*	5 *(Dispose)*	**4** *(Highly probable)*	**72** ***(Moderate)***
Non-Hazardous and Inert Waste	**2** *(Minor)*	4 *(Long-term - impact ceases after closure of activity)*	**2** *(Local)*	5 *(Dispose)*	5 *(Definite / don't know)*	**65** ***(Moderate)***
E-waste	6 *(Moderate)*	**4** *(Long-term - impact ceases after closure of activity)*	3 *(Regional)*	5 *(Dispose)*	**4** *(Highly probable)*	**72** ***(Moderate)***
Impact on soil and groundwater						
Hazardous	6 *(Moderate)*	4 *(Long-term - impact ceases after closure of activity)*	3 *(Regional)*	5 *(Dispose)*	4 *(Highly probable)*	**72** ***(Moderate)***
Non-Hazardous and Inert Waste	2 *(Minor)*	2 *(Short-term. 0 to 5 years)*	2 *(Local)*	5 *(Dispose)*	3 *(Medium probability)*	**33** ***(Minor)***
E-Waste	8 *(High)*	4 *(Long-term - impact ceases after closure of activity)*	3 *(Regional)*	5 *(Dispose)*	4 *(Highly probable)*	**80** ***(Major)***
Impact on workers						
Hazardous	8 *(High)*	4 *(Long-term - impact ceases after closure of activity)*	4 *(National)*	5 *(Dispose)*	3 *(Medium probability)*	**63** ***(Moderate)***
Non-Hazardous and Inert Waste	2 *(Minor)*	4 *(Long-term - impact ceases after closure of activity)*	**2** *(Local)*	5 *(Dispose)*	**3** *(Medium probability)*	**39** ***(Minor)***
E-Waste	1 *(None)*	2 *(Short-term. 0 to 5 years)*	3 *(Regional)*	5 *(Dispose)*	1 *(Improbable)*	**11** ***(Negligible)***

Table 9-13 Potential operational impact significance summary

	Hazardous Waste	Non-Hazardous and Inert Waste	E-Waste
Waste infrastructure	*Moderate*	*Minor*	*Moderate*
Soil and groundwater	*Moderate*	*Minor*	*Major*
Construction workers	*Moderate*	*Minor*	*Negligible*

9.4.3 IMPACT DURING DECOMMISSIONING

It is expected that hazardous waste and E-waste associated with the removal of the PV solar panels will be the main waste streams associated with the decommissioning phase of the Project, in addition to non-hazardous inert waste streams associated with building and amenity infrastructures.

HAZARDOUS WASTE STREAMS

Hazardous waste streams during the decommissioning phase may include but not limited to: oils, hydraulic fluids, solvents, and cleaning agents may be treated similarly to waste streams generated during the operational phase of the Project.

→ Waste Management Infrastructures

In a 'worst case scenario', hazardous waste streams would be diverted to the Swaqa hazardous waste treatment centre. However, taking into consideration that Jordan operates only one hazardous waste treatment centre, the disposal of the hazardous waste streams on this waste management infrastructure is expected to be of **moderate negative significance**.

→ Soil and Groundwater

Similar to the operational phase, it is anticipated that potential impacts associated with the generation of hazardous waste streams during the decommissioning phase of the proposed Project may cause impacts of **moderate** to **major significance** if not managed or disposed of properly subject to the type of waste, quantities and receptors.

Additionally, uncontrolled or unlicensed dumping of waste is also common in the region and physical or procedural control measures should be established in order to ensure that this practice is prohibited during the decommissioning phase of the Project.

→ Construction Workers

During the decommissioning phase of the Project, if adequate mitigation measures are not implemented, workers could be exposed to occupational health and safety risks. The impact is therefore considered to be of **major negative significance**.

NON-HAZARDOUS AND INERT WASTE STREAMS

Much of the non-hazardous solid material including concrete and masonry, steel, power cables and pipes may be diverted to recycle and alternatively sold as scrap or used in road building. Alternatively, if not reusable the remaining non-hazardous waste may be diverted to the only engineered landfill site operating in Jordan situated just 7km from the site.

→ Waste Management Infrastructures

In the absence of mitigation measures and taking in consideration that the waste streams are diverted to landfill for final disposal, it is expected that the impact on the limited existing waste management infrastructures would be considered to be of a **moderate negative significance**.

→ Soil and Groundwater

Due to the likely significant volumes of non-hazardous and inert waste streams generated during the decommissioning phase, it may be expected that changes on the environment may occur if non-hazardous and inert waste streams are not properly handled, stored and overall managed, the impact is therefore considered to be of **moderate negative significance**.

→ Operational Workers

By their composition, non-hazardous and insert waste streams should not directly impact on the workers, however, if not adequately managed, local nuisances including but not limited to odour and pest infestation may be generated, the impact is therefore considered to be of **minor negative significance**.

E-WASTE

It is anticipated that E-waste streams would predominantly be associated with the removal of the PV solar panels during the decommissioning of the Project which would be the most prominent waste stream generated at this stage of the lifecycle of the Project.

→ Waste Management Infrastructure

In absence of a regulatory framework associated with E-Waste in Jordan or approved facilities to deal with significant quantities, in a "worst case scenario", this waste stream could be disposed of in municipal solid waste containers and collected informally by mobile scrap dealers for recovery of plastics and metal components. Taking in consideration, that the volumes are anticipated to be very high during the decommissioning phase, the impact is therefore considered to be of a **major negative significance**.

→ Soil and Groundwater

It is anticipated that potential impacts associated with the generation of E-waste streams during the decommissioning phase of the Project are likely to be of a **major negative significance** due to the potential to cause contamination through the release of hazardous elements.

→ Workers

E-waste waste should not directly impact on the workers during the decommissioning phase of the Project, the impact is therefore considered to be of **negligible negative** significance

SUMMARY OF DECOMMISSIONING IMPACTS

Based on the ranking system presented in Table 9-5, the potential waste impact severity for the categories of waste anticipated to be generated during the decommissioning phase of the proposed Project are provided in Table 9-14 and Table 9-12. This assessment is prior to the implementation of any mitigation measures.

Table 9-14 Potential waste impact severity during decommissioning phase

Type of Waste	Intensity	Duration of Waste Generation	Geographic Extent	Adherence to Waste Hierarchy	Probability	Impact Severity
Impact on waste infrastructure						
Hazardous	**6** *(Moderate)*	4 *(Long-term - impact ceases after closure of activity)*	3 *(Regional)*	5 (Dispose)	**4** *(Highly probable)*	**72** ***(Moderate)***
Non-Hazardous and Inert Waste	**2** *(Minor)*	**2** *(Short-term. 0 to 5 years)*	**2** *(Local)*	5 (Dispose)	**4** *(Highly probable)*	**44** ***(Minor)***
E-Waste	**8** *(High)*	**4** *(Long-term - impact ceases after closure of activity)*	**4** *(National)*	5 (Dispose)	**4** *(Highly probable)*	**84** ***(Major)***
Impact on soil and groundwater						
Hazardous	8 *(High)*	4 *(Long-term - impact ceases after closure of activity)*	3 *(Regional)*	5 (Dispose)	**4** *(Highly probable)*	**80** ***(Major)***
Non-Hazardous and Inert Waste	6 *(Moderate)*	2 *(Short-term. 0 to 5 years)*	2 *(Local)*	5 (Dispose)	3 *(Medium probability)*	**45** ***(Moderate)***
E- Waste	8 *(High)*	4 *(Long-term - impact ceases after closure of activity)*	**4** *(National)*	5 (Dispose)	4 *(Highly probable)*	**84** ***(Major)***
Impact on workers						
Hazardous	10 *(Very high / don't know)*	5 *(Permanent)*	4 *(National)*	5 (Dispose)	5 *(Definite / don't know)*	**120** ***(Major)***
Non-Hazardous and Inert Waste	2 *(Minor)*	2 *(Short-term. 0 to 5 years)*	2 *(Local)*	5 (Dispose)	4 *(Highly probable)*	**44** ***(Minor)***
E- Waste	1 *(None)*	2 *(Short-term. 0 to 5 years)*	3 *(Regional)*	5 (Dispose)	1 *(Improbable)*	**11** ***(Negligible)***

Table 9-15 Potential decommissioning impact significance summary

	Hazardous Waste	Non-Hazardous and Inert Waste	E-Waste
Waste infrastructure	*Moderate*	*Minor*	*Major*
Soil and groundwater	*Major*	*Moderate*	*Major*
Construction workers	*Major*	*Minor*	*Negligible*

9.5 MITIGATION

9.5.1 PROCUREMENT AND DESIGN CONSIDERATIONS

WASTE MANAGEMENT HIERARCHY PRINCIPLE

The principle objective of sustainable waste management is to divert waste streams from landfill through the efficient use of materials and alternative end use treatment or disposal methods. The waste management hierarchy principle illustrated within Figure 9-4 which promotes waste avoidance, reduction and reuse, with landfill disposal as a last resort, will be used as a guiding principle against which waste generation and management activities at the proposed Project will be evaluated.

The types and quantities of waste streams from each phase of the proposed Project, including the PV solar panels and associated waste electrical and equipment associated with the decommissioning phase of the Project, will be evaluated during the course of the initial procurement stage. The primary objectives to respond to the waste management hierarchy principles, may include: diversion of the decommissioned PV solar panels to the original manufacturer for repair and future re-use; diversion of the PV solar panels to approved E-waste recyclers, operating inside or outside Jordan, for recycling. The least preferred option is considered the diversion of the PV solar panels to the Swaqa hazardous waste treatment centre or into an alternate engineered landfill facility.

Figure 9-4 Waste management hierarchy principle

9.5.2 CONSTRUCTION

PROCUREMENT

In accordance with the World Bank Group EHS Guidelines (Waste Management), waste minimisation should be encouraged among suppliers.

During the procurement stage, it would be important for Wärtsilä (and reviewed by Project Company) to analyse the lifecycle of any purchased materials, including primarily PV solar panels and the inverters. The primary objective would to identify end-of-life options in line with the waste management hierarchy principle requirements and develop strategies associated either with the return of E-waste to the manufacturer or provider for potential reuse, or the diversion of this waste stream to an appropriate E-recycler for subsequent processing.

The strategy is also likely to involve requiring suppliers to commit to reducing surplus packaging associated with any construction materials; particularly common packaging materials including but not limited plastics, cardboard and wooden pallets.

This may also involve improving procurement strategy and consultation with selected suppliers regarding commitments to waste minimisation, recycling and the emphasis on continual improvements in environmental performance.

Table 9-16 summarises the most important mitigation measures that will be implemented, with the primary objectives to minimise the potential waste of on-site materials during the construction phase of the Project.

Table 9-16 Measures to reduce the waste of on-site materials

PROCUREMENT	
Do: → Material Lifecycle Analyses (LCA) → Identify waste hierarchy management requirements → Identify potential agreements with suppliers (back to providers and suppliers for re-use, refurbishment and recycling) → Identify Waste Management Providers associated with waste streams identified from the lifecycle analysis	
SELECTION AND ORDERING	**DELIVERY**
Avoid: → Over ordering (order 'just in time' where practicable); → Ordering standard lengths rather than lengths required; → Ordering for delivery at the wrong time (update programme regularly).	**Avoid:** → Damage during loading operations → Delivery to inappropriate areas of the site; → Accepting incorrect deliveries, specifications, or quantities.

Procurement	
Storage	**Handling**
Avoid: → Damage to materials from incorrect storage arrangements; → Loss, theft, or vandalism through secure storage and on-site security.	**Avoid:** → Damage or spillage through incorrect or repetitive handling.

KEY PERFORMANCE INDICATORS

In order to monitor the implementation of the waste management hierarchy principle, a set of performance measures will need to be set out in order to achieve appropriate on-site waste targets and focus upon:

- Quantifying raw material wastage;
- Quantifying the generation of each waste stream;
- Evaluating methods by which the waste streams are being handled and stored;
- Quantifying waste materials diverted for re-use;
- Quantifying waste materials diverted for recycling;
- Quantifying the material disposed of off-site to landfill facilities; and
- Identifying responsibilities against roles.

Setting waste targets and undertaking future measurement and monitoring will assist in determining the success of the waste management initiatives adopted at the proposed Project particularly with respect to the construction phase.

CONSTRUCTION WASTE MANAGEMENT PLAN

Once the waste is characterised, the Wärtsilä will then need to consider the ways in which the waste streams might be managed and disposed, in accordance with the waste management hierarchy principle as illustrated by Figure 9-4 and with respect to available waste management facilities and legislation.

During the construction phase of the proposed Project, the Wärtsilä will be required to minimise the impacts on the environment that may arise as a result of construction activities through the establishment and the implementation of a formal waste management plan, which would be structured around the requirements of the ISO 14001 standard. The principles of this plan are contained within the accompanying CEMP (Appendix D).

Wärtsilä will also need to promote the commitment to continual improvement and the identification of appropriate opportunities to reduce waste and, where practicable, promote potential reuse of materials and recycling. They should also identify types and quantities of waste that can be minimised or effectively segregated for recycling or re-use and the materials that would ultimately require disposal to landfill.

Engineering mitigation measures to be employed on side include but are not limited to clearly labelled waste skips in order to facilitate the separation of specific waste materials such as metal, wood, cardboard and polythene for re-use or recycling, in addition to separate skips or containers for residual waste streams, which would ultimately diverted for landfilling.

Any waste fuels, oils and chemicals will be required to be stored separately in a dedicated compound provided with a secondary containment system, and situated on an impermeable surface in order to prevent any contamination issues prior to collection by authorised disposal companies.

WASTE ACCEPTANCE CRITERIA

The construction contractor would undertake detailed audits of the waste streams generated during the key construction phases in order to establish whether the waste:

- Is prohibited from disposal to landfill;
- Is hazardous and suitable for landfill or other treatments in its current condition;
- Is hazardous and would meet the waste acceptance criteria at dedicated hazardous waste management facilities;
- Is hazardous and regarded as stable and non-reactive;
- Requires testing prior to being certain as to which waste management infrastructure could be required;
- Has, or may be subject to treatment of some sort.

WASTE REGULATORY CONTROL AND COMPLIANCE

Wärtsilä shall be responsible for the identification of non-hazardous waste and hazardous waste streams that it would generate, as well as for ensuring that such wastes are stored, handled, treated and disposed of adequately with the primary objective to minimise environmental impacts.

To this end, the contractor shall be required to:

- Classify and identify their waste streams;
- Refrain from delivering or transferring wastes to a waste transporter or to a treatment, storage or disposal facility which is either not registered or not licensed by the relevant authority;
- Refrain from delivering consignments of waste for transportation outside the treatment, storage or disposal facility without being accompanied by a waste tracking form and receipts;
- Comply with segregation and storage requirements;
- Prepare the waste for adequate transportation.

It is also a responsibility of the contractor to prepare a Waste Tracking Form in line with best practice, which will provide the following details:

- The Generator's name, address, municipality and contact details;
- The name, address, and contact details of the person to whom the waste is to be transported;
- The day and time the Generator gives the waste to the transporter for transporting;
- The type and number of containers if the waste is hazardous; and
- The following waste details:
  - The type of waste;
  - The amount in kilograms, tonnes, cubic metres or litres;
  - Its physical nature (liquid or solid);
  - Its hazardous waste code, if relevant;
  - The waste origin code for the activity that produced the waste.

The contractor will be required to record and keep for a minimum period of five (5) years the following information:

- The information detailed in the waste tracking form; and
- Waste manifests and receipts of receiving facilities.

WASTE HANDLING AND STORAGE

It is anticipated that the following mitigation measures would be implemented by the contractor during the construction phase of the Project:

- Segregation practices would be adopted in order to reduce the risk of the waste streams being incorrectly classified and ensures that the correct procedures are followed from the point of generation through to final treatment or disposal options;
- Liquids shall be kept separate from solid wastes, and non-hazardous and inert waste shall be segregated from hazardous wastes, so as to create effective segregation systems to:
  - Prevent unwanted or potentially dangerous reactions;
  - Reduce the rate of accidental exposure to potentially hazardous substances;
  - Ease handling and disposing of wastes;
  - Increase the diversion of waste for the purposes of recycling; and
  - Keep the cost of waste disposal to a minimum.

Waste storage areas would need to respond to the following criteria:

- Storage areas must be strategically located to eliminate or minimise the double handling of waste;
- Storage areas must be clearly marked and signed with regard to the quantity and hazardous characteristics of the wastes stored therein;
- The contractor may use satellite storage areas and the designated waste manager of the main waste storage will responsible for the proper accumulation, maintenance and housekeeping of their storage areas, ensuring that:
  - Waste streams do not get mixed and that no waste other than the normal waste stream, approved for the container, is placed in the collection container.
  - The waste components are correct and complete for each waste container.
  - Accurate records are maintained to ensure compliance with onward transportation of the waste and to minimise analytical costs associated with disposal.
  - All leaks, spills, and releases are recorded.
  - Major leaks, releases or spills sufficient to pose a threat to human health or the environment are brought to the attention of the Ministry of Environment.
  - All major hazardous spills (>25 litres) are reported immediately to the Ministry of Environment and the appropriate evacuation action taken.
- Storage areas must be constructed such that any spillage or loss of containment of a particular waste type cannot spread to other waste streams. This is particularly important where flammable materials are involved.
- The total maximum storage capacity of the storage areas must be clearly and unambiguously stated in writing, accompanied with details of the method used to calculate the volumes held against this maximum. The stated maximum capacity of storage areas must not be exceeded.

- The storage arrangements must be marked on a site plan which clearly illustrate:
  - Waste types to be stored in particular areas;
  - Separation arrangements;
  - Any fire breaks proposed; and
  - The maximum storage capacity of each storage area.
- Storage area drainage infrastructure must ensure all contaminated runoff is contained and that drainage from incompatible wastes cannot come into contact with each other;
- There must be vehicular access, for example trucks, and pedestrian access at all times to the whole of the storage area such that the transfer of containers is not reliant on the removal of impediments which may be blocking access, other than drums in the same row; and
- Containers must be stored in such a manner that leaks and spillages cannot escape over bunds or the edge of the sealed drainage areas.

9.5.3 OPERATION

OPERATIONAL WASTE STRATEGY

Current international best practice, considered within the World Bank and IFC guidelines, advocates the need to operate sustainable waste management practices for major industrial developments.

In line with the Waste Management Hierarchy Principle requirements, such guidance sets out scenarios for dealing with waste streams in a preferential order from waste prevention and reduction through to re-use, recovery (energy and materials) and disposal, aforementioned illustrated by Figure 9-4.

Therefore, waste management practices to be adopted during the operational phase of the proposed Project would involve considerations of the following:

- To comply with national and international best practice guidance;
- To encourage opportunities in order to minimise waste streams;
- To provide good on-site storage practices, including the provision of suitable waste receptacles for the segregation of waste streams for future recycling at licensed facilities; and
- To provide fully dedicated waste storage areas in order to minimise pollution events and local nuisance.

HAZARDOUS WASTE MANAGEMENT

Hazardous wastes generated from maintenance activities and Project operations are likely to include waste oils, fuels, empty containers, filters, and chemical residues, which may have hazardous properties. However, due to the nature of the Project minimal hazardous waste is anticipated to be produced during the operational phase.

Hazardous waste streams should be handled by a locally registered waste contractor and transferred either to an appropriately licensed hazardous waste facility either for re-use or recycling (waste oil) or for disposal (chemical residues, contaminated containers). At current time of developing this report, Jordan operates only the Swaqa hazardous waste treatment centre, therefore it is critical that volumes of hazardous waste generated during the operational phase of the Project remain low. If volumes are low as expected then options should be considered to share loads between the proposed plant and existing thermal plants.

Key requirements are included below, which will need to be complied with during the operational of the proposed Project.

- To containerise and pack hazardous waste in a proper and environmentally sound manner, and placing warning labels on each package in accordance with the specifications and standards prevailing in Jordan;
- To accurately fill the product data on the appropriate section of the hazardous waste transportation document in accordance with the instructions provided in the document;
- To confirm with the relevant regulatory authority, that the storage, treatment or disposal facility designated in the transportation document is capable of managing the hazardous waste stream that will be diverted to it;
- To make the necessary arrangements with the transporter who will carry the waste and the receiving facility designated in the transportation documents as the destination for the hazardous waste stream - such as providing the facility with full and detailed information on the waste and samples for analysis;
- To provide the transporter with the transportation document and copy of the safety data sheets for each type of hazardous waste being transported; and
- Comply with the hazardous waste transportation instructions provided in the transportation document.

The operator shall comply with the following for keeping of records and reports:

- To keep one copy of each transport document it has generated pending receipt of the signed copy from the facility designated in the document. As good practice, it should also keep the signed copy for at least 5 years;
- To retain copies of the results of all tests and analysis performed on hazardous waste streams (if any mandatory tests required for registered waste removal partner) as well as copies of all pertinent reports, correspondence and documents for at least 5 years from the last date of handling of such waste.

NON-HAZARDOUS AND INERT WASTE MANAGEMENT

The Project's operator, through general maintenance activities, is likely to generate quantities of non-hazardous waste streams including waste paper, cardboard, plastic, metal, packaging that have the potential to be segregated for either re-use or recycling.

Suitable waste receptacles will need to be provided at central locations with the primary objective to ensure that segregation is effective.

The segregated waste materials will subsequently be diverted to the central storage area, which will consist of dedicated containers for recyclable waste and general waste.

The storage area for non-hazardous waste will be located on an impermeable hard-standing surface and located under cover.

9.5.4 DECOMMISSIONING

WASTE DECOMMISSIONING PLAN

The Ministry of Health and the Ministry of Environment may require to have a plan in place associated with the decommissioning of the Project, which would result in redundant Solar PV units within 20-40 years typically.

A waste decommissioning plan would need to be established by the Project developer in order to outline required steps to remove the overall system, dispose of or recycle its components, and restore the land to its original state including an estimated cost schedule and a form of decommissioning security. Subject to the detailed design, it is envisaged that the following decommissioning tasks would need to be performed:

- Remove Rack Wiring
- Remove Panels
- Dismantle Racks
- Remove Electrical Equipment
- Breakup and Remove Concrete Pads or Ballasts
- Remove Racks
- Remove Cable
- Remove Ground Screws and Power Poles
- Remove Fence
- Grading
- Seed Disturbed Areas
- Truck to Recycling Centre or disposal centres as appropriate with reference to waste hierarchy and preference being given to recycling and reuse.

EXCESS MATERIALS AND WASTE MANAGEMENT

The decommissioning of the Project is intrinsically linked with the materials and design of the plant. Consideration of the potential for reuse/recycling should be made at the procurement stage with recognition that the materials would need to be dismantled/decommissioned in the future. It is proposed that the following management options, illustrated by

Table 9-17, are considered prior to the decommissioning phase:

Table 9-17 Excess Materials Management

WASTE MATERIAL	MEANS OF MANAGING EXCESS MATERIALS AND WASTE
PV SOLAR MODULES	→ If there is no possibility for reuse for local communities, PV solar modules will either need to be returned to the manufacturer for appropriate refurbishment or recycling or will be transported to a recycling facility, operating within or outside Jordan, where glass, metal and semiconductor materials will be separated and recycled. → Panels will be managed as per best management practices that may be in effect at the time of decommissioning. → Disposal of these modules would be considered the least preferred option.
Metal array mounting racks and steel supports	→ These materials will be recycled off-site at an approved facility preferably within Jordan.
Inverters, fans, fixtures	→ The metal components of the inverters, fans and fixtures will be recycled preferably within Jordan. → Remaining components will be disposed of in accordance with the standards prevailing in Jordan at the time of the decommissioning phase.

WASTE MATERIAL	MEANS OF MANAGING EXCESS MATERIALS AND WASTE
Gravel (or other granular)	→ It is possible that the municipality may accept uncontaminated material without processing for use on local roads, however, for the purpose of this report it is assumed that the material will be removed from the Project location by truck to a location where the aggregate can be processed for salvage. It will then be reused as fill for construction Projects, ideally at local level. → In the unlikely event that the aggregate or portions of the aggregate is contaminated it will need to be transported to an approved hazardous waste/disposal facility operating in Jordan.
Geotextile fabric	→ It is currently unclear whether the plant will utilise geotextile. Should it be incorporated it is assumed that, during excavation of the aggregate, a large portion of the geotextile will be "picked up" and sorted out. → Geotextile fabric that is remaining or large pieces that can be readily removed from the excavated aggregate will be disposed of off-site at an approved disposal facility operating in Jordan.
Concrete inverter/transformer foundations	→ Concrete foundations will be broken down and transported by certified and licensed contractor to a recycling or an approved disposal facility.
Cables and Wiring	→ The electrical line that connects the substation to the point of common coupling will be disconnected and recycled, if possible, or disposed of at an approved facility. → Support poles (if present), if made of untreated wood, should be chipped for reuse. → Associated electronic equipment (isolation switches, fuses, metering) should be transported off-site to be sent back to the manufacturer for re-use or recycling, or safely disposed off-site (at the less preferred option) in accordance with current standards and best practices prevailing in Jordan at the time of the decommissioning phase.
Fencing	→ Fencing should be removed and recycled at a metal recycling facility
Debris	→ Any remaining debris on the site will be separated into recyclables/residual wastes and will be transported from the site and managed as appropriate.

- Recyclable materials will be transported off-site by truck and managed at appropriate facilities in accordance with waste management regulations.
- Residual waste materials for disposal will be removed by a licensed contractor and transported to an approved facility. It is not anticipated that any waste materials will be left on-site with the possible exception of foundations or steel piles broken off below 1.2 metres in depth and/or disconnected underground electrical wires buried below 1 metre in depth.
- The final decision on waste recycling, reuse or disposal will be made by the Project developer who will refer to the standards for waste generated at the Project prevailing at the decommissioning phase period and with due consideration of the potential reuse within local communities of materials which would otherwise be disposed of.
- Given that methods of managing wastes and recyclables may change in the future, information in this report will need to be updated as necessary to conform to future national and international requirements prevailing in Jordan.

PV SOLAR PANELS RECYCLING

As previously indicated, it is considered critical that the selection of the PV solar panel modules is undertaken at an early stage of the Project and on the basis of a material lifecycle analyses with the primary objective to quantify recyclables following manual dismantling and potential chemical processes.

The below figure illustrate inputs and outputs of the recycling of 1000 kg of c-Si PV waste panels, following a "gate-to-gate" approach, accounting for the impacts occurring from the delivery of the waste to the recycling plant, up to the sorting of the different recyclable material fractions and the disposal of residues.

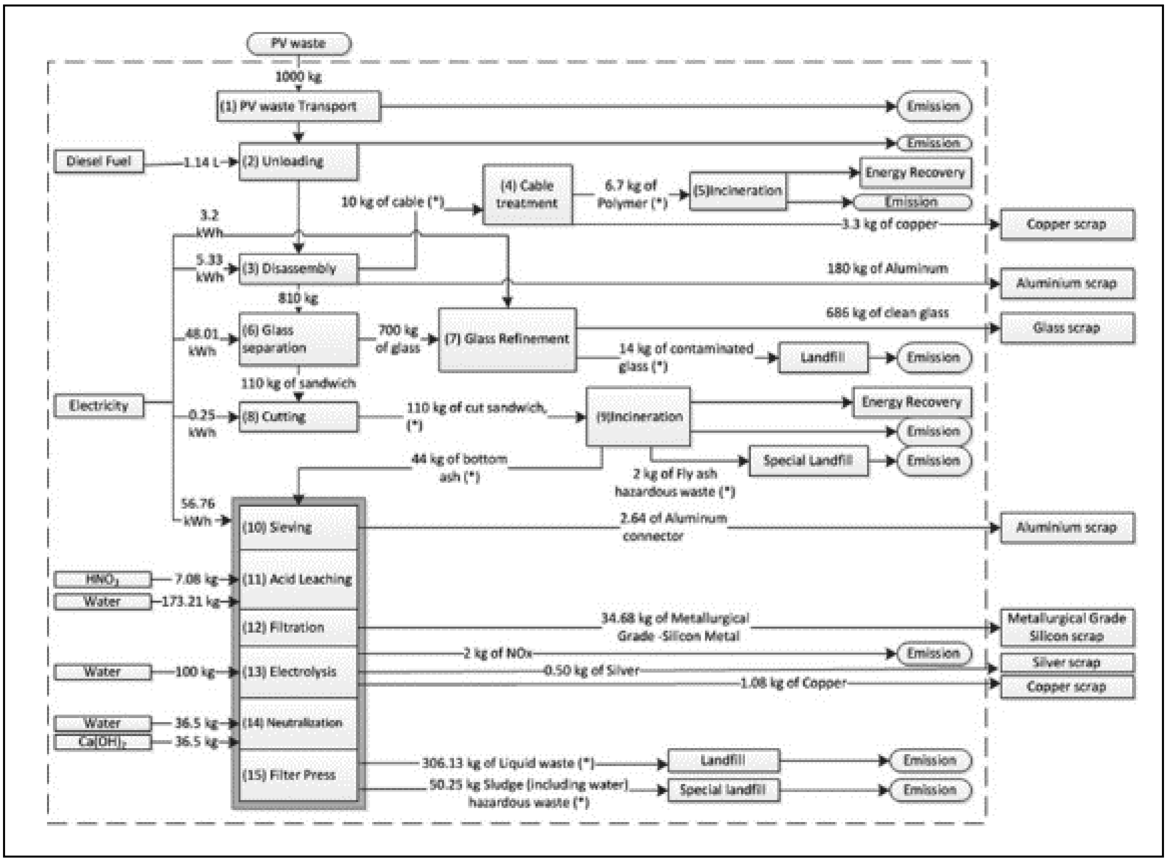


Figure 9-5 Disassembly process for typical (1000kg) PV panels

9.6 CUMULATIVE IMPACTS

9.6.1 CONSTRUCTION

The following have been identified as potential cumulative impacts in relation to waste management associated with:

Type 1 Cumulative Impacts:

- → Inadequate storage, handling and transportation arrangements could potentially lead to air pollution, land and groundwater contamination, ranging from dust generation to acute accidental release of contaminants onto the soil and the underlying aquifer.
- → The vehicular transfers required for off-site recycling or disposal will contribute to a slight increase in truck movements, contributing to a release of air pollutants from exhaust emissions.

Type 2 Cumulative Impacts:

- Additional waste streams will be generated by concurrent developments at local or regional levels, contributing therefore to additional strain on the existing waste management infrastructure.

9.6.2 OPERATION

Type 1 Cumulative Impact and Type 2 Cumulative Impacts would be similar in nature to those of the Construction Phase, however, they will intend to be more prolonged as they are associated with the lifetime of the Project, which would typically being between 20 and 40 years.

9.6.3 DECOMMISSIONING

Type 1 and Type 2 Cumulative Impacts would be similar in nature to those of the Construction Phase, however, volumes would be expected to be generated at a higher rate and during a shorter period, in addition to include significant E-waste quantities.

9.7 RESIDUAL EFFECTS

All predicted impacts are amendable to mitigation.

Following the implementation of recommended mitigation measures through the enforcement of a construction waste management plan responding to the requirements of the waste management hierarchy principles, the residual impacts during the construction phase would range from negligible to minor negative significance.

During the operation phase, all residual impacts would be considered to be negligible following adoption of the proposed mitigation measures.

Following the implementation of recommended mitigation measures through the enforcement of an appropriate decommissioning waste management plan responding to the requirements of the waste management hierarchy principles, the residual impacts during the construction phase would range from negligible to moderate negative significance, primarily attributable to the generation of a high number of PV solar panels.

9.8 SUMMARY OF IMPACTS

A summary of the impacts on waste management as a result of the proposed Project are shown in Table 9-18.

Table 9-18 Summary of waste and hazardous impacts and mitigation

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive / Negative	Permanent / Temporary (P/T)	Direct / Indirect (D/I)	Short term (ST) Medium term (MT) Long Term (LT)		Major, Moderate, Minor, Negligible
Construction							
Pressure on waste infrastructure due to the generation of hazardous Waste	Major	Negative	T	D	MT	→ Waste Management Hierarch Principle and Procurement Strategy → Life Cycle Analyses and Procurement Strategy → Construction Waste Management Plan → Waste Acceptance Criteria → Waste Regulatory Control and Compliance → Waste Handling and Storage	Minor
Pressure on waste infrastructure due to the generation of non-hazardous and Inert waste	Minor	Negative	T	D	MT		Negligible
Pressure on waste infrastructure due to the generation of E-waste	Moderate	Negative	T	D	MT		Minor
Contamination of soil and groundwater due to the generation of hazardous waste	Major	Negative	T	D	LT		Minor

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive / Negative	Permanent / Temporary (P/T)	Direct / Indirect (D/I)	Short term (ST) Medium term (MT) Long Term (LT)		Major, Moderate, Minor, Negligible
Deterioration of soil and groundwater due to the generation of non-hazardous and inert waste	Moderate	Negative	T	D/I	ST/MT		Negligible
Deterioration of soil and groundwater due to the generation of E-Waste	Minor	Negative	T	D	LT		Negligible
Exposure of construction workers to contaminated and/or hazardous waste	Major	Negative	T	D	MT/LT		Minor
Exposure of construction workers to non-hazardous and/or inert waste	Minor	Negative	T	D/I	MT		Negligible
Exposure of construction workers to E-waste	Negligible	Negative	T	D/I	MT		Negligible

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive / Negative	Permanent / Temporary (P/T)	Direct / Indirect (D/I)	Short term (ST) Medium term (MT) Long Term (LT)		Major, Moderate, Minor, Negligible
Operation							
Pressure on waste infrastructure due to the generation of Hazardous Waste	Moderate	Negative	P	D	LT	→ As for CEMP → Operational Waste Strategy → Hazardous Waste Management → Non-Hazardous Waste Management	Minor
Pressure on waste infrastructure due to the generation of non-Hazardous and Inert waste	Minor	Negative	P	D	LT		Negligible
Pressure on waste infrastructure due to the generation of Hazardous Waste	Moderate	Negative	P	D	LT		Negligible
Contamination of soil and groundwater due to the generation of hazardous waste	Major	Negative	P	D/I	LT		Minor

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive / Negative	Permanent / Temporary (P/T)	Direct / Indirect (D/I)	Short term (ST) Medium term (MT) Long Term (LT)		Major, Moderate, Minor, Negligible
Deterioration of soil and groundwater due to the generation of non-hazardous and inert waste	Moderate	Negative	P	D	LT		Negligible
Deterioration of soil and groundwater due to the generation of E-Waste	Major	Negative	P	D/I	LT		Minor
Exposure of construction workers to contaminated and/or hazardous waste	Major	Negative	P	D/I	LT		Minor
Exposure of construction workers to non-hazardous and/or inert waste	Minor	Negative	P	D/I	LT		Negligible
Exposure of construction workers to E-waste	Negligible	Negative	P	D/I	LT		Negligible

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive / Negative	Permanent / Temporary (P/T)	Direct / Indirect (D/I)	Short term (ST) Medium term (MT) Long Term (LT)		Major, Moderate, Minor, Negligible
Decommissioning							
Pressure on waste infrastructure due to the generation of Hazardous Waste	Moderate	Negative	T	D/I	ST/MT	→ Waste Management Hierarch Principle and Procurement Strategy → Life Cycle Analyses and Procurement Strategy → Waste Decommissioning Plan → Excess Materials and Waste Management → PV Solal Panels Recycling Analyses	Negligible
Pressure on waste infrastructure due to the generation of non-Hazardous and Inert waste	Minor	Negative	T	D/I	ST/MT		Negligible
Pressure on waste infrastructure due to the generation of E-waste	Major	Negative	T	D/I	ST/MT		Minor
Contamination of soil and groundwater due to the generation of hazardous waste	Major	Negative	P	D/I	LT		Minor
Deterioration of soil and groundwater due to the	Moderate	Negative	T	D/I	LT		Negligible

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive / Negative	Permanent / Temporary (P/T)	Direct / Indirect (D/I)	Short term (ST) Medium term (MT) Long Term (LT)		Major, Moderate, Minor, Negligible
generation of non-hazardous and inert waste							
Deterioration of soil and groundwater due to the generation of E-Waste	Major	Negative	P	D/I	LT		Minor
Exposure of construction workers to contaminated and/or hazardous waste	Major	Negative	P	D/I	MT/LT		Minor
Exposure of construction workers to non-hazardous and/or inert waste	Minor	Negative	P	D/I	MT		Negligible
Exposure of workers to E-waste	Negligible	Negative	P	D/I	MT		Negligible

10 TERRESTRIAL ECOLOGY

10.1 INTRODUCTION

This Chapter considers the potential impacts of the Project on terrestrial ecology during both the construction and operational phases. Where significant impacts are identified, appropriate avoidance and mitigation measures are provided.

The baseline conditions of the Project Site and the surrounding area are presented followed by an assessment of impacts from the Project upon the terrestrial ecology of the site.

10.2 BASELINE

10.2.1 OVERVIEW OF TERRESTRIAL ECOLOGY WITHIN JORDAN

The Project site exists in the Mediterranean Biogeographic Zone, which is restricted to the highlands of Jordan extending from Irbid in the north to Ras Al Naqab in the south. The altitude of this Biogeographic Zone ranges from 700-1750m above sea level, with rainfall typically ranging from 300mm to 600mm per year.

The Project site is located within the highland ecosystem, which consists of escarpments, mountains, hills and undulating plateaus which extend mainly from Irbid in the north to Ras Al Naqab in the south, and from the Rift Valley region in the west to the Badia in the east. More than 80% of Jordan's cities and villages are located within this biogeographic zone (Source: Al–Eisawi, D., (1996), *Vegetation of Jordan*, UNESCO – Cairo Office).

Jordan has approximately 2,500 recorded species of vascular plants, belonging to 152 families, representing about 1% of the total flora of the world. One hundred species are endemic, forming about 2.5% of the total flora of Jordan. Many species are considered rare or endangered, but the status of many plants remains unknown (Royal Society for the Convention of Nature, n.d.).

A total of 82 mammal species are known to exist in Jordan. These species belong to 7 orders and 24 families (Royal Society for the Convention of Nature, n.d.). A total of 98 reptile species belonging to 18 families are recorded in Jordan (Royal Society for the Convention of Nature, n.d.).

More than 434 bird species, 69 breeding species and 21 migrant species belonging to 58 families have been recorded in Jordan (Source: *State of Jordan's Birds*, 2013, RSCN and Birdlife International).

There are 30 designated sites for nature conservation in Jordan including 13 nature reserves, 10 special conservation areas (SCAs), 2 UNESCO Bio-sphere reserves and several others including forest reserves and RAMSAR wetland.

The nearest conservation sites to the Project area are; Azraq Wetland Reserve and As-Samra Wastewater Treatment Plant which are considered as an Important Bird Areas, as shown in Figure 10-1 and which lie approximately 70km and 30km respectively from the proposed solar plant site.

In 1977, the RAMSAR Wetland Convention declared Azraq Wetland and the adjacent mudflat as an Important Bird Area due to the availability of open water ponds (perennial and seasonal marshes), for migratory birds on the African-Eurasian flyway. The wetland has subsequently suffered significantly as a result of over-abstraction of water to support Amman's growing population and, as a result, the number of birds has dropped dramatically. The wetland is now artificially maintained through provision of water by the Ministry of Water (Source: Azraq Wetland Reserve Museum, visited 2009) but does reportedly still provide a stop for migratory birds.

As-Samra Wastewater Treatment Plant is considered an Important Bird Area, since it provides a rest station for migratory birds during migration seasons (spring and autumn). It is located at aerial distance of approximately 30km to the north of the Project area.

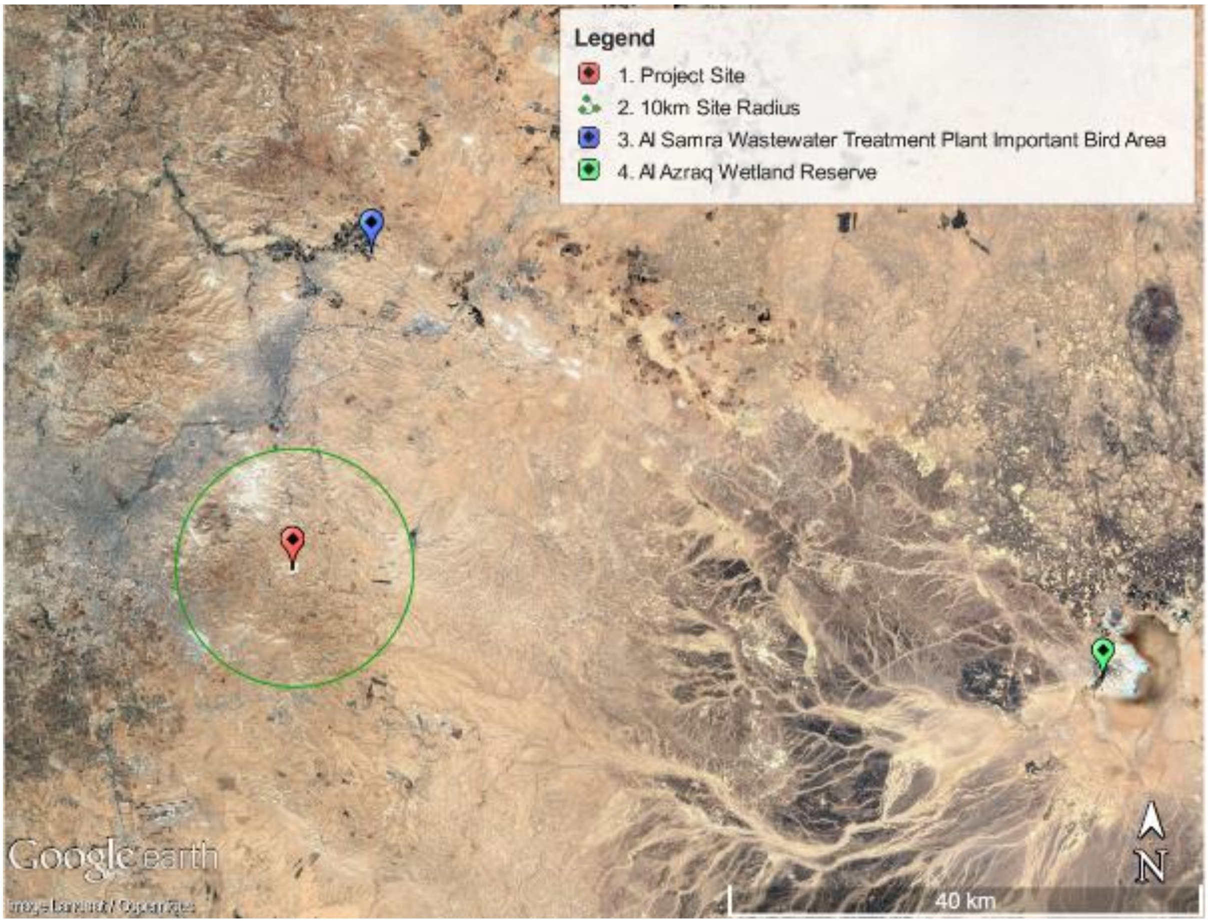


Figure 10-1 Locations of protected areas in relation to the Project site

10.2.2 EXISTING SITE CONDITIONS

10.2.2.1 TOPOGRAPHY

The Project area consists of small hills of limestone and flat area. The Project area is located within one topographic zone. This topographic nomenclature is 'Badia' (Eastern Desert). The term 'Badia' is used throughout much of the Middle East and refers to arid, desert environments. It extends from the margin of the Amman conurbation towards Iraq and between the international boundaries of Syria in the north and Saudi Arabia in the south.

10.2.2.2 SOIL TYPE

The Project area is located within aridisols order of soil type (US Department of Agriculture). This order is characterized as moderately deep with fine silty loam texture within the soil profile, subsoil horizons are rich in $CaCO_3$ (calcareous soil), the surface layer of soil is yellowish brown to brown, there is a high silt content of the soil surface and poor in organic matter content.

10.2.2.3 CLIMATE

The Project area climate belongs to the Arid Mediterranean region. Mean annual maximum temperature for the region ranges between 35°C and 40°C. The mean annual minimum temperature ranges between 2°C and 9°C.

Mean annual rainfall ranges from less than 50mm in the south of the region to 250mm in the north.

10.2.2.4 HABITAT

A terrestrial ecology baseline survey was conducted over the course of one day at the Project site on 8 January 2017, by biodiversity specialists within the Royal Scientific Society (RSS). The site survey identified that the Project area is within a highland ecosystem, which consists of escarpments and mountains, hills and undulating plateaus.

The survey results indicate that the Project area is covered with compacted materials (base course or sub-base materials), see Figure 10-2 (also refer to Figure 10-5 and Figure 10-6) and is considered barren land. Less than 10 specimens of *Anabasis syriaca* were recorded during line transect surveys within the middle of the Project site. It is considered that the poor biodiversity is a direct result of the land preparation/clearances undertaken by the Ministry of Finance in 2010.

Figure 10-2 Graded site conditions, looking south across the site from the north-east of the Project

10.2.2.5 VEGETATION AND FLORA

The general Project area is dominated by one vegetation type (Steppe vegetation), which is confined to the Irano-Turanian biogeographic zone. The vegetation is a timber-less (no trees) comprised predominantly of shrubs and bushes, such as *Retama raetam, Ziziphus lotus, Artemisia sieberi, Noaea mucronata* and *Anabasis syriaca.* Only *A. syriaca* was identified within the Project site, with typical conditions shown in Figure 10-3.

Figure 10-3 Project site conditions identified during the site visit undertaken on 8 January 2017

10.2.2.6 FAUNA

Fauna (mammals) and herpetofauna (amphibians and reptiles) species were not recorded within the Project area during the ecology survey, likely due to the lack of vegetation cover and distribution within the habitat.

One individual specimen of avifauna (birds) was identified during the site visit. A single white wagtail (*Motacilla alba*) was observed at the eastern boundary of the Project site, adjacent to an area of fly-tipped domestic food waste. White wagtails are a winter visitor to Jordan during the migratory season.

10.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

10.3.1 ASSESSMENT OF BASELINE CONDITIONS

10.3.2 ECOLOGICAL SITE SURVEY

The terrestrial ecology conditions of the proposed Project site was assessed through a combination of desk study and field survey observations. Desk studies for the area included a review of ecological survey data from the field survey, literature review of habitats and fauna and verification on the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of species that may have been recorded in the proposed Project area.

A rapid ecological survey was conducted over the proposed Project site and immediate surrounding area over the course of one day, on 8 January 2017, in order to record baseline flora and fauna. Opportunistic observations were also recorded during the ecological survey. Vegetation cover, fauna and any visible animal tracks were examined in order to identify potential species. Bird sightings and incidental observations of invertebrates were recorded. No trapping or specimen collection was undertaken due to the disturbed condition of the habitats encountered within the Project site.

Habitats and flora were identified according to the Vegetation of Jordan (Al-Eisawi D. M., 1996), Jordan Plant Red List (Taifour, 2014), and Field Guide to Wild Flowers of Jordan and Neighbouring Countries (Al-Eisawi D. M., 1998).

Fauna encountered at the site was identified according to Jordan Country on Biological Diversity (Amr, 2000).

The following subsections outline the survey methodologies which were conducted during the ecological survey.

LINE TRANSECT METHOD

This method incorporated walking inside the study area for a specified time in random directions, depending mainly on the topography. While walking, the team searched for signs of flora/fauna species presence such as footprints, scats, dens and even live specimens. The walk was undertaken during the daytime due to safety concerns.

The line transects were located in areas which supported vegetation to ensure that species were identified, and in areas bordering adjacent agricultural land and/or wadi paths. In total, three (3) transect lines were surveyed, as shown in Figure 10-4.

Figure 10-4 Line transect locations completed on 8 January 2017

Figure 10-5 Conditions at line transect 2, looking east

Figure 10-6 Conditions at line transect 3, looking north

OPPORTUNISTIC OBSERVATION METHOD

Opportunistic observations included other field observations that were not conducted during the timed and designed field methods. It represented casual encounters (sightings, footprints, faecal remains and skeletal remains)

SENSITIVITY ASSESSMENT

Ecological features that were identified during the ecological survey were assessed for sensitivity. A definition of sensitivity is provided in Section 6, the ecological sensitivity ranking is shown in Table 10-1.

Table 10-1 Ecological sensitivity ranking

SENSITIVITY	EXAMPLE OF FEATURE TYPE
Low	No or little vegetation present, area currently disturbed.
Medium	Ornamental landscaping present including mature date palms. Native species of vegetation growing across the site including mature trees.
High	A mosaic of habitats present including mature native trees and known reptile burrows

10.3.2.1 ASSESSMENT OF ENVIRONMENTAL IMPACTS

ASSESSMENT OF CONSTRUCTION IMPACTS

Following the identification of sensitive ecological receptors and activities that are likely to cause impacts have been described, the potential resultant changes to the receptor have been assessed to ascertain the overall significance of the impact. Impacts have been assessed in the context of the described baseline conditions within the zone of influence during the lifetime of the development. Impacts have been considered in two stages; the construction phase and the operational phase. Construction phase impacts are predominantly concerned with site clearance and construction activities and include, but are not limited to:

→ Increased noise levels;

→ Increased vibration;

→ Collision risk with site vehicles; and

→ Habitat loss, damage and disturbance.

ASSESSMENT OF OPERATION IMPACTS

Operational phase impacts which will be considered relevant to ecology include, but are not limited to:

→ Barrier effect between habitats;

→ Shading resulting from the suspended PV panels;

→ Electrocution risk from overhead transmission lines (associated facilities off-site); and

→ Collision risk with maintenance vehicles.

10.3.3 SIGNIFICANCE CRITERIA

The significance of impacts to terrestrial ecology during the construction and operational phases has been considered through the methodology outlined in Chapter 6: EIA Methodology.

Ecological impact significance is summarised in Table 10-2, as guided by CIEEM (2006).

Table 10-2 Ecological impact significance (importance)

IMPACT	DEFINITION
Positive	A habitat is rehabilitated or enhanced as a result of the Project
Negligible	Limited deterioration to existing degraded habitats via indirect impacts. Temporary disturbance to fauna caused by indirect impacts such as noise generation.
Minor	The loss of limited areas of degraded habitat or widespread flora species which regenerate disturbed areas.
Moderate	The loss of vegetation and trees, or localised loss of habitat. Displacement of breeding birds and widespread reptile and mammal species.
High / Critical	The destruction of high value or protected habitats. Death and displacement of protected fauna species.

10.3.3.1 LIMITATIONS AND ASSUMPTIONS

The survey undertaken at the Project site provides baseline information on the habitats and species present at that point in time. Existing baseline conditions have been described, and construction and operation activities associated with the proposed Project development have been assessed with regards to their impact on key ecological features which are identified as requiring special protection or due consideration. Impacts have been characterised in terms of their duration, magnitude, extent, reversibility, timing and frequency. The significance of impacts has been considered in the context of ecosystem functions, ecological processes, ecological networks and population viability. Impacts have been described in a quantitative manner where possible although where qualitative assessments have been necessary, these have been based on professional judgement. The significance of impacts has been based on a conservative 'worst case' basis in accordance with the precautionary principle.

10.4 IMPACT ASSESSMENT

10.4.1 IMPACTS DURING CONSTRUCTION

10.4.1.1 HABITAT LOSS

The construction of the Project will result in the loss of sparse, localised vegetation within the Project site. It is considered that damage and destruction of the low-diversity/frequency and common vegetation will be of low magnitude and result in an impact of **negligible** significance.

10.4.1.2 BARRIER EFFECT

Due to the site grading and ground preparation that has already been conducted across the Project site, barrier effects and habitat fragmentation will not occur. Therefore, the impact is considered to be of **negligible** significance.

10.4.1.3 NOISE DISTURBANCE

No suitable bird nesting habitat was identified within the Project site or immediate boundary, and no field signs or fauna was seen. Therefore, the disturbance to fauna behaviour and distribution at the Project site is considered to be of **negligible** significance.

10.4.1.4 LIGHTING DISTURBANCE

Light spill from construction activity and the perimeter fence onto open desert has potential to disturb fauna, particularly crepuscular (twilight) species. Due to the absence of faunal field signs, in addition to the historical site preparation works which have been completed at the Project site, it is considered that light spill will represent a slight magnitude and an impact of **negligible** significance.

10.4.1.5 DUST SETTLEMENT

Construction activities will result in the generation of dust and subsequent dust settlement, which can degrade habitats and damage vegetation. Vegetation within the Project site has been identified as natural and highly localised, with low abundance, low diversity, with only one, nationally common, species. Nonetheless, dust settlement has potential to reduce the future health of the habitat and restrict the regrowth of vegetation and the recovery of limestone gravel plain habitat. The impact magnitude of dust settlement is considered to be low, and the impact significance is **negligible**.

10.4.1.6 COLLISION RISK

There is potential for wildlife, feral animals and roaming livestock to be involved in collisions with site vehicles and construction equipment, along haul roads and site access roads. The impact magnitude of wildlife being involved in collisions with site vehicles is assessed to be medium, and the significance is **minor negative**.

10.4.1.7 OPEN EXCAVATIONS

There is potential for wildlife, feral animals and roaming livestock to become trapped within excavations at the construction sites if these are left exposed. Excavations could lead to injury and potentially death of wildlife. The impact magnitude of wildlife accessing excavations is assessed to be medium, and the significance is **moderate negative**.

10.4.1.8 GROUND CONTAMINATION

Contamination events as a result of chemical and hydrocarbon spills have to potential to degrade or damage habitats and vegetation, however due to the modified conditions of the Project site and type of development anticipated to require low volumes of such materials, the impact is considered to be of **negligible** significance. For more detail as to the impacts of chemical spill, please refer to **Chapter 11: Soil, Hydrology and Water Quality**.

10.4.2 IMPACTS DURING OPERATION

10.4.2.1 LIGHTING DISTURBANCE

Light spill from the perimeter fence security lighting (as indicated by the Project Company) onto open desert has potential to disturb fauna, particularly crepuscular species. Due to the expected 25-30 year operational life of the Project, it is considered that light spill onto the surrounding open desert will represent a slight magnitude and an impact of **minor negative** significance.

10.4.2.2 BACKGROUND NOISE LEVELS

Due to the absence of ecological features within the Project site and survey boundary, in addition to the isolated nature of the habitats bounded by the existing road to the south of the Project site, the impact is considered to be **negligible** in significance.

10.4.2.3 BARRIER EFFECT

The installation of a perimeter fence at the Project site will prevent and/or limit access to transient land mammals. However, due to the extensive site clearance and grading which was undertaken in 2010 by the Ministry of Finance, it is considered that fauna will have migrated away from the site. Therefore, the impact of barrier effect during the operational phase is deemed to be **minor negative** significance.

10.4.2.4 COLLISION RISK

There is no existing road network within the location, and as such, the impact significance of collisions with fauna (wild, feral or livestock) is considered to be **minor negative**.

10.4.2.5 ELECTROCUTION RISK (ASSOCIATED FACILITIES- TRANSMISSION LINE)

It is understood that electrical cabling within the site will be predominantly ground or underground-based. As a result, the expected risk on site of electrocution of animals, particularly birds, is considered negligible. As described within Section 3 however, it has been indicated that NEPCO, who will be responsible for connecting the Project’s substation to the existing substation at IPP4 approximately 2km from the site, are considering the use of overhead transmission lines (OHTL) adjacent to the road on the southern edge of the site. As with all OHTL there is a risk of electrocutions for birds. Approximately 150m to the south of the site there are also existing OHTL from the IPP3 plant (c.7km east of the Project site) to the IPP4 substation. Based on the minimal vegetation at the site (and along the short 2km routing to IPP4) and correspondent lack of birdlife, particularly raptors, it is considered that the risk of bird mortalities is low.

10.5 MITIGATION

10.5.1 DESIGN

As the Project site has already undergone site clearance and grading, no mitigation within the design stage is applicable.

10.5.2 CONSTRUCTION

Wärtsilä will be required to develop an appropriate terrestrial ecology management plan in accordance with the CEMP included within this EIA. The CEMP will include the following measures:

- Location of laydowns and stockpiles shall not be within open desert areas, and shall be restricted to within the site boundary;
- Stockpiles shall be dampened with water or covered in high winds, to reduce fugitive dust and subsequent settlement on adjacent open desert areas;
- Haul vehicles shall be sheeted to prevent dust and debris settling on adjacent open desert;
- Working corridors will be restricted to the smallest practicable area to avoid disturbance to open areas outside of the Project site;
- Spill kits will be available at all work sites to efficiently clean any spills which may occur;
- Wastes, chemicals and fuels shall be stored within impermeable bunds of 110% the volume of the container, and located within the Project site, away from open adjacent desert and natural drainage channels;
- Baffles shall be fitted to all site lighting to prevent light spill onto adjacent open desert;
- Significant excavations should be back-filled or covered to prevent wildlife and feral animals from falling and becoming trapped;
- Prohibit hunting on site particularly by construction workers;
- Ensure domestic waste is appropriately covered and removed from site on regular basis to avoid attraction of pests;

- Speed limits will be restricted to allow maximum response times to animals within haulage and access routes; and
- Should animals be encountered onsite then the Municipality shall be called, and the animal left undisturbed.

10.5.3 OPERATION

General mitigation measures for implementation during the operational phase include:

- The limiting of vehicle use to asphalted/compressed track roads to reduce impacts on desert habitats;
- Positioning lighting or fitting baffles to perimeter luminaires to avoid light spill onto adjacent open desert;
- Installing road signs with posted speeds will assist in ensuring vehicles adhere to speed restrictions, and improve reaction time to account for potential animals in the road; and
- Due to the security requirements surrounding power projects it is considered not feasible to include access points within the fence structure to allow fauna to pass through the site.

10.6 CUMULATIVE IMPACTS

10.6.1 CONSTRUCTION

There are no expected cumulative impacts during the construction phase of the Project.

10.6.2 OPERATION

There are no expected cumulative impacts during the operational phase of the Project.

10.7 RESIDUAL EFFECTS

All predicted impacts are amendable to mitigation. Following the implementation of recommended mitigation measures through the enforcement of a CEMP, the residual impacts during the construction phase are **negligible**.

During the operation phase, all residual impacts are considered to be **negligible**.

10.8 SUMMARY OF IMPACTS

A summary of the impacts on ecological features as a result of the Project are shown in Table 10-3.

Table 10-3 Summary of Terrestrial Ecology impacts and mitigation

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive / Negative	P/T	Direct / Indirect (D/T)	Short Term (ST) Medium Term (MT) Long Term (LT)		Major, Moderate, Minor, Negligible
Construction							
Habitat loss and vegetation removal	Negligible	-	-	N/A	-	→ Implementation of CEMP to ensure best practice measures including: ▪ Location of laydowns and stockpiles shall not be within open desert areas, and shall be restricted to within the site boundary; ▪ Stockpiles shall be dampened with water or covered in high winds, to reduce fugitive dust and subsequent settlement on adjacent open desert areas; ▪ Haul vehicles shall be sheeted to prevent dust and debris settling on adjacent open desert ▪ Ensure domestic waste (food waste) is appropriately stored, covered and removed from site on regular basis to avoid pests; ▪ Prohibit hunting of animals on site by construction workers; ▪ Working corridors will be restricted to the smallest practicable area to avoid disturbance to open areas outside of the Project site;	Negligible
Barrier effect	Negligible	-	-	N/A	-		Negligible
Noise disturbance	Negligible	-	-	N/A	-		Negligible
Lighting disturbance	Negligible	-	-	N/A	-		Negligible
Dust settlement	Negligible	-	-	N/A	-		Negligible
Collision risk	Minor	Negative	T	I	ST		Negligible
Trapping and injuring animals through falls into open excavations	Moderate	Negative	T	I	ST		Negligible
Ground contamination	Negligible	-	-	-	-		Negligible

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive / Negative	P/T	Direct / Indirect (D/T)	Short term (ST) Medium Term (MT) Long term (LT)		Major, Moderate, Minor, Negligible
						▪ Spill kits will be available at all work sites to efficiently clean any spills which may occur; ▪ Wastes, chemicals and fuels shall be stored within impermeable bunds of 110% the volume of the container, and located within the Project site, away from open adjacent desert; ▪ Baffles shall be fitted to all site lighting to prevent light spill on to adjacent open desert; ▪ Excavations to be left unattended shall be back-filled or covered to prevent wildlife and feral animals from falling and becoming trapped; ▪ Signage shall be erected to alert drivers and machine operators to the potential presence of animals within the site, and speed limits will be restricted to allow maximum response times to animals within haulage and access routes; and ▪ Should animals be encountered onsite then the Municipality shall be called, and the animal left undisturbed.	
Operation							
Lighting disturbance on adjacent open desert	Minor	Negative	P	D	LT	→ Ensure any lighting provision does not create light spill on adjacent open desert.	Negligible

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive / Negative	P/T	Direct / Indirect (D/T)	Short term (ST) Medium Term (MT) Long term (LT)		Major, Moderate, Minor, Negligible
Disturbance from increased background noise levels	Negligible	-	-	-	-	→ N/A	Negligible
Barrier effect	Minor	Negative	P	D	LT	→ Due to the security requirements surrounding power projects it is not possible to include access points within the fence structure to allow fauna to pass through the site.	Minor Negative
Collision risk	Minor	Negative	P	I	LT	→ Provision of road signs alerting road users to the potential presence of animals, and posted road speeds.	Negligible
Electrocution risk (bird mortality)	Minor	Negative	P	D	LT	→ None	Minor negative

11 SOIL, HYDROLOGY AND WATER QUALITY

11.1 INTRODUCTION

This Chapter considers the potential impacts of the Project on the soil, hydrology and water quality within and surrounding the Project site during both the construction and operational phases. Where significant impacts are identified, appropriate avoidance and mitigation measures are provided.

The baseline conditions of the Project site and the surrounding area are presented followed by an assessment of impacts from the Project upon the soil, hydrology and water quality of the site.

11.2 BASELINE CONDITIONS

11.2.1 SITE CONDITIONS

During the walkover, no evidence of soil contamination was observed on or surrounding the Project site.

The Project is located in the east of Amman governorate in the Sahab district, in the eastern end of the Amman-Zarqa Basin area. The site sits at an elevation of approximately 800m above sea level and slopes to the east with variations in elevation. A geotechnical investigation was undertaken for the Project in June 2016. This included drilling of 13 boreholes drilled to a depth of 30m, as per Table 11-1 and Figure 11-1. Soil samples were collected from each of the boreholes; groundwater was not encountered in any boreholes.

Table 11-1 Borehole locations at the Project site

BH No.	Coordinates		Elevation (m)
BH1	31° 54.670' N	36° 6.009' E	810
BH2	31° 54.670' N	36° 6.132' E	816
BH3	31° 54.670' N	36° 6.267' E	812
BH4	31° 54.569' N	36° 6.009' E	816
BH5	31° 54.569' N	36° 6.132' E	822
BH6	31° 54.569' N	36° 6.267' E	814
BH7	31° 54.460' N	36° 6.009' E	816
BH8	31° 54.460' N	36° 6.132' E	823
BH9	31° 54.460' N	36° 6.267' E	815
BH10	31° 54.372' N	36° 6.009' E	814

BH No.	Coordinates		Elevation (m)
BH11	31° 54.372' N	36° 6.267' E	817
BH12	31° 54.328' N	36° 6.132' E	826
BH13	31° 54.284' N	36° 6.009' E	811

National Soil Map and Land Use Project (NSMLUP) has produced soil maps and divided the country into 16 land regions, as shown in Figure 11-2. Based on this NSMLUP classification, the Project site is located in the Northern Jordan Basalt Plateau area. A feature of irrigation in this area is the rapid build-up of salinity which has resulted in many abandoned farms across this region.

Figure 11-1 Borehole locations

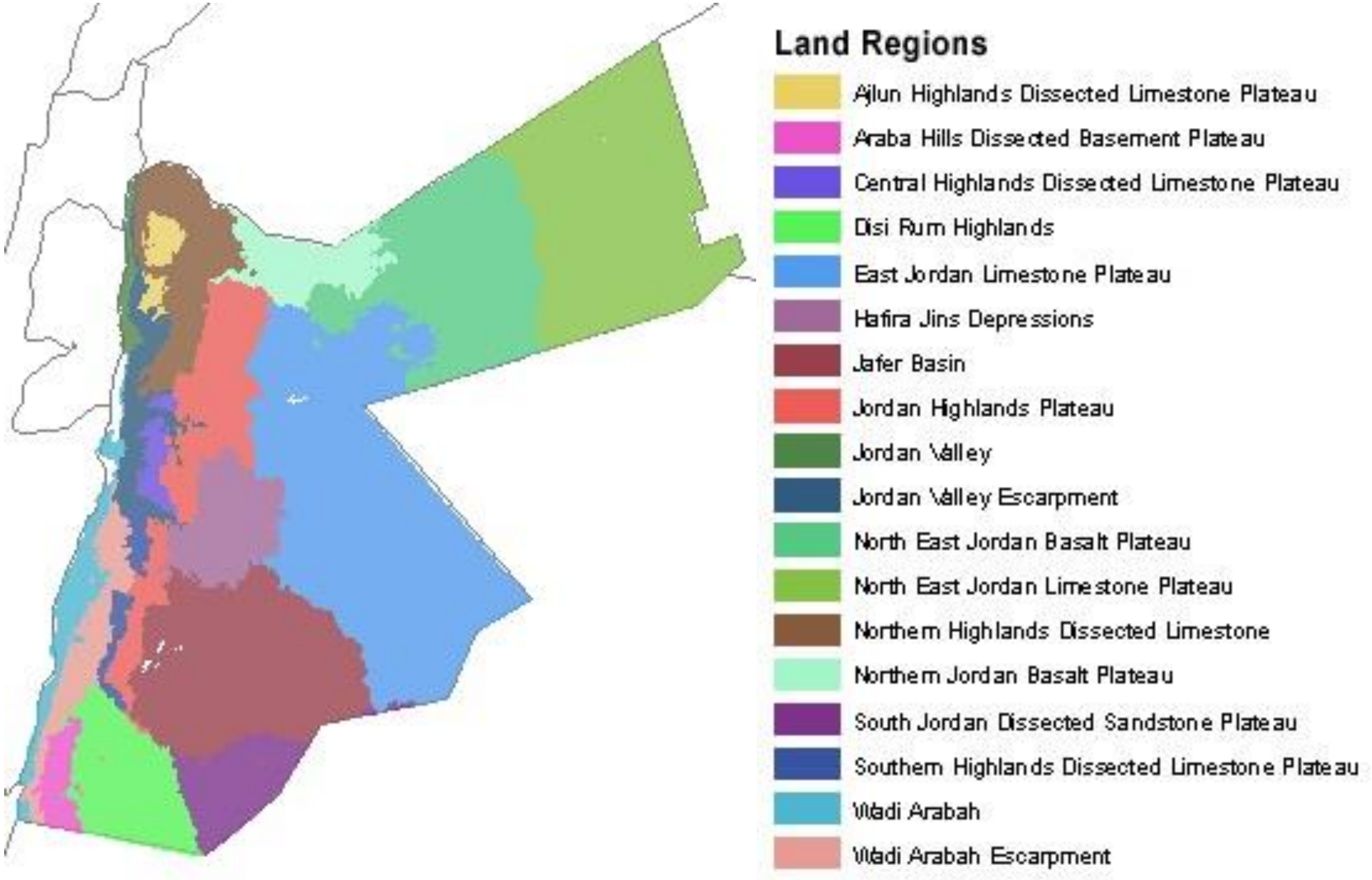


Figure 11-2 Land Regions of Jordan (Office of Arid Lands Studies, 2006)

SOILS, GEOLOGY, AND SEISMOLOGY

Soil surveys have been undertaken by the Ministry of Agriculture since the 1950s using the USDA classification of 1938. These surveys indicate that Jordan has four soil orders, which can be further distinguished between nine groups. Figure 11-3 represents the distribution map of soil orders found throughout the Hashemite Kingdom of Jordan.

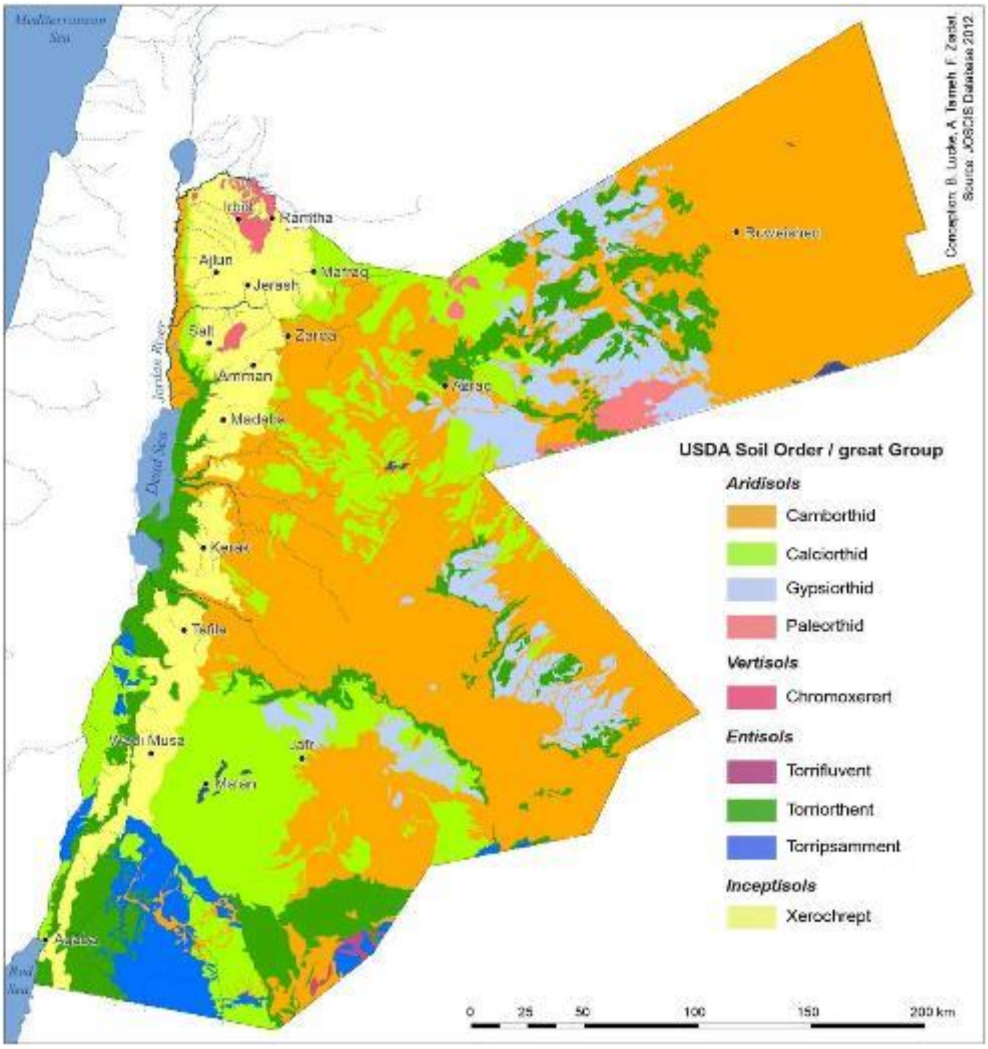


Figure 11-3 Jordan Map of Soils (Lucke , Ziadat , & Taimeh , 2013)

The Project site is located within an area of aridisols order. The soils in this order are common in dry climates and are characterised by lime or gypsum accumulation and salty layers, and are typically of low organic matter content. Although aridisols are of generally low productivity, where irrigation is available they can be capitalised upon as productive soils with the use of fertilisers and appropriate management.

The major soil subgroups in this classification of land region are xeric and xerochreptic calciorthids. Xerochreptic paleorthids are the second-most common subgroup. Lithic subgroups are also common in this area as well as camborthids in the valleys, basins and lower footslopes.

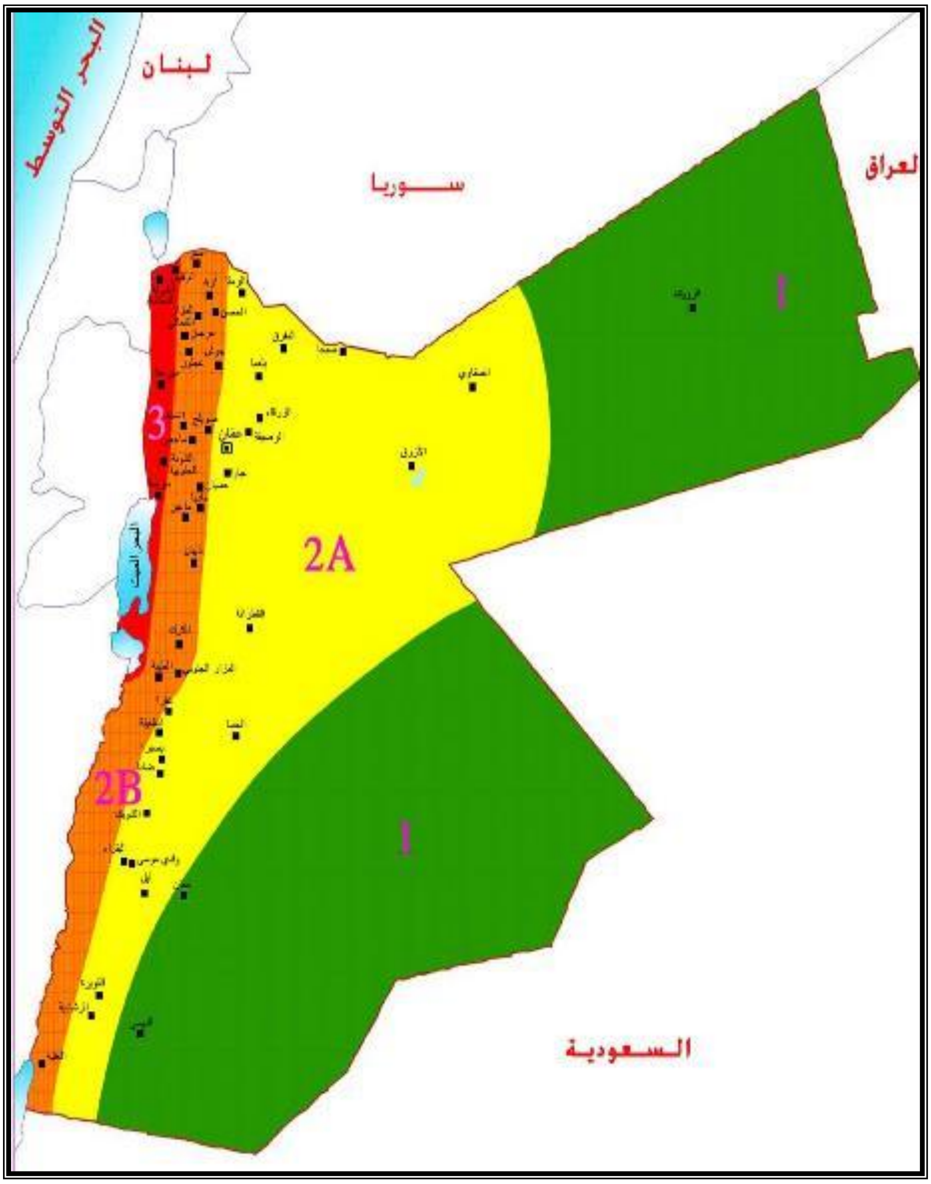


Figure 11-4 Jordan Seismic Hazard map

The Project site is within seismic area 2A, and geotechnical report includes engineering and design recommendations based on the known soil composition on site, being a mixture of silty clay, mixture and marl, and limestone. The full geotechnical report has been included in Appendix E for reference.

During the site visit, a sheep farm was identified on the opposite side of the Project area. Approximately 8km to the east of the Project, the Gabawi landfill is located which comprises the largest managed landfill in Jordan. The landfill facility also comprises a leachate treatment plant and a medical and hazardous waste incinerator. Close to the landfill is the Amman East Power Plant (IPP3) with the IPP1 and IPP4 power plants located approximately 2km to the west of the proposed site.

GROUNDWATER AQUIFERS

Jordan has identified 12 groundwater basins comprised of several aquifer systems. The three largest aquifers together contain approximately 80% of Jordan's groundwater reserves (Ministry of Water and Irrigation, 2010). It is understood that most renewable groundwater resources are currently exploited to their maximum capacity (Ministry of Water and Irrigation, 2017).

The Project lies within the Amman–Zarqa Basin area. The Basin is an estimated area of 4,120km^2 and divided into two parts: The eastern part is located to the north-east of Wadi Zarqa that flows to the west, and a western part extending to the west of Wadi Zarqa that flows to the east. The Basin consists of two main aquifers in the Project area. These are the deep Hummer formation (A4) and the shallow complex consisting of Wadi Sir-Amman silicified unit (B2/A7). These two aquifers are related to the Upper Cretaceous Hydraulic System and Upper Cretaceous Hydraulic Aquifer.

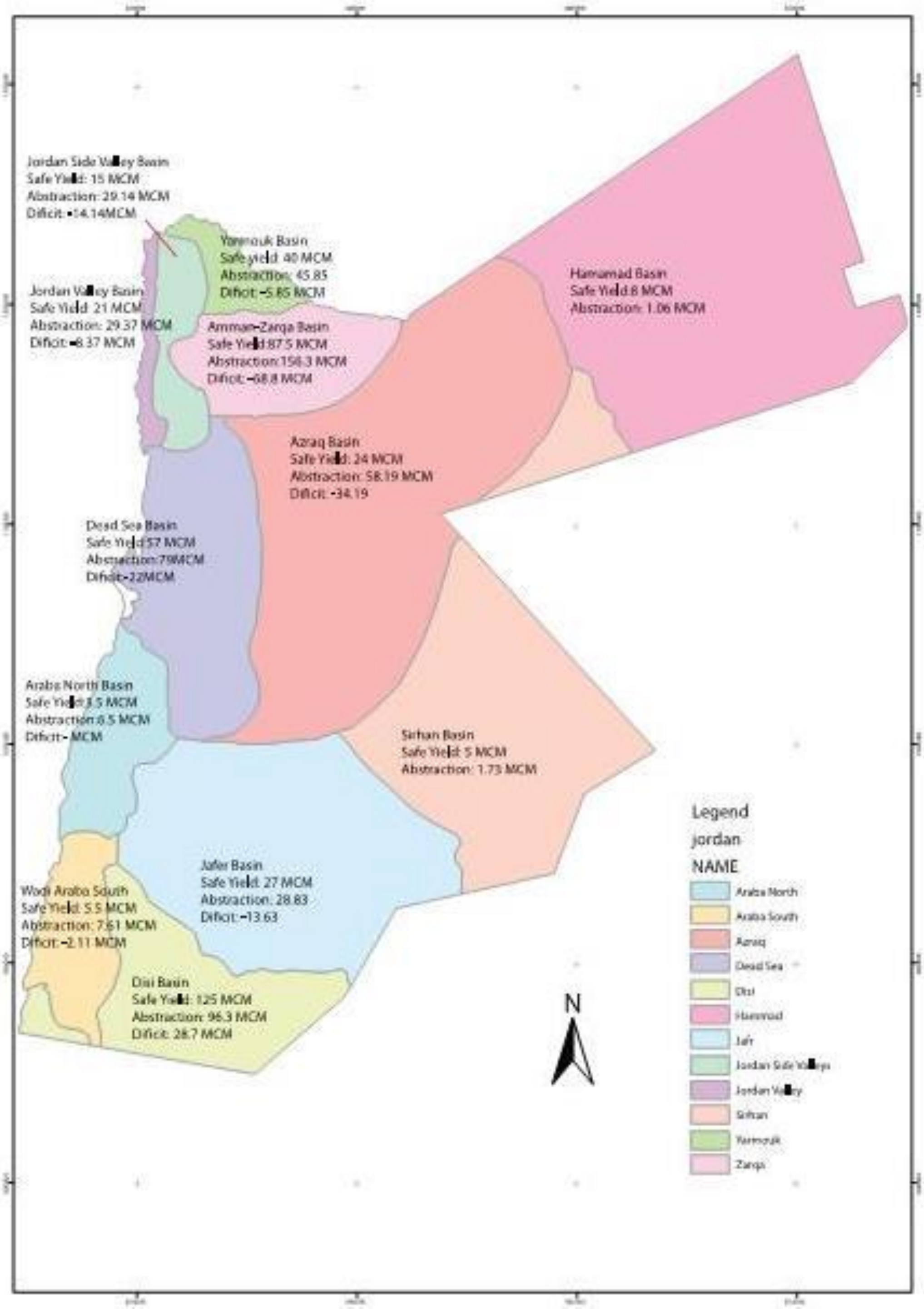


Figure 11-5 Jordan's 12 groundwater basins (Jordan Ministry of Water & Irrigation, 2013)

The average renewable groundwater quantity in the Basin is approximately 88 million cubic meters (MCM) per year, of which approximately 35MCM/ year return to the surface as base flow in the Zarqa River. The remaining 53MCM/ year is pumped through wells distributed over the basin area.

The direct recharge to the Basin comes from precipitation, floodwater flows and infiltration resulting from irrigation activities. The contribution of domestic, industrial and irrigation activities in groundwater recharge is estimated to be approximately 40 MCM /year. The groundwater quality in the basin is affected by various factors such as over pumping, inflows of wastewater and leaching of solid wastes.

Studies undertaken estimate the total recharge of this aquifer based on the flow-net analysis of groundwater is approximately 5 MCM /year.

The Ministry of Water and Irrigation maintain and document groundwater resources and wells. Two closest wells identified within the vicinity of the Project area are identified in Table 11-2 and Figure 11-6.

Table 11-2 Well information within the vicinity of the Project

Well Id	Station Name	Aquifer Description	Yield (m^3/h)	Static Water Level (m)	Drawdown (m)	Specific Capacity (m3/h/m)	Well Depth (m)
AL1789	Madouneh No1	Amman/Wadi Sir (B2/A7)	58	148.3	3	19.33	203
AL1797	Mohammad Hamlan 3	Amman/Wadi Sir (B2/A7)	66	169.3	15.7	4.2	220

Figure 11-6 Groundwater wells within the vicinity of the Project site

These wells are recharged by the Wadi Sir-Amman aquifer (B2/A7), and static water levels measured at these wells range between 148m to 200m. The yield of these wells range from 58 to 66 m^3/h. Based on the geotechnical investigation, the groundwater flow within the Project area is indicated to be towards the north and northeast direction, and averages at approximately 650m above sea level (with site at approximately 800m above sea level).

SURFACE WATER

There are three main sources of potable water within Jordan being: springs, treated wastewater, and dams. These resources are all found around the Amman-Zarqa Basin and are some distance (greater than 4km) from the Project site. The average annual rainfall in the Project area is approximately 220mm/year. Peak runoff (calculated in line with the Soil Conservation Service methodology) has been estimated as 90.6mm/year. Therefore, based on a maximum runoff of 0.00454 MCM for a 24-hour rainfall scenario and 270.9 km^2 surface area, the maximum flood flow volume has been calculated as 24.5 MCM.

Flash floods are reported to occur within the vicinity of the Project site, but these are currently not directly exploited water resources.

Two wadis have been identified close to the Project site: one at the western side of the site, flowing to the north; and the second wadi at the south of the site, flowing north-west. Nevertheless, wadi flows have already been disrupted within the Project site due to pre-existing disturbance associated with grading of the land and levelling through the use of compacted base-coarse material. As previously indicated, the Project site slopes generally , with some depressions due to effect of rainfall and degree of compaction. The Figure 11-7shows the Project site with the wadis indicated.

Figure 11-7 Project site with two wadis

Part of the wadi on the southern side had been covered with the base coarse materials (likely during the site grading undertaken by the Ministry of Finance in 2010) leading to changes in the flow path with similar conditions noted for the second wadi. This condition could enhance the corrosion of fine materials leading with time to unstable sides of the Project area. While the quality of the surface runoff passing near the farm across the other side of the road could be affected (e.g. contaminants such as nitrogen compounds, organic and E-Coli), as the site is several metres above the farm point it is considered unlikely that any such contaminated surface water would flow in to the Project site. Due to the nature of the Project land (e.g. permeable sand substrate) and the local wadis in the vicinity, it is considered that flooding likelihood in the Project area is low. However, given the relatively large area which may also be compressed further during construction (reducing infiltration), consideration of a suitable drainage system will be necessary on the Project site to ensure erosion is controlled, particularly with reference to minimising erosion on adjacent farmlands. Drainage points should avoid the northern agricultural land and roadway (unless directly connecting into existing wadis).

According to the instruction for water protection issued by Ministry of Water and Irrigation in 2011, there no main wadis that have been identified as close to the Project area and, accordingly, there are no protection zones of surface water resources in the Project vicinity. According to surface water utilization policy (2016) by Ministry of Water and Irrigation only 50% of surface water in Jordan is utilized, so the Ministry encourages the utilisation of surface water resources due to the deficit between water supply and demand in Jordan. In remote areas, such as the Project area, water harvesting is highly encouraged.

As noted within the waste section (Section 9), around the site a number of what appear to be fly tipped piles of waste, predominantly consisting of construction waste or agricultural waste (e.g. sheepskins) are present, particularly on the southern and eastern boundaries. While most wastes appear to be inert (e.g. concrete rubble, rebar) with limited likelihood of impacting upon soil/groundwater, care will still need to be given during disposal to ensure the safety of construction workers- particularly with respect to the sheepskin/wool waste piles observed.

11.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

11.3.1 ASSESSMENT METHODOLOGY

Current guidance within Western Europe and the USA advocate the use of a conceptual risk assessment model to establish the potential links between a hazardous source of contamination and a sensitive receptor via an exposure pathway, as illustrated in Figure 11-8.

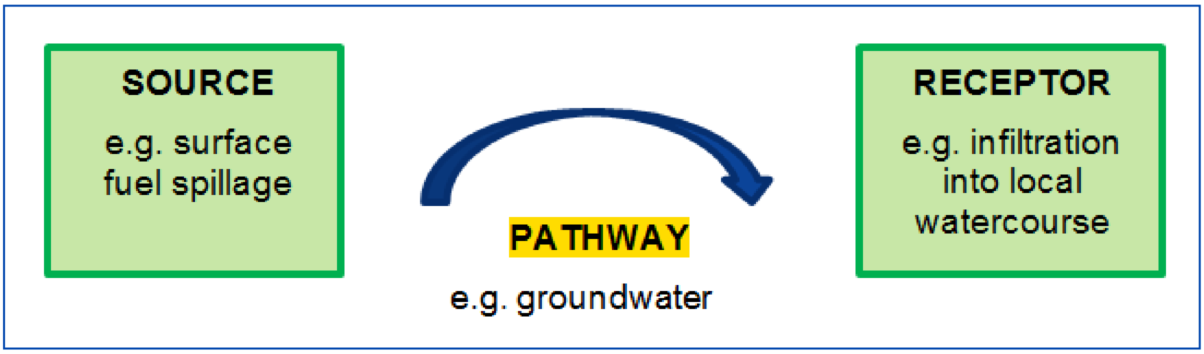


Figure 11-8 Contamination risk assessment pollution linkage

The concept behind this approach is that, without all of the three elements (source, pathway and receptor), there can be no potential contamination risk. Thus, the presence of a contamination hazard at a particular site does not necessarily imply the existence of associated risks.

IFC General EHS Guidelines (2007) defines 'exposure pathway(s)', as; '*a combination of the route of migration of the contaminant from its point of release (e.g. leaching into potable groundwater) and exposure routes (e.g. ingestion, transdermal absorption), which would allow receptor(s) to come into actual contact with contaminants.*'

Potential existing sources of contamination have been identified in earlier sections (predominantly Section 9) and assessed within different baseline conditions sections. While limited earthworks are expected on site as Ministry of Finance have already profiled the area to a great extent there will need to be a watching brief on site for surface/subsurface contamination during any groundworks and site preparation in order to reassess potential sources.

11.4 IMPACT ASSESSMENT

11.4.1 IMPACTS DURING CONSTRUCTION

The development of the Project will require site preparation, excavation, earthworks, compaction and vehicle movements which will all impact the physical condition of the existing ground. The severity of the impact is assessed as high, however, the receptor sensitivity is classified as low. Consequently, the impacts associated with disturbance of the ground are minor.

Ground clearance and soil compaction are expected to be undertaken as part of the construction activities of the Project. These changes may produce subsequent impacts to existing drainage channels and increased surface water runoff.

During the course of the construction of the Project, it is anticipated that accidental spills and leaks may occur, for example during vehicle maintenance/refuelling activities or from storage of liquids at the site. Risks associated with such spillages include the potential for contamination of the underlying aquifer (although current groundwater level is very deep) due to infiltration through the permeable strata at the site.

The severity of impacts associated with contamination of soil due to construction activities is assessed as medium, whilst the receptor sensitivity results in an impact classification of **moderate**. With respect to the receptor sensitivity of localised groundwater conditions (as deep wells are required and limited wells appear to be present/registered in the area) and impact severity, the significance of contamination impacting the groundwater is assessed as **minor**.

Site workers would potentially come into contact with contaminated soil during the course of the works, should previously unidentified contamination be located, or should accidental spillages occur.

The impact severity of soil contamination on workers would be classified as high, whilst the sensitivity of the receptor would also be high. Consequently, the impact of soil contamination on site workers is assessed as **major**.

While only two offsite (although immediately adjacent to the site) wadis have been registered by the Ministry of Water and Irrigation, earthworks undertaken on site and site compaction may result in potential increased surface run-off. This may impact on either the site directly (if inadequate drainage) or off site, predominantly through erosion due to water velocities expected during such events though mobilisation of contaminants, if present, may also

11.4.2 IMPACTS DURING OPERATION

Due to the nature and design of solar plants, there is limited opportunity to accommodate other uses of the land. The land represents relatively low value for agricultural cultivation (particularly following the ground preparation works undertaken by Ministry of Finance in 2010), and therefore is considered a **minor** impact with respect to changing land use. This is discussed further in the Socio-economics section – Section 13.

There is a potential that, during the course of operation, spillage or leakage of liquids may occur. However, as dry cleaning of the PV panels will be employed and limited hazardous chemicals are expected during operation, the likelihood of such spills or leaking is considered low. Nevertheless, the severity of impacts associated with contamination of soil due to operational activities is assessed as medium, whilst the receptor sensitivity results in an impact classification of moderate negative. When considering the receptor sensitivity of groundwater and an impact severity, the significance of contamination impacting the groundwater is assessed as **moderate**.

11.5 MITIGATION

11.5.1 DESIGN

Based on the potential for flash flood occurrences at the selected site location, the friable soil, likely soil compaction and surrounding sensitive agricultural land, consideration will need to be made within the design of suitable storm water management on site. The drainage channels will need to take into account appropriate disposal points to ensure:

- Avoidance of impacts to adjacent agricultural land or road (e.g. floods or erosion)
- Avoidance of erosion (e.g. minimise water velocities and avoidance of structural foundations)
- Avoidance of mobilisation of contaminants (away from equipment such as inverters or storage areas);
- Avoidance of 'filling in' existing wadis.

The geotechnical investigation results have also indicated the following necessary mitigation measures are incorporated within the design:

- → Structural foundations are appropriate based on soil profile;
- → Foundations account for necessary seismic resilience;
- → Stable slopes during temporary excavations (e.g. reducing gradients/supporting structures as necessary); and
- → Accounting for electrical resistivity.

11.5.2 CONSTRUCTION

In the event that any soil contamination is discovered, particularly during the preparatory stages of construction, these areas should be remediated appropriately. Based on the site having undergone site preparation in 2010 and the site effectively being considered as 'greenfield', no areas of particular contamination risk have been identified, although care will need to be taken during removal of existing wastes on site. Any contaminated materials that may be encountered should be disposed of correctly as hazardous waste by an approved contractor.

Modular wastewater storage tanks and chemical toilets will be used on the Project site to provide adequate containment facilities for the construction workforce. Wastewater tanks will be monitored to ensure they are emptied prior to filling by approved contractors and all such removals will be recorded with waste manifests/receipts from the transporter/receiving disposal facility being kept on site. It is anticipated that there will be no discharge or overflow of sanitary waste on site.

Hazardous materials such as fuel oils and chemicals used during the construction phase that have the potential to cause contamination will be appropriately managed through implementation of a CEMP. All fuel oil and chemical storage areas will be appropriately constructed to prevent impacts to the soil/groundwater in the event of an accidental spillage. The CEMP will provide detailed Environmental Control Plans for construction workers and personnel and sub-contractors including personnel safety, site conduct, security, storage of hazardous material and emergency preparedness.

The key control measures which will be incorporated into the CEMP to promote on-site environmental best practice throughout the construction process in relation to the storage of fuels, chemicals and oils onsite will include:

- Substitution of any hazardous substances with safer alternatives if possible;
- Changing work methods in order to prevent the production or release of potentially contaminative materials;
- Using a potentially hazardous material away from high risk areas;
- Limiting the quantities of hazardous substances during the construction process to reduce the risk of spillages;
- Reviewing drainage effectiveness on site (to minimise erosion/flooding on site or off-site) and that nearby wadis are not negatively impacted upon;
- Ensuring that all substances are stored in suitable, undamaged containers that are clearly marked with the type, nature and content of the material. This will ensure that all staff are aware of the material and its properties;
- Appropriate storm water management procedures to ensure that contaminants are not mobilised into the wider environment;
- Where practicable, retaining substances during the construction process in a central controlled and appropriately designed storage compound in accordance with best practice guidance and appropriate risk assessment based on the Material Safety Data Sheet (MSDS) provided by manufacturer (e.g. the Control of Substances Hazardous to Health (COSHH Regulations 2002) which provides a similar framework in the UK);
- Register of hazardous materials on site, including volumes, types and central database of MSDS;
- The storage areas should prevent damage to containers by any means, prevent the unauthorized use of material (e.g. responsible person to sign materials in and out of the compound), should be capable of containing any spillage from materials / substances (by the use of an impermeable surface and walls) and separate any materials that may become a hazard if combined;
- Returning any unused materials, spent containers, contaminated clothing, rags and tools to the central compound for appropriate disposal;
- As part of the CEMP, emergency clean-up procedures will need to be in place in the event of any potential spillages and account for contaminated material being appropriately cleaned up, stored and disposed of ; and
- As part of the CEMP, on-site staff and personnel will need to be briefed through toolbox talks and training on the control of substances and informing them of all control measures and location of spill response equipment on-site.

In addition, the CEMP would also contain control measures to be adopted during the construction stage to minimise potential impacts associated with leaks and spills from on-site activities. Such measures will include the following:

- All plant machinery should be regularly maintained with servicing undertaken on impermeable hard standing, and appropriate drip-trays should be located below mobile plant such as generators;
- Chemicals and fuels shall be stored within an impermeable bunded area, with a capacity of 110% of the total volume of the containers;
- Washout from concrete mixing plant or from cleaning ready-mix concrete lorries is contaminated with cement and therefore is highly alkaline. This should be avoided on site where possible or appropriately stored and treated/disposed of; and,
- All vehicle/plant re-fuelling should be closely supervised on a specific area of impermeable hardstanding. Appropriate spill trays shall be utilised where appropriate.

The ongoing evolution of the site CEMP will need to be monitored by Wärtsilä and Project Company in order to ensure that any unforeseen potential environmental and health and safety issues are adequately managed. This will ensure good working procedures are followed and will decrease the potential risk of pollution incidents occurring.

In addition, appropriate housekeeping precautions will be implemented to prevent construction workers from having contact with potentially contaminated soils. Construction workers will be required to wear suitable personal protective clothing and have appropriate training.

11.5.3 OPERATION

While limited information has been provided at the time of this EIA on the operational requirements for hazardous materials, based on typical designs for PV plants, the likelihood of soil and groundwater pollution during the operational phase of the Project is considered low. impacts resulting from soil and groundwater contamination due to spillage and activities on site during operation are expected to be possible to be mitigated against through the implementation of an Operational Management Plan (OEMP), supported by appropriate storage and handling of materials. Frequent audits and appropriate implementation of plans would mitigate against the impact and its significance. Implementation of these mitigations would render the impacts of **minor** significance.

It is recommended (and will likely be required by regulators) that an OEMP is developed which will contain the key operating procedures that are to be implemented for the Project to prevent contamination of the ground and groundwater, particularly following rain events and accidents.

The OEMP shall set out measures in relation to the following:

- Regularly reviewing discharge channel effectiveness and discharge point erosion if any;
- If hazardous chemicals and materials are to be stored at the site these should be appropriately stored in secure, bunded compounds and located on an impervious surface. The storage areas will need to be clearly labelled and have MSDS maintained and available;
- Details and properties for each material should be clearly detailed which include its hazard (poisonous, corrosive, flammable), prohibitions on its disposal (dumpster, drain, sewer) and the recommended disposal method (recycle, sewer, burn, storage, landfill);
- Provision of emergency response procedures for spillage incidents to ensure that contamination is avoided or minimised if they occur; and
- Provision of awareness training for all employees including security, management, office staff and technical staff on pollution prevention and control techniques and best practices.

11.6 CUMULATIVE IMPACTS

11.6.1 CONSTRUCTION

Cumulative impacts would include the potential for liquid spillage to soil and the cumulative impact that may have on the groundwater quality due to infiltration.

11.6.2 OPERATION

Cumulative impacts would include the potential for contamination of surface runoff , particularly during storm events, to the soil and the cumulative impact that may have on the groundwater quality due to infiltration.

11.7 RESIDUAL EFFECTS

The adoption of good on-site working and storage practices and the implementation of suitable control measures and on-site training and emergency preparedness will ensure that the potential for contamination events to occur is minimised as far as possible.

The implementation of a detailed CEMP will ensure that appropriate control measures are implemented to minimise any potential risks from contamination to the workforce and the environment during the construction phase. The residual impact is therefore considered to be of **minor** negative significance.

11.8 SUMMARY OF IMPACTS

A summary of the impacts as a result of the Project on the soil, hydrology and water quality of the area is provided in Table 11-3.

Table 11-3 Summary of soil, groundwater and hydrological impacts and mitigation

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive / Negative	Permanent (P) / Temporary (T)	Direct (D) / Indirect (I)	Short term (ST) Medium Term (MT) Long Term (LT)		Major, Moderate, Minor, Negligible
Construction							
Mobilisation of contaminants to affect soil and groundwater following rain events	Moderate	Negative	T	D	ST	The key control measures which will be incorporated into the CEMP to promote on-site environmental good practice during the construction process in relation to the storage of fuels, chemicals and oils on-site will include: → Consideration of measures outlined within Section 9 → Ensuring appropriate wastewater/sanitary collection, storage and disposal on site to minimise risk of spillages; → Reviewing storm water management on and immediately off-site during rain events; → Returning any unused materials, spent containers, contaminated clothing, rags and tools to a central area for appropriate disposal; → Onsite staff and personnel will need to be briefed through toolbox talks and training on the control of substances and informing them of all control measures and location of spill response equipment on-site (considered within accompanying CEMP);	Minor
Improper storage and usage of hazardous materials	Moderate	Negative	T	D	ST		Minor
Potential for aqueous effluents to lead to contamination of soil and groundwater	Minor to moderate	Negative	T	D	ST		Minor
Soil erosion from wind-blown dust and runoff during storm events.	Minor	Negative	T	D	ST		Negligible

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive / Negative	Permanent (P) / Temporary (T)	Direct (D) / Indirect (I)	Short term (ST) Medium Term (MT) Long Term (LT)		Major, Moderate, Minor, Negligible
						→ Appropriate collection and disposal of existing waste (fly-tipped waste piles) on site; → Hazardous materials such as fuel oils and chemicals used during the construction phase that have the potential to cause contamination will be appropriately managed through a CEMP. → The CEMP will provide detailed Environmental Control Plans for construction workers and personnel and sub-contractors including personnel safety, site conduct, security, storage of hazardous material and emergency preparedness. → The CEMP would also contain control measures to be adopted during the construction stage to minimise potential impacts associated with leaks and spills from on-site activities.	
Erosion/flooding of adjacent agricultural land or road	Moderate	Negative	T	I	ST	→ Ensure temporary construction on site does not result in storm water being directed to road or adjacent agricultural land → Review storm water management immediately during and after significant rainfall events and proactively monitor weather forecasts with respect to likely storm events	

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive / Negative	Permanent (P) / Temporary (T)	Direct (D) / Indirect (I)	Short term (ST) Medium Term (MT) Long Term (LT)		Major, Moderate, Minor, Negligible
Workers' exposure to contaminated soils, groundwater and hazardous materials	Moderate	Negative	T	I	ST	→ Watching brief for visual and olfactory (odour) inspections of disturbed soils to identify contamination for appropriate health and safety measures to be considered → Housekeeping and health & safety measures including PPE to be worn on site at all times to prevent construction workers from having contact with potentially contaminated soils.	
→ Operation							
Mobilisation of contaminants to affect soil and groundwater following rain events	Moderate	Negative	T	I	ST	→ Hazardous chemicals should be appropriately stored in secure, bunded compounds, suitable distance from drainage channels and located on an impervious surface. The storage areas will need to be clearly labelled and have MSDS maintained and available; → Central register of hazardous materials with material safety data sheets; → Details and properties for each material should be clearly detailed which include its hazard (poisonous, corrosive, flammable), prohibitions on its disposal (dumpster, drain, sewer) and the recommended disposal method (recycle, sewer, burn, storage, landfill).	Minor

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive / Negative	Permanent (P) / Temporary (T)	Direct (D) / Indirect (I)	Short term (ST) Medium Term (MT) Long Term (LT)		Major, Moderate, Minor, Negligible
						→ Review storm water management on site after significant rain events to ensure not negatively impacting upon adjacent land → Provide emergency response procedures for spillage incidents to ensure that contamination is avoided or minimised if they occur; and → Provision of awareness training for all employees including management, office staff and technical staff on pollution prevention and control techniques and best practices.	

12 LANDSCAPE AND VISUAL

12.1 INTRODUCTION

This Chapter assesses the potential landscape and visual impacts resulting from the Project. The assessment considers the impacts on the physical landscape fabric, the wider landscape character, and the visual impact from sensitive viewpoints.

12.2 BASELINE

The aim of the landscape baseline is to provide an understanding of how the landscape will be affected, and the aim of the visual baseline is to establish the area in which the Project may be visible to receptors in the surrounding area.

STUDY AREA

In the absence of Jordanian or IFC standards for visual assessment, the study area for the assessment has been defined in accordance with the guidance provided in the Guidelines for Landscape and Visual Impact Assessment (GLVIA) 3rd edition, 2013, which advises that the study area for a landscape assessment needs to cover *"…the site itself and its wider landscape context, within which the proposed development may influence landscape character".*

The Study Area for the landscape and visual assessment (LVIA) is based on an identified indicative Zone of Theoretical Visibility (ZTV) shown in Figure 12-6. The indicative ZTV identifies the approximate area of land from which there would be potential views of the proposed Project development. Representative 3m towers spaced every 10m systematically covering the site area have been used to model the site infrastructure. This is based on provisional designs from the Project Company indicating an assumed maximum height of 3m for the rear elevation of the solar arrays. These representative towers were entered into GIS software together with topographic data from SRTM (Shuttle Radar Topography Mission) to calculate the ZTV. A worst-case scenario was considered, no screening from intervening vegetation, buildings or other obstacles were included in the model.

An assessment area with a radius of up to 5km has been considered for the indicative ZTV which, it is considered, is the maximum distance within which we would anticipate significant visual effects to arise from this type of development due to the nature of the surrounding terrain and the potential receptors that may be impacted by the development.

12.2.1 EXISTING CONDITIONS

SURVEYS

Desktop reviews were carried out on provided materials related to the landscape of the site and its wider context. Materials included a brief about the Project's description and mission, existing power project assessments and publicly available information on the Sahab district. Fieldwork enabled the recording of various landscape elements such as land use, vegetation (or lack of), and viewpoints. From the analysis of this combination of materials, it was possible to carry out an evaluation of landscape character and assess the predicted effect of the proposed development.

Topography in the area is typical of the Highlands Topographic Region in which the Project site is located (Figure 12-1); Figure 12-2 and Figure 12-3 provide a context of the characteristics of the site. The Highlands Topographic Region extends from Um Qais in the north passing through the Ajlun Mountains, the hills of Amman and Moab Regions, and the Edom Mountains Region.

Many creeks and wadis drain from these hills from north to south and lead to the River Jordan, Dead Sea and Wadi Araba. The southern highlands are higher than those in the north, though they are home to fewer species of vegetation types that also have a lower density.

The Project site comprises of north / west shallow slopes of Al Manakher hills that are crossed by small wadis as a result of rainfall drainage towards the south, as shown in Figure 12-4. Satellite images of the Project site from April 2008 illustrate that the proposed site was originally arable land and was cleared by the Ministry of Finance in 2010. The site is not within any aviation routes and there are no nearby airports.

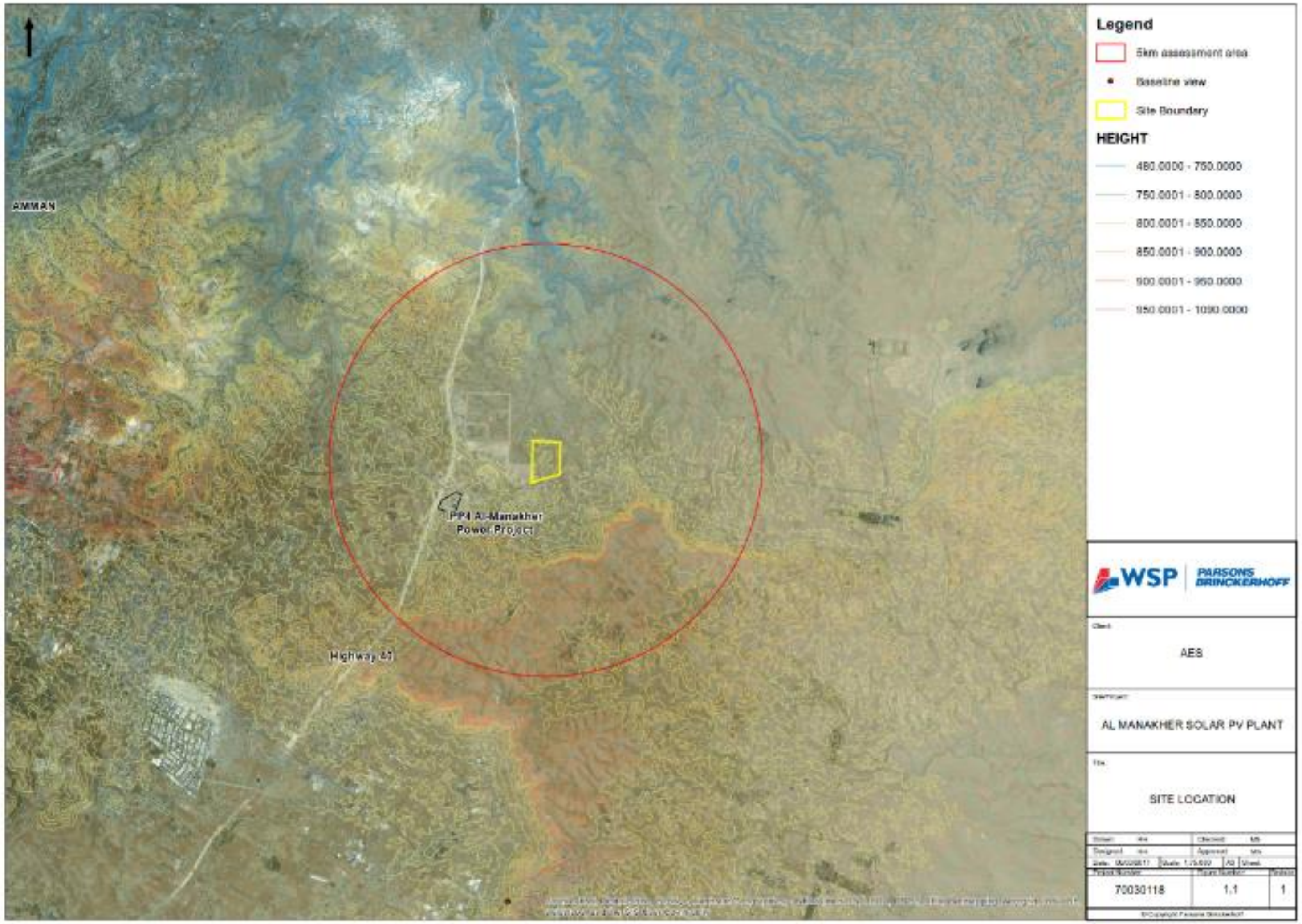


Figure 12-1 Project Location and Area Contours

Figure 12-2 Existing landscape context of the Project site

Figure 12-3 Existing landscape context of the Project site

Figure 12-4 Minor wadi running through Project site

Based on multiple site visits to the area and review of the general landscape and features it is considered that the Project site does not appear to have significant character or distinctive characteristics, exacerbated by the extensive groundworks in the Project area which were undertaken by the Ministry of Finance in 2010. The Project site and surroundings are barren and have no vegetation except for some scattered shrubs. To the south of the site are high voltage pylons/transmission lines (OHTL) from the IPP3 power plant. The IPP3 Power Plant is located approximately 7km to the east of the proposed site, with the connecting OHTL travelling east to west to link to the existing IPP1/IPP4 substation. The IPP1/IPP4 power plant and towers are visible from the Project site through a gap in the surrounding undulating landscape . Isolated farm dwellings are predominantly on the southern side of the road and to east of the Project site. No communities or villages are visible from the Project site. The lack of significant character/features in the area could potentially be considered of benefit to the Project with respect to the Project creating a distinctive character in the area, relatively unique in this part of Jordan.

The Project site and the surroundings are mostly comprised of sand substrate which in high wind conditions and low precipitation seasons results in general haze, reducing long distance visibility. The area is subject to seasonal variations, seasonal rains lead to the growth of increased ground vegetation in the land surrounding the Project site. As the site has been cleared no additional vegetation is present within the Project site.

Elevation of the Project site is between 805 – 818m (above sea level) with the highest point to the south of the site. The highest hills overlooking the site are to the south and to the west from an elevation of 846 – 924m.

12.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

12.3.1 ASSESSMENT METHODOLOGY

A WSP | Parsons Brinckerhoff environmental consultant surveyed the site in January 2017, with further landscape walkovers undertaken by specialists from RSS in January/February 2017. Walkover surveys were conducted to establish the baseline characteristics of the Project site and to identify viewpoints in order to develop photomontages of the Project site and the proposed development.

ASSUMPTIONS

Reference to the Project site should be interpreted as the area contained within the yellow line area with a red border in Figure 12-2.

All visual assessment field survey work has been undertaken from within publically accessible areas only: views from private properties and commercial buildings are approximate and have been estimated, with reference to the nearest publicly-accessible location from which assessment could reasonably take place.

LANDSCAPE SENSITIVITY

Landscape Receptor

The term 'landscape receptor' means an element or a group of elements which will be directly or indirectly affected by the development. Landscape receptors are physical elements or attributes of the landscape that could be affected by the development, such as landscape character, landform, water courses, woodland, groups of trees or hedgerows, land uses and field boundaries.

Visual Receptor

The term 'visual receptor' means an element - or group of elements - that will be directly or indirectly affected by the proposal. These would include viewpoints available to the users of outdoor facilities, sporting activities (none in area) and users of public roads; viewpoints from landscape features and beauty spots; viewpoints outside local properties (which would represent the view for local residents) and viewpoints available to people travelling through the landscape. Views may be glimpsed and fleeting, or open and sustained.

Sensitivity of visual receptors is dependent on their interest in the visual environment, their viewing opportunity and duration, and the context of the views. These factors may be expressed through:

- The value of the view reflects the intrinsic character and scenic qualities of its location and context. Where recognised through the designation of an area, either nationally or locally, value is increased, while the presence of detracting features in a view will generally reduce value. Higher value views/viewpoints are likely to be more sensitive to change;
- The importance of the view – as indicated by some form of recognition, e.g. as noted in a guidebook, marked on a map or indicated on the ground by a sign or other visible feature. The provision of facilities e.g. seating, parking, footpath may also indicate a location of higher importance. Views gained from locations where people gather outdoors may also be of higher importance; and
- Viewers' expectations, occupation and activities when experiencing the view.

The assessment criteria is summarised in Table 12-1 to Table 12-8.

Table 12-1 Landscape sensitivity ranking

SENSITIVITY	LANDSCAPE RECEPTORS	VISUAL RECEPTORS
High	Important / highly valued landscape recognised by national or regional designation. The qualities for which the landscape is valued are in good condition, with a clearly apparent and distinctive character. The key characteristics are fragile and unable to accommodate change without significant character change.	Viewers' attention likely to be focused on the landscape or have proprietary / high interest in their everyday visual environment and/or with prolonged and regular viewing opportunities. Such receptors would include: ▪ Residents experiencing views from dwellings. ▪ People experiencing views from important landscape features of physical, cultural or historic interest, beauty spots and picnic areas ▪ Large number of viewers and/or location in highly valued landscape could elevate viewer sensitivity to highest level.
Medium	Landscape of moderately valued characteristics reasonably tolerant of changes; Landscape is not recognised by national or regional designation; The landscape is relatively intact, with a distinctive character; Key characteristics of the landscape are vulnerable but with some limited ability to accommodate development in limited situations without significant character change.	Viewers with moderate interest in their environment, and discontinuous and/or irregular viewing periods. Such receptors would include: ▪ Road users ▪ A view including some overt or intrusive man-made elements. ▪ A view experienced by a moderate number of receptors.
Low	Relatively degraded or low value landscape with no designations; Landscape integrity is low, with a landscape in poor condition and a degraded character; and Key characteristics of landscape are robust and able to accommodate development without significant character change.	Small number or low sensitivity of viewers assumed. Viewers with a passing interest in their surroundings and momentary viewing periods. Such receptors include: ▪ Drivers/travellers and/or passengers of moving vehicles including trains. ▪ People at their place of work, including agricultural workers and other non-motorised users on most roads or those already impacted by intrusive features. ▪ A view including a number of overt or intrusive man-made elements.

Table 12-2 Criteria for the assessment of magnitude of change

Level	Criteria
High	A noticeable change to the landscape over a wide area or an intensive change over a limited area
Medium	Minor changes to the landscape over a wide area or noticeable change over a limited area
Low	Very minor changes to the landscape over a wide areas or minor changes over a limited area
Negligible	No or minimal perceptible changes to the landscape

Table 12-3 Significance of landscape impact

		Magnitude of Change			
		High	Medium	Low	Negligible/ None
Landscape Sensitivity	High	Major	Major/ Moderate	Moderate	Moderate to Minor
	Medium	Major/ Moderate	Moderate	Moderate/ Minor	Minor
	Low	Moderate	Moderate/ Minor	Minor	Minor/None
	Key:	Significant		Not Significant	

Table 12-4 Description of significance of landscape impact

Significance	Definition Guideline	Threshold
Major	A fundamental change to the environment	Noticeable change to a highly sensitive or nationally valued landscape, or intensive change to less sensitive or regionally valued landscape
Moderate	A material but not a fundamental change to the environment	Noticeable change to a landscape tolerant of moderate levels of change, or minor change to a highly sensitive or nationally valued landscape
Minor	A detectable but not material change to the environment	Minor changes to a landscape considered tolerant of change
None	No detectable change to the environment	No discernible change to the landscape

Table 12-5 Criteria for the assessment of visual receptor sensitivity

SENSITIVITY LEVEL	VIEW FROM
High	Public views from: ■ Settlements or groups of dwellings ■ Public open space ■ National trails or named recreational paths ■ Designated tourist routes ■ Outdoor recreational and tourism spaces/activities ■ Private views from residential properties
Medium	Public views from: ■ Main railways ■ Local railways ■ Other public footpaths/bridleways
Low	Public views from: ■ Low usage roads ■ Private views ■ Commercial properties ■ Industrial properties ■ Agricultural land ■ Very modified / disrupted land

Table 12-6 Criteria for the assessment of magnitude of change

MAGNITUDE	CHARACTERISTICS
High	A major change or obstruction of an existing view, with the development being directly visible and appearing as a dominant feature in the foreground.
Medium	A moderate change or partial view of a new element within the existing view that may be readily noticed, with the development being directly or obliquely visible (including glimpsed, partly screened or intermittent views) such that it appears a prominent feature in the middle ground.
Low	A low level of change to the existing view, with the possibility that the development may be obliquely viewed or partly screened such that it appears as a visible feature in the background landscape.
Negligible	A small intermittent change to the existing view, with the possibility that the development may be obliquely viewed and mostly screened such that it appears as a minor element in the distant background. This may include the development being viewed at high speed over short periods and capable of being missed by the casual observer.

Table 12-7 Significance of impact on visual amenity

		Magnitude of change			
		High	**Medium**	**Low**	**Negligible/ None**
Visual Amenity Sensitivity	**High**	Major	Major/ Moderate	Moderate	Moderate to Minor
	Medium	Major/ Moderate	Moderate	Moderate/ Minor	Minor
	Low	Moderate	Moderate/ Minor	Minor	Minor/None
	Key:	Significant		Not Significant	

Table 12-8 Description of significance of visual impact

Significance	Criteria
Major	A substantial deterioration or improvement to the existing view or situation
Moderate	A moderate deterioration or improvement to the existing view or situation
Minor	A small deterioration or improvement to the existing view or situation
None	No change

12.3.2 ZONE OF THEORETICAL VISIBILITY METHODOLOGY

The term Zone of Theoretical Visibility (ZTV) is used to describe an area from which a development can theoretically be seen and is based on digital terrain data. A development is theoretically visible as it may not actually be visible in reality, for example due to screening other than the intervening terrain such as vegetation or obstructing buildings. A ZTV is also only considered to represent potential visibility, they do not convey the nature of magnitude of visual impacts or whether visibility will result in positive or negative impacts nor whether they significant.

For Al Manakher Solar Plant an assessment area of 20km has been used to ensure that all potential receptors are included, such as Amman, Al Zarq and views along the Highway 40 to the south of the site.

The ZTV was modelled using GIS and specialist software including WindFarm-4. This is a commonly used software for producing visualisation (although primarily for wind farms as the name suggests). In order to utilise the software the solar plant was represented by 3m towers spaced every 10m systematically to cover the site area. This assumed the highest point of a solar plant would be the rear elevation of the arrays and spaced to reflect common spacing between rows.

The geographical coordinates of each ‘tower’ (effectively a solar panel), in WGS84 37N projection, were input into the model. Height contours extracted from the SRTM (Shuttle Radar Topography Mission) database were also included, covering the 20km assessment area.

The ZTV was calculated to show the areas where at least part of one panel was visible; a part being either the bottom, middle or top of the panel. This demonstrates a worst case as from some locations only a small part of the development may be visible. The resulting ZTV was input into GIS and overlaid onto the site boundary and aerial imagery of the surrounding area.

12.4 IMPACT ASSESSMENT

Based on the indicative ZTV (Figure 12-6), the above views have been selected as having potential to be impacted by the development, these are shown on Figure 12-5. The sensitivity of the view has been assessed based on the criteria described in Section 12.3 and is shown within Table 12-9.

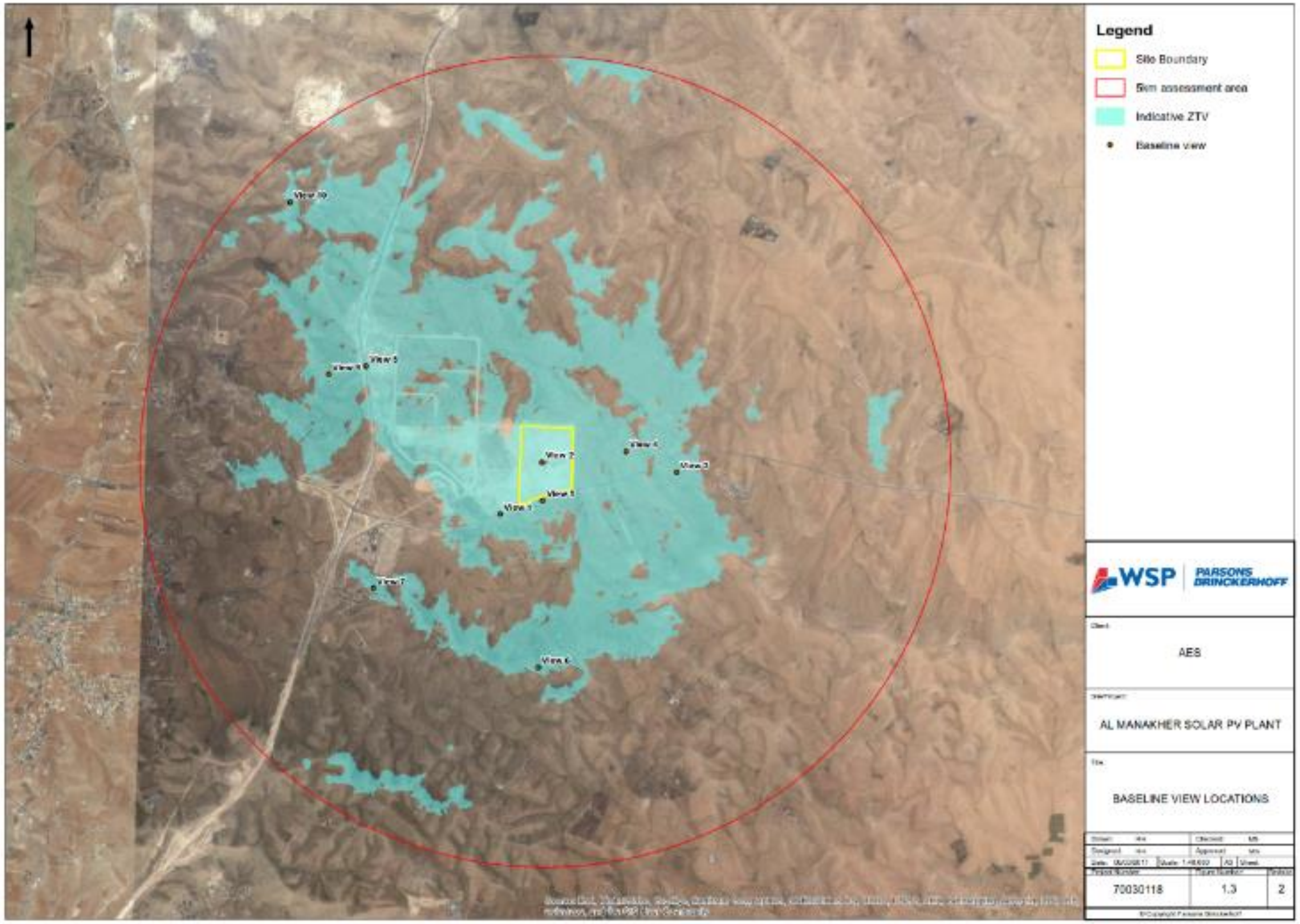


Figure 12-5 Landscape Viewpoints

For all views the landscape sensitivity is considered **low** as there are no unique characteristics and as a result is able to accommodate the development without significant character change.

Table 12-9 Viewpoint Impacts

View number	Location & distance from site	Grid reference	Receptor type	Components in Existing View	Sensitivity
View 1	Highway 40 leading up towards site – 0.8km	25405.96, 3533307.40	Road user	The road is not used heavily by traffic (and traffic is predominantly industrial in nature) and the view will only be temporary and transient.	Low
View 3	Farm east of the site (south of Highway 40) – 1.7km	227582.44, 3533822.40	Commercial	The development is more exposed from this height but due to the use of the facility, views for personnel overlooking the site are not primary. The road and electrical pylons are visible.	Medium
View 4	Farm east of the site – 0.5km	225928.95, 3533473.50	Commercial	View is from a similar elevation as the development with little to no intervening topography or vegetation. Views for personnel however are not primary.	Medium
View 5	Farm south of Highway 40 – 1.1km	225928.95, 3533473.50	Commercial	Open views towards the site with only the road as any obvious barrier. Views for personnel are not primary.	Medium
View 6	Residential units on top of the	223839.21, 3531415.50	Residential	The view is from an elevated location looking	High

VIEW NUMBER	LOCATION & DISTANCE FROM SITE	GRID REFERENCE	RECEPTOR TYPE	COMPONENTS IN EXISTING VIEW	SENSITIVITY
	southern hills – 2.6 km			down onto the development. Some intervening hills as well as electrical pylons visible.	
View 7	Residential units on the hill behind IPP4 power plant – 2.6 km	223839.21, 3532393.30	Residential	Views towards the development are largely obscured by the IPP4 power plant and electrical pylons in the foreground.	Medium
View 8	Highway 45, north west of the site – 2.5km	223750.26, 3535133.40	Road user	Views of the development would only occur for traffic travelling south at this location. Views are distant with a backdrop of large hills.	Low
View 9	Residential units on top of the western hills – 2.8km	223290.36, 3535034.30	Residential	Views are distant with electrical pylons in the foreground and in the distance which would appear in front and behind the development. Hills are also visible behind the development site.	Medium
View 10	Residential units on top of the north-western hills – 4.5km	22812.18, 3537151.10	Residential	Elevated but distant views of the site with buildings and electrical pylons visible.	Medium

12.4.1 IMPACTS DURING CONSTRUCTION

During construction, there are potential impacts on the landscape fabric, landscape character and visual resources.

12.4.1.1 IMPACT ON LANDSCAPE FABRIC

There will be minimal loss of vegetation cover due to the construction of the solar panel structures, due to the site being previously cleared in 2010 by Ministry of Finance. However, there will be impacts on the landscape fabric due to expected trenching for installation of the underground cables, although, similar to the panels this will occur on previously graded land and is not considered a significant change in character. No access roads are being constructed as part of the Project, whilst stockpiling of materials and storage of construction equipment will have an impact on the landscape fabric. It is anticipated that there will be less impact on the northern, eastern and western side of the Project site where there are no immediate sensitive receptors at these locations.

The sensitivity of the landscape fabric is **low to negligible** and the magnitude of impact during construction is also **low**. Therefore, the significance of the impact is considered to be **minor**.

12.4.1.2 IMPACT ON LANDSCAPE CHARACTER

The impact on the landscape character during the construction phase is variable and will change as construction activities progress. With an expected relatively short construction period (<1 year) it is considered more appropriate to assess the significance of landscape character impacts during operation only.

12.4.1.3 IMPACT ON VISUAL RESOURCES

There will be a visual impact due to the introduction of construction equipment such as machinery and large vehicles on the Project site. The short-term impact of the presence of the construction equipment on the visual resources is **Minor to Moderate** for all viewpoints (VP's).

12.4.2 IMPACTS DURING OPERATION

The potential impact associated with the Project on landscape and visual amenity is the creation of visual intrusion and disruption to aesthetic quality and light reflectivity from the solar module surfaces arising from the installation of solar PV modules (operation phase). The Project site has already been cleared and has minimal vegetation cover, with no vegetation of any significance. Therefore, as no clearing of vegetation on-site will be required no visual intrusion and disruption to aesthetic quality of the existing site will occur. The proposed solar PV installations have been indicated to be no taller than 3-4M above ground level and, as such, there will be limited visibility of the Project site from the surrounding area. This will be partially aided by a chain-link fence which would surround the Project site (also expected throughout construction phase) and the generally flat topography of the surrounding area together with the minimal receptors close to the Project site.

Figure 12-6 shows the ZTV based on a 3m high representation of the Al Manakher solar plant infrastructure.

The development is most visible within 5km of the site boundary with screening from the terrain to the south-west. Views are very limited to the north and south past this distance with sporadic visibility from elevated areas. The terrain again provides screening to the east and west with views from approximately 10 – 15km from the site boundary after which the site is not visible.

With regards to potential impacts there are potential views on the outskirts of Amman although there is likely to be further screening due to surrounding buildings. In general, the area is sparsely developed with the settlements to the west being of most concern. Highway 40 to the south of the site will also have views of the development when travelling along it and towards the development although most traffic along this route relates to the army base, IPP3 and landfill in the east rather than residential traffic.

In order to further assess the visibility of the solar plant, photographs have been taken from the surrounding area. Photomontages have been prepared for viewpoint 6 and viewpoint 10 (the locations of which are shown in Figure 12-5) to represent the views from both the east and west. The photomontages are contained within Figure 12-6 and Figure 12-7.

Figure 12-6 Photomontage from viewpoint 6

Figure 12-7 Photomontage from viewpoint 10

The potential impacts on landscape and visual amenity relating to visual intrusion and disruption of aesthetics arising from site clearing and installation of solar PV modules are considered to be **negative**, indirect and localised in nature. The duration the impact is predicted to be long term while the impact magnitude is **low**. It is probable the impact would occur. The sensitivity of the receptors of the visual character of the landscape following installation of the solar modules is considered to be **medium**. The overall significance of the impact is considered to be **minor**.

12.5 MITIGATION

Potential landscape and visual impacts during the construction and operational life of the Project will be mitigated by:

- In general, construction activities would be contained within the Project site as much as practical;
- Use of low level solar module mount design system (2 – 3m) that will not disrupt the aesthetic view of the Project site and surrounding areas;
- Implementation of lighting restrictions including downward facing lights at perimeter fencing;
- Conspicuous and frequent small-vehicle traffic for worker access and frequent large-equipment (trucks, graders, excavators, and cranes) traffic for road construction and site preparation that could produce visible activity and dust in dry soils will be minimised where practicable (e.g. use of worker buses rather than individual cars);
- Positioning of laydown areas, stockpile areas and welfare facilities away from the Project boundary and identified sensitive receptors;
- Vehicles leaving site will be appropriately cleaned/covered in order to avoid transferral of soil or dirt onto public roads. Any mud, soil or dirt which has been spread onto public roads will be removed and cleaned promptly by Wärtsilä and the appointed O&M Company;
- The height of material stockpiles where necessary will be controlled so that they are not excessively noticeable;
- Ground disturbance and vegetation removal that could result in visual impacts that produce contrasts of colour, form, texture, and line will be minimised;
- Introducing perimeter fence vegetation along the boundaries to screen sensitive viewing areas such as the southern side of the Project site, close to the road which runs parallel and the neighbouring farm; and
- Use of low visual reflective solar modules with anti-reflective coating (ARC) that reduces reflectance from the solar PV modules.

Landscape and visual impacts from the proposed Project are expected to be minimal with the identified impacts being site-specific in nature and of low magnitude. Therefore, although landscape and visual impacts will arise from undertaking the Project, with the isolated nature of the site combined with the intrinsic design of the solar plant together with the implementation of the proposed mitigation measures, the significance of the mitigated impacts are expected to be very low to negligible.

12.6 CUMULATIVE IMPACTS

12.6.1 CONSTRUCTION AND OPERATION

The impact on the landscape fabric during construction will be mitigated through the implementation of the following mitigation measures:

- Ensure appropriate fencing/construction hoardings surround the whole site particularly the southern boundary next to the road as early as possible within the fence; and
- Minimisation of time spent working in areas close to the sensitive receptors.

While mitigating the visual impacts of the panels from long distance during operation is difficult, fencing and planting of vegetation is recommended, along with the use anti-glare technology in order to reduce short to medium distance impacts. Mitigating the visual impact of other Project components such as the cabling on site will be achieved through the use of underground cables where possible.

It is understood that the transmission line connecting the Project substation (currently expected in south west corner of site in order to minimise subsequent distances) and the main grid substation adjacent to the IPP1/IPP4 developments will be the responsibility of NEPCO with respect to gaining necessary approvals and construction/maintenance. Initial indications are that the transmission line will be through the use of overhead transmission lines (OHTL) of 132kV which will follow the road for approximately 2km until nearing the IPP4 plant and then travel underground to the existing IPP1/IPP4 substation. With respect to the landscape character being impacted by the new transmission line it is noted that there are existing OHTL and distribution lines running parallel in the area, the former associated with the IPP3 power plant, approximately 7km east of the site. As such the additional transmission line could be considered only an incremental change from the existing scenario.

While it is recognised that the transmission line falls outside the Project Company's responsibility, it is noted that this line would be considered an 'associated facility' with respect to the IFC Performance Standards. As such, the Project Company should try to initiate dialogue with NEPCO to discuss the potential mitigation which could take place for this line. Based on the transmission line being highlighted as a potential impact by the local communities (with particular respect to a perceived potential decrease in land value) it is recommended that consideration/discussion with NEPCO be held to determine the feasibility of the entire route using underground cable rather than OHTL. Alternatively, if the requirement for OHTL is absolute, consideration could be made to try to combine/follow the routing of the existing OHTL to minimise the other lands which would be impacted upon by the line.

12.7 RESIDUAL EFFECTS

The impact on the landscape fabric is considered to be minor and will be minimised as much as possible during construction and operation, although no landscaping work is currently proposed and the fence to be installed is not a solid structure. It is recommended that the Project Company should consider the planting of vegetation at the southern boundary fence in order to mitigate for the impacts (albeit low) on the road and farm on the southern side of the road.

Although the magnitude of change to the landscape is medium, the significance of impact on the landscape character is moderate due to the low sensitivity of the Project site. It is considered a material but not fundamental change to the environment and within the threshold of a noticeable change to a landscape tolerant of moderate levels of change.

12.8 SUMMARY OF IMPACTS

A summary of the impacts as a result of the Project on the landscape character of the area are described in Table 12-10.

Table 12-10 Summary of landscape and visual impacts and mitigation

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive / Negative	P/T	D/I	ST/MT/LT		Major, Moderate, Minor, Negligible
Construction							
Impact on landscape fabric	Minor	N	T	D	ST	→ In general, construction activities would be contained within the Project site as much as practical; → Use of low level solar module mount design system (2-3m) that will not disrupt the aesthetic view of the Project site and surrounding areas; → Use of low visual reflective solar modules with anti-reflective coating (ARC) that reduces reflectance from the solar PV modules; → Implementation of perimeter lighting restrictions including downward facing lights; → Conspicuous and frequent small-vehicle traffic for worker access and frequent large-equipment (trucks, graders, excavators, and cranes) traffic for road construction and site preparation that could produce visible activity and dust in dry soils will be minimised; → Positioning of laydown areas, stockpile areas and welfare facilities away from the Project boundary and identified sensitive receptors; → Cleaning and appropriate covering of vehicles leaving site. Monitoring of mud, soil or dirt which has been spread onto public roads which will be removed and cleaned promptly; → The height of material stockpiles will be controlled so that they are not visually noticeable;	Negligible
Impact on landscape character	-	-	-	-	-		-
Impact on visual resources	Minor to Moderate	N	T	D	ST		Negligible

DESCRIPTION OF LIKELY SIGNIFICANT IMPACTS	SIGNIFICANCE OF IMPACTS					SUMMARY OF MITIGATION / ENHANCEMENT AND MONITORING MEASURES	SIGNIFICANCE OF RESIDUAL IMPACTS
	MAJOR, MODERATE, MINOR, NEGLIGIBLE	POSITIVE / NEGATIVE	P/T	D/I	ST/MT/LT		MAJOR, MODERATE, MINOR, NEGLIGIBLE
						→ Introducing perimeter fence vegetation along the boundaries to screen sensitive viewing areas such as the southern side of the Project site, close to the road which runs parallel and the neighbouring farm.	
Associated facility- 2km Transmission line	Moderate	Negative	P	D + I	LT	→ Dialogue with NEPCO to ensure transmission line assessment considers IFC standards and consideration of underground cabling or routing along existing OHTL to minimise negative impacts (incl. visual impacts).	Minor to Moderate
Operation							
Impacts on landscape and visual amenity relating to visual intrusion and disruption of aesthetics arising from installation of solar PV modules	Minor to Medium	Negative	P	D	LT	→ Introducing perimeter fence vegetation along the boundaries to screen sensitive viewing areas such as the southern side of the Project site, close to the road which runs parallel and the neighbouring farm. It is recommended solid fence or vegetation is used on the boundary located close to the sensitive receptor.	Minor

13 SOCIO-ECONOMICS

13.1 INTRODUCTION

This Chapter assesses the socio-economic of the proposed Project during construction and operation. A desk review was undertaken in conjunction with field data gathering, primarily in the form of stakeholder engagement sessions.

The proposed Project site is located to the east of Amman, specifically the Sahab District (approximately 2.5km from Al Manakher village), within the Amman Governorate. The proposed Solar PV Plant Project lies in a sparsely populated area.

With the exception of the existing IPP1, 3 and 4 thermal power plants, there are no industries in the immediate vicinity of the Project site. The nearest residential properties to the Project is Al Manakher village at approximately 2-3km west of the Project. There is sheep farm on the opposite side of the road running parallel to the southern boundary of the Project site.

The Arab Gas Transmission Pipeline, which provides natural gas from Egypt to Jordan runs to the immediate south of the Project in an east to west configuration, connecting the thermal power plants in the area.

13.2 BASELINE – DESKTOP RESEARCH

13.2.1 DEMOGRAPHICS

POPULATION

A census was undertaken by the Jordanian government and the population of Jordan was estimated at 9,531,712 in the year 2015. The Jordanian annual population growth rate is 3.1% and the annual population growth in 2004-2015 stood at 5.3% which has been attributed to forced immigration and refugees into the country, predominantly from Syria and Iraq. The average population density in Jordan is 107.7 people per km^2. Statistics in the following sections are primarily sourced through the Jordanian Department of Statistics. Where the source differs, details have been provided.

The population of Amman Governorate was estimated at 4,007,526 in the year 2015 (which represents 42% of the national population) with a population density of 52.9 people per km^2. In 2011, the population of Sahab District was estimated at 54,704 with the population of Al Manakher village was estimated at 543. In 2015, the population of Sahab District was 169,434 and the population of Al Manakher village was estimated at 1,372 indicating a significant level of growth, primarily through 'inorganic' growth via the influx of refuges.

The Amman Governorate is divided into nine districts as shown in Table 13-1.

Table 13-1 Estimated Population by Administrative Division for Amman Governorate 2015[7]

Administrative Division	Population
Amman Qasabah District	855,953
Marka District	956,104
Quaismeh District	582,659
Al Jami'ah District	743,980
Wadi Essier District	367,370
Sahab District	169,434
Jizah District	118,004
Jizah Sub-District	104,165
Umm Al Rasas Sub-District	13,839
Muqqar District	84,340
Muqqar Sub-District	47,753
Rajm Al Shami Sub-District	36,617
Na'oor District	129,650
Na'oor Sub-District	78,992
Um Elbasatien Sub-District	19,517
Hosba'n Sub-District	31,141

The Sahab District is located southeast of Amman and includes the following ten localities and/or communities:

- Sahab;
- Al Abdalyieh;
- Zmlet Al Alia;
- North Khshafiyeh;
- South Khshafiyeh;
- Al Manakher;
- Qa'afour;
- Al Bayda;
- Rmaydan; and
- Al Madouna.

Sahab accommodates the largest industrial estate in Jordan. The Abdullah II Ibn Al Hussein Industrial Estate (AIE) is approximately 12km southeast of Amman comprising a total area of 400 ha.

The main sources of economy for communities in the region of the Project site include:

[7] Source of information: Department of Statistics.

- **Agriculture** - Due to the scarcity of water resources, agricultural activities in Jordan are limited. In 2009, the agricultural sector contributed 3% to the country's gross domestic product (GDP). This was boosted by irrigation and technological advancements in farming methods, particularly drip irrigation. The workforce in the agricultural sector is estimated to be approximately 10% of the workforce at the national level. In 2010, the total planted area in Jordan was estimated at 553,990 acres.

  In regards to the Project site, there are a number of small farms in the general vicinity (<3 km) to the proposed location including a sheep market and camel farm. Alain Farm is located approximately 3km from IPP3.

- **Industrial sector** - Jordan is considered relatively attractive for foreign investments in the Middle East primarily due to political stability and its central location in the region. Industry in Jordan is principally dominated by two main types:

  Manufacturing - this includes: leather and footwear manufacturing; chemical industry; plastic industry; IT industry; furniture industry; food industry; packaging industry; and manufacturing of engineering technology. This sector contributes approximately 18%of the Jordanian GDP.

  - **Mining** - this sector contributes approximately 2.6% of the Jordanian GDP. In 2011, 21,207 industrial establishments were recorded in Jordan. This represents 48.5% of the country's industrial sector. Of these, 10,292 industrial establishments are located in the Amman Governorate. There are three Qualifying Industrial Zones (QIZ) in the Amman Governorate including the King Abdullah II Industrial Zone in the Sahab municipality, Qastal Qualified Zone in Jiza municipality, and, Tujma'at Industrial Zone in Sahab municipality.

AGE DISTRIBUTION

Jordanian society is currently characterised by a high population percentage of young people. More than 34.4% of the total population are under the age of 15 years.

This is also true for the Amman Governorate, where the percentage of population under the age of 15 is 31.3%, as shown in Table 13-2. The high levels of the younger generation impacts upon the needs of the local community and its aspirations, on both private and public development efforts.

Table 13-2 Age Distribution

Age group (Year)	Age distribution (%)		
	Jordan (2015)	Amman Governorate (2015)	Sahab District (2015)
Less than 15	34.4	31.27	34.6
15 – 24	19.8	19.7	20.2
25– 35	16.4	17.41	19.6
35-64	25.8	27.42	23.8
More than 65	3.7	4.2	2.0

13.2.2 GENDER DISTRIBUTION

The gender distribution of the populations of Jordan, Amman Governorate, Sahab District and Al Manakher Village are shown in Table 13-3.[8]

Table 13-3 Gender Distribution

SEX	GENDER DISTRIBUTION			
	Jordan	Amman Governorate	Sahab District	Al Manakher Village
Male	52.9	53.7	58.7	50.6
Female	47.1	46.3	41.3	49.4

13.2.3 EDUCATION

SCHOOLS

The government of Jordan spends more than 5% of gross domestic product (GDP) on education and approximately 9% on health (Source: World Bank, 2012 data, website accessed February 2017). These contributions are higher than those made by other similar lower-middle-income countries and have been instrumental in improving Jordan's literacy and health indicators. Women have been equal beneficiaries of these policies. The main general educational services providers in Jordan are the Ministry of Education and the private sector, in addition to Armed Forces.

The educational level and the years spent in each grade within Jordan consists of:

- Kindergartens (2 years);
- Basic education (10 years); and
- Secondary education (2 years).

Jordanians education levels are moderate, where illiteracy rate is 6.4% for those above 15 years old (9.5% for female and 3.4% for male).

The average yearly number of students enrolled in all schools in Jordan is approximately 1,268,614 and the number of teachers providing education was 78,720 in the year 2014. The total numbers of students in Amman Governorate are 379,284 and the number of teachers providing education was 19,463 in the year 2014. In Jordan, there are 5,718 secondary schools, 50 colleges, 8 public and 13 private universities and 49 vocational training centres. The distribution in education levels for Jordan and Amman Governorate are shown in Table 13-4.

Table 13-4 Educational levels for the year 2014 (%)[9]

EDUCATIONAL LEVEL	JORDAN	AMMAN GOVERNORATE
Illiterate	6.4	7.5

[8] Source of information: Department of Statistics.
[9] Source of information: Governorates Indicators

Educational level	Jordan	Amman Governorate
Less than secondary	40.1	37
Secondary	36.6	40.3
Intermediate diploma	6.2	7.1
Bachelor degree and above	10.1	8.1

13.2.4 ECONOMIC CHARACTERISTICS FOR AMMAN GOVERNORATE

HOUSEHOLD INCOME AND EXPENDITURE

The average family size in Jordan and Amman is 4.8 and 4.6 respectively, with average family annual income of 9,626.0 JD (US$13500) in Jordan and 11,553.2 JD (US$16235) in Amman. The average family annual income in Sahab District was 8080.8 JD (US$11350) for the year 2013.

LABOUR FORCE

The unemployment rate in Amman Governorate is approximately 9% compared to 11.9% nationally as of the year 2015. Table 13-5 shows the percentage of the economically active and inactive persons registered in Amman Governorate.

Table 13-5 Economically and not Economically Active Persons (%)[10]

Activity status	Jordan	Amman
Economically inactive	63.6	59.8
Economically active	36.4	40.2
Employed	36.4	36.3
Unemployed	33.1	3.9

13.2.5 INFRASTRUCTURE AND BASIC SERVICES IN AMMAN GOVERNORATE

ROADS AND TRANSPORTATION

The existing transportation infrastructure in Jordan consists primarily of:

- Air transportation: Jordan has three airports, two international airports (Queen Alia International Airport in Amman, and King Hussein International Airport in Aqaba), and one civil airport (Amman Civil Airport);
- Sea transportation: Aqaba city has the only port in Jordan; most of the imported and exported cargo is transported through Aqaba Port. In addition, this port is used for passengers traveling by boats to and out of the country; and
- Land transportation: The road network in Jordan has progressed in terms of design, construction and maintenance where the total length of the network in Jordan (2012) in the is 7,201 km; divided into three types of roads (Highways, secondary and village roads).

[10] Source of information: Department of Statistics website

The total length of the road network in Amman governorate is 1,072 km. These roads link the towns and villages in the governorate, also maintained links with the rest of the kingdom. The length of the highway network in Amman governorate is 277km used for transportation between the north and south in the kingdom. There are other types of methods such as secondary roads and rural roads linking cities and villages of the governorate. The length of the secondary roads is 231km and the length of rural roads is 564km.

The Project site is located in the Al Manakher area, which falls under the management of the Sahab municipality. During the construction phase it is envisaged that Sahab - Jwaideh and airport roads will be used for transporting the abnormal loads (machinery and heavy equipment). Table 13-6 shows the daily number of vehicles using the two roads in the year 2016.

Table 13-6 Number of vehicles crosses the two main roads, 2016[11]

Main Roads	Number. of Vehicles Per Day Passing Through the Road of Each Site	
Sahab - Jwaideh	14,660	To Sahab
	17,529	To Jwaideh
Airport- Amman	14,758	To Amman
	12,067	To Airport

The vehicle fleet of the kingdom amounted in 2015 to 1,411,666 vehicles (1,326,154 private and 85,512 public). Table 13-7 shows the number of licensed vehicle by type of vehicle, ownership and governorate in 2015.

Table 13-7 Number of licensed vehicles by type of vehicle, ownership and governorate, 2015[12]

Type of vehicles	Jordan	Amman Governorate
Saloons	1,011,503	862,993
Private	987,345	845,595
Public	24,158	17,398
Other	0	0
Buses	23,566	15,024
Private	15,764	11,151
Public	7,802	3,873
Other	0	0
Vans and trucks	266,103	191,131
Private	250,677	180,232
Public	15,426	10,899
Other	0	0
Trailers	34,459	25,831
Private	3,891	1,878
Public	30,568	23,953
Other	0	0
Other	66,456	47,842
Private	65,002	46,560

11 Source of information: Ministry of Public Works and Housing
12 Source of information: Jordan statistical yearbook.

TYPE OF VEHICLES	JORDAN	AMMAN GOVERNORATE
Public	1,454	1,282
Other	0	0

13.2.6 COMMUNICATION

Communication services in Amman governorate include the telecommunication system and mail services which are provided by private and public sectors.

Jordan Telecom is the only operator of fixed lines. Out of a population of 9.6 million, there are only approximately 369,000 fixed line subscribers. Jordan Telecom also provides a mobile service and internet services. There are currently three mobile phone operators in Jordan. The number of telephone subscribers in Amman governorate is 359,280 while the number of post offices is 63 and the number of post boxes 101,716.

13.2.7 HEALTH CARE

Health care in Amman governorate is provided by the Ministry of Health, the Armed Forces and the private sector. There are 50 hospitals in the governorate (5 public, 38 private, 7 government). There are 7,045 hospital beds in the governorate.

Amman governorate also has the following facilities and centres: 86 health centres, 29 village clinics, 74 maternity and child health centres, 65 dental clinics, one Epidemic Disease centre and 1348 pharmacies.

There are five health centres available within Sahab district; one located within the Al Manakher village.

13.2.8 HOUSING

Housing in Jordan varies from small-crowded dwellings to large villas, with the total number of building in Jordan estimated at 1,253,352 in year of 2013. Total number of buildings in Amman governorate is estimated at 513,503 buildings.

13.2.9 ENERGY

According to the Jordan Petroleum Refinery Company, the fuel prices in 2016 are as shown in Table 13-8.

Table 13-8 Fuel price in Jordan, 2016[13]

MAIN ROADS	COST OF FUEL (JD TO US$ C.1:1.4)
Unleaded 90 octane	0.620 JD / litre
Unleaded 95 octane	0.810 JD / litre
Diesel, Kerosene	0.465 JD / litre
Cooking Gas	7 JD / cylinder

[13] Source of information: Jordan Petroleum Refinery Company

The electricity consumption per capita in Jordan is 2294 KWh and the percentage of the supplied population with electricity is 99.9%. Table 13-9 shows the prices of electricity by usage in Jordan.

Table 13-9 Electricity tariff in Jordan, 2016[14]

PRICE OF ELECTRICITY	FILS/KWH
Household (Fils/kWh)	
1 to 160kW/h (monthly)	33
161 to 300kW/h (monthly)	72
301 to 500kW/h (monthly)	86
501 to 600kW/h (monthly)	114
Commercial use (minimum tariff)	129
Industrial use (small industry)	
First Block : from 1-2000kWh/Month	71
Second Block : more than 2000kWh/Month	81
Agricultural use	60
Water pumping	94
Hotels	
Day Energy (Fils/kWh)	164
Night Energy (Fils/kWh)	145

13.2.10 LAND USE

This section considers the major land use in Jordan including Amman governorate.

AGRICULTURE

Due to the scarcity of water resources, agricultural activities in Jordan are limited. The agricultural sector contributed a 3% to the GDP in 2014, which is boosted by irrigation and technological advancement in farming methods, especially drip irrigation. The work force in the agricultural sector is estimated to be about 10% of the workforce at the national level. The total planted area in the Kingdom is estimated at 2,859,283 dunums in 2015; distributed as shown in Table 13-10.

Table 13-10 Planted Area in Jordan in the year 2015 and Amman in the year 2013[15]

AGRICULTURE INDICATOR	UNIT	JORDAN	AMMAN GOVERNORATE
Planted area with fruit trees	Dunum	864,200	928,700
Planted area with field crops	Dunum	1,314,000	299,851

[14] Source of information: Jordan Electric Power Company
[15] Source of information: Jordan statistical yearbook.

Agriculture indicator	Unit	Jordan	Amman Governorate
Planted area with vegetables	Dunum	487,700	798,652

In Jordan, natural grazing lands, as well as barley and hay production from grains and legumes, comprise the main forage production which maintain livestock during winter. There are almost 3,530,200 heads of livestock in Jordan, 684,200 heads of which are located in Amman governorate.

13.2.11 ELECTRICITY PRODUCTION

The electricity production in Jordan is estimated at 14,272GWh in 2010, while the electricity consumption is 12,843GWh. The provision of additional electricity supply to the country as a whole has a positive impacts on the socio-economic conditions of the country. Operation of the planned power plant at Al Manakher is considered vital to avoid supply disruptions and to secure the needed power, a primary factor which would otherwise potentially limit economic growth of Jordan. As noted within Section 5, the proposed solar plant also contributes to Jordan's intention to source a percentage of its power requirements via renewables in addition to reducing the GDP contribution to purchasing energy/fuel from outside the country.

13.3 PRIMARY DATA GATHERING – STAKEHOLDER ENGAGEMENT

13.3.1 INITIAL CONSULTATION

The accompanying Stakeholder Engagement Plan (SEP) provides a summary of stakeholder engagement activities associated with the proposed Project and anticipated future engagement and disclosure activities. The following sections provide an overview of the engagement undertaken during the proposed Project assessment.

During the preparatory (scoping) work undertaken in 2015, AES, the developer, invited a representative group of stakeholders (35 groups in total), which were approved by the MoE, to a scoping session to discuss the Project in Amman in November 2015. Of the 35 groups, 17 representatives from 14 stakeholder groups attended. Attendees and key points discussed within the stakeholder consultation meeting are provided within the appendices of the Scoping Report (see Appendix A).

As part of this EIA, RSS were appointed to conduct stakeholder activities in the areas surrounding the Project site. RSS were previously involved in stakeholder engagement activities for IPP1/IPP4 so have existing relationships in the area.

The original scoping session provided an early forum for interested parties to discuss their concerns or issues with the Project with a broad cross-section of parties selected, addressing the national consultation requirements. While the plant sizing is slightly smaller than the original maximum size considered in 2015 (up to 80MW was originally envisaged though the planned size is closer to 50MW) the Project site and general concept remain the same. As a result, it is considered that the findings of the stakeholders' discussion held in 2015 remain relevant. This also corresponds to MoE's acceptance of the Scoping and ToR reports in January 2017 (and Cabinet approval in principle for the Project in December 2016). However, during the course of the review of stakeholder engagement considered within the Scoping and ToR reports it was determined that heavy rains during the time of the first consultation resulted in some of the originally invited parties from the local communities not attending.

13.3.2 BASELINE STUDY CONSULTATION

Following the initial consultation and as part of the baseline studies further consultations were held. In order to ensure that key stakeholders were provided with an opportunity to express their concerns/issues with the proposed Project, additional workshops were arranged with local communities at Manakher, Al Beida and Al Kashafiyeh on the 1st 2nd and 11th February 2017 respectively, with the local consultant RSS and the AES community liaison officer for IPP1/IPP4.

The meeting aimed at identifying the residents' concerns about the Project activities in relation to the major environmental and social aspects. Figure 14-1 shows an image of the first meeting held at Al Manakher village on 1 February 2017 by RSS team and AES team.

Figure 13-1 Stakeholder consultation at Al Manakher village

The interviewees indicated that they think the Project will lead to an increase employment opportunities in the area; with the key roles that would be made available would be just for guards and construction workers. Of the interviewees, 85% believed that the Project would contribute positively in the area prosperity, both during the construction and the operation phases. Interviewees believed that the Project would not affect the land price and believed that communities surrounding the Project site will see an increase in the living standard. There also is a belief that the Project would bring other similar Projects to the area. It is repeated that overall the majority of the stakeholders approached during this consultation were in support of the existence of the proposed Project. The attendees highlighted that as a result of the Project being developed close to their village they envisaged that they should receive a number of benefits/recommendations:

- Painting the mosque;
- Having a bus for the school students;
- Fixing solar panels to residential properties;
- They recommended forming an environmental committee from the local community to submit complaints officially; and
- To have secondary school.

Regarding the existing scholarship for public university students, they suggested the Project Company give scholarship(s) for private university students in case students were not accepted in the public university.

The second meeting was held at Al Beida village on 2 February 2017, the meeting was conducted by the RSS team and supported by the AES team, as shown in Figure 13-2.

Figure 13-2 Stakeholder consultation at Al Beida village

The residents of the area own land surrounding the Project site, they indicated that the Project would have the potential to reduce their land price and did not see opportunities for employment. They mentioned that the village currently suffers from existing power developments in the area through the use of the tall overhead transmission lines which they consider as an eyesore and reduce the land values, in addition to vehicle movements from the facilities. The interviewees indicated that they were against the Project being constructed due to negative experiences with the thermal power plants in the past.

The villagers raised the following concerns relating to the Project and the impacts upon their village:

- Decrease in surrounding land price; and
- The villages do not want any large overhead transmission lines similar to the ones at surrounding sites being built.

The villagers had the following requests to be implemented as a result of the Project:

- Building a health care centre to serve the village;
- Building at raining centre to serve the village;
- Skill training and support for the members of the local communities;
- Supporting the village Fund; and

- Lighting the area.

The third meeting was held at Al Khshafiyeh village on 11 February 2017 by the RSS team and supported by the AES team.

One of the interviewees indicated that they owned land around the Project site; the interviewees believe that the Project would reduce their land price. There was hope that the proposed Project would increase the employment opportunities during both the construction and operation phases. The interviewees were reported to be in support of the Project as long as the following requirements were met:

- The Project provides existing schools with solar energy – through the installation of panels;
- Training of the local community;
- Fair compensation for landowners located close to existing transmission towers;
- Fair compensation for landowner if their land value lowers because of the proposed Project;
- They requested that an environmental committee be formed from the local community to control and evaluate the Project during the operation and to have a grievance mechanism established;
- They requested that the Project owner should appoint a second accredited consultant to monitor the cumulative impact in the area from all existing operation power plants;
- Financial support to the local community relating to universities and school fees;
- Providing scholarships for university students;
- To give priority for local contracts in the construction phase;
- The representative of East Amman Society for Environmental Protection (EASEP) engineer Farhan Al Daboby indicated that the community should be involved in reviewing the process for environmental monitoring.

13.3.3 LENDER BANK MEETING AND CONSULTATION

A site visit was undertaken on March 14, 2017, this site visit was initiated by OPIC in order to undertaken a ground truthing exercise as well as to consult various stakeholders first hand. WSP | Parsons Brinckerhoff environmental consultants also attended this meeting, along with the AES Project Manager.

The meetings were held over one day and consulted with:

- **Staff members of Al Manakher Primary School** - This school is located centrally within the village of Al Manakher which boarders the AES operated IPP1 and IPP4 power plants. Approximately 275 pupils, aged 5-12 years old attend the school which has been open in the community since 1973. The staff members who were involved in the consultation were female and included the head teacher (Mrs. Majedah Raggad);
- **Village leaders of Al Manakher Village ( )** – a meeting was held at the Majlis of the two leaders (Mutllaq Sallameh Bnian & Odallah Bnian) of the Al Manakher Village. Four other senior members of the village also attended.
- **Head of the Al Baida Community Centre (Abed Faleh Dabobi)** – the community centre is located in the Al Baida village which is located 5.5km west of the Project site. The community centre has received funding from AES's previous community and stakeholder funding programmes. The centre is used to host various events in the village such as birthday celebrations, weddings and funerals; and

- **The Governor of Sahab District (Dr Mohammad Abu Romman)** – the Governor has only recently taken up his post in office over the last 4 months. Sahab is district number 23 out of 27 and is located south east of the capital Amman.

All meetings held were positive and all of the members who were consulted were in support of the proposed Project. Each of the stakeholders who were consulted with all indicated that Project company – AES have provided support to them, namely in a financial manner.

13.4 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

13.4.1 ASSESSMENT METHODOLOGY

The significance of impacts on socio-economics has been assessed by comparing the baseline conditions to the likely conditions during both construction and operation. Consideration has been given to identification of both potentially beneficial and adverse social impacts which have been assessed by comparing the quality of the baseline conditions with the predicted quality of the social environment once the Project is in place.

13.4.1.1 SIGNIFICANCE CRITERIA

The significance of the impacts during construction and operation have been assessed using the criteria provided in Table 13-11 to Table 13-13.

Table 13-11: Sensitivity criteria

SENSITIVITY OF RECEPTORS	DEFINITION
High	Vulnerable social receptor with little capacity to adapt to impacts or with very little access to alternative similar sites or services.
Medium	Vulnerable social receptor with some capacity to adapt to impacts or with little access to alternative similar sites or services.
Low	A non-vulnerable social receptor with limited capacity to adapt to impacts and with some access to alternative similar sites or services.
Negligible	A non- vulnerable social receptor with capacity to adapt to potential impacts and with good access to alternative similar sites or services.

13.4.1.2 MAGNITUDE CRITERIA

The magnitude of impacts has been determined through consideration of the extent to which an impact may result in social receptors gaining or losing access to or control over socio-economic resources, resulting in a beneficial or adverse effect on their individual and collective well-being. Wellbeing is considered as the financial, physical and emotional conditions and quality of life of people and communities.

For beneficial impacts, the extent to which local wellbeing is likely to be enhanced has also been considered. This is in accordance with international SIA practice moving towards an increased focus on enhancing long-term development benefits for local communities' sustainability. As such, the magnitude criteria includes consideration of the extent to which benefits are anticipated to be shared with, or realised by, local people and communities.

The assessment of magnitude has been undertaken in two stages. Firstly, key social impacts associated with the Project have been identified. Secondly, the magnitude of impacts and effects have been categorised as either major, moderate, minor or negligible based on consideration of the parameters listed below along with professional judgement:

- Duration of the impact;
- Local benefit sharing/realisation;
- Number of people or groups affected; and
- Likelihood.

Table 13-12 Magnitude criteria

MAGNITUDE (POSITIVE OR NEGATIVE)	DEFINITION (CONSIDERS DURATION OF THE IMPACT, SPATIAL EXTENT, REVERSIBILITY AND LEGISLATION IF APPLICABLE)
Major adverse/beneficial	A probable impact that affects the wellbeing of many people or business entities within a widespread area beyond the Project life.
Moderate adverse/beneficial	A possible impact that will likely affect either the wellbeing of a group of people or business entities beyond the local area of influence into the wider area of influence or continue beyond the Project life.
Minor adverse/ beneficial	An impact that may affect the wellbeing of a small number of people and/or households or businesses, or occurs exceptionally, mostly within the Project area of influence and does not extend beyond the life of the Project.
Negligible	An impact that is localised to a specific location within the Project site boundary and is temporary or unlikely to occur with no detectable effect on the wellbeing of people.

The significance of an impact has been determined by the interaction between the magnitude of impacts and the sensitivity of receptors affected, with this interaction summarised within Table 13-13 below.

Table 13-13 Socio-economic significance criteria

MAGNITUDE OF IMPACT	SENSITIVITY OF RECEPTORS			
	Negligible	**Low**	**Medium**	**High**
Negligible	Insignificant	Insignificant	Insignificant	Insignificant
Minor	Insignificant	Minor	Minor	Minor
Moderate	Insignificant	Minor	Moderate	Moderate
Major	Insignificant	Minor	Moderate	Major

13.5 IMPACT ASSESSMENT

13.5.1 IMPACTS DURING CONSTRUCTION AND DECOMMISSIONING

The issues associated with the construction (and decommissioning as the impacts are considered to be similar to construction) phase of the Project are discussed in the following section.

EMPLOYMENT AND TRAINING OPPORTUNITIES

The number of workers during construction is estimated to be 465 people during peak periods, which will include managers, engineers and technicians. The Project is expected to increase the work opportunities and recruitment of unskilled labour from the local communities. Generally, new work opportunities present a **minor** to **moderate positive short-term** impact, dependent on the type and conditions of such opportunities. Conversely, if employment opportunities are predominantly realised by workers coming in from other areas then there could be a feeling of unfairness by local communities that they are not reaping the benefits from the Project being developed in their area. As such, while short-term, if such a situation arises through the employment strategy followed on site, this could be deemed a **minor** to **moderate** negative impact.

LOCAL BUSINESS PROSPERITY

It is expected that the Project will enhance business prosperity in Sahab District where the construction workers will represent a new purchasing power within the local market. They will increase the demand for several local goods and services in the market. It is expected that small shops and food and beverage stores can be positively affected (**minor** positive) while there could also be negative impacts associated with excessive demands on local industry which the businesses in their current state are not able to manage (**minor** negative).

PASTURE AND FARM LAND USES

To the south and east of the Project site, there are a limited number of agricultural dwellings belonging to Bedouin/local families. These groups reportedly use the land primarily for grazing livestock.

Interviews were conducted with the local farmer who owns a sheep farm in the area opposite to the Project. Through the consultation, it has been determined that sheep grazing does not habitually occur in the area where the Project will be established, particularly since the site was cleared by Ministry of Finance in 2010. Therefore, it is considered that the lost opportunity cost of utilising the Project area for farming or grazing purposes is not applicable and the impact is therefore deemed **neutral** or **negligible**.

LOCAL ROAD NETWORK

While design information is limited at this stage it is understood that the main access point to the existing road will be constructed using interlocking rock / stone as a base material and then paved using gravel. Concrete will be sourced locally where feasible to minimise impacts on the wider road network.

During the construction phase, Sahab-Jwaideh and Airport-Amman roads will be used for transporting the heavy loads (including plant machinery and heavy equipment). The exact number of heavy loads will be finalised during the tendering process by the contractor. The transportation of construction material will increase the number of vehicles utilizing Sahab-Jwaideh and Airport-Amman roads on a daily basis. Thus, it is expected that an increase in traffic flows will take place at different times during the construction period and will generally contribute to local traffic throughout the construction phase. Although road traffic levels are relatively low when compared to roads in populated urban areas, the roads highlighted in this assessment provide key access routes and as such represents moderate sensitivity, and thus **minor negative** impact.

13.5.2 IMPACTS DURING OPERATION

EMPLOYMENT AND TRAINING BENEFITS

Once operational, the operational and management company is expected to employ approximately 20 employees in relation to the operation of the power plant although a number of these are likely to be stationed at the IPP4 plant which will remotely control the operations of the solar plant. It is understood that priority will be given to the local community members where appropriately trained/skilled individuals exist. This will have a **positive** social and economic impact although, without positive encouragement of employment of local communities I particular, the local benefit may be marginal. It is understood that the cleaning regime for the solar plant (approximately 2 cleans per month in dry months) will be outsourced to external contractors.

In addition to direct financial compensation, it is expected that employees will also be provided with social security and health insurance benefits.

SUPPORTING THE LOCAL COMMUNITY

The Project is owned by AES Netherlands Holdings B.V. and Mitsui & Company Ltd, the owner of the two existing power plants in the area. During public consultation, local community members highlighted that the existing power plants negatively affect the community. However, there were mixed perceptions between different communities that the land values may either increase or decrease as a result of the proposed Project. The associated decrease of land values was particularly in respect to adjacent lands to the Project site and associated with lands near transmission lines- and increasing with respect to general area perception of improved power supply and industry.

During public consultation, the local community particularly highlighted a general sense of lack of support for the local educational opportunities and healthcare facilities.

LOCAL ROAD NETWORK

During the operational phase, it is expected that transportation requirements and processes will be limited to non-routine tasks (such as equipment replacement or repair works) and periodic maintenance activities and does not represent significant impact from the Project.

DISPOSAL OF SOLAR PANELS

While there are no direct greenhouse gas emissions associated with generating electricity from solar energy, there are indirect emissions associated with other lifestyle stages of the solar lifecycle including manufacturing and production, materials transportation, installation, maintenance, and decommissioning.

The estimated lifespan of a solar panel is typically between 20 and 30 years. Thin-film photovoltaic (PV) cells contain a number of toxic materials. The panels are considered hazardous and electronic waste by the Ministry of Environment and will be need to be handled, stored, transported and disposed of accordingly. Improper handling and disposal of hazardous and electronic waste including illegal dumping and fly tipping can lead to up to a **major negative** impacts depending on the ultimate disposal method and receptor.

13.6 MITIGATION MEASURES

13.6.1 CONSTRUCTION AND DECOMMISSIONING

EMPLOYMENT AND TRAINING OPPORTUNITIES

The Project is expected to create temporary jobs for both skilled and non-skilled employees during construction and decommissioning.

In order to maximise the employment benefits to local communities, manage expectations and help avoid social conflict that may otherwise arise in relation to perceived inequality of recruitment, the following approaches are recommended:

- Widespread disclosure of a Recruitment Policy that specifically includes a requirement to prioritise local employment (local communities and Sahab district) taking into account available skills. The Policy should be supported through contract targets or incentives. Contractors should be encouraged to provide additional specialised training and skills development to the local workforce. The Policy should consider local literacy levels and gender issues. By disclosing the local Recruitment Policy widely, people from further afield should be discouraged from visiting or moving to the area on a large-scale for work. It is understood that this can be done in cooperation with the Labour Directorate.
- Written descriptions of the types of employment and supply chain opportunities to be provided to/by local people and businesses for the construction and operational phases of the Project including skill levels, indicative timeframes for recruitment and likely duration of contracts. This will allow prospective local employees and companies to prepare for opportunities and make informed decisions about assignments.
- Development of appropriate training programmes to promote the uptake of jobs among local workers.

WORKER INFLUX

Reducing the chance of an influx of workers to the Project area will be managed through measures such as the centralised recruitment policy and working with the Labour Directorate. This will reduce the number of people who travel to the Project area in search of potential work.

A Code of Conduct for all workers will need to be developed and included as part of the employment contract. This will cover procedures related to interactions with the local community as well as expectations regarding behaviour at work.

LOCAL BUSINESS PROSPERITY

As far as practicably possible, material purchases should be made locally with contracts arranged by the Project Company ideally explicitly noting this requirement, potentially with minimum local content specifications where feasible.

Appropriate traffic management measures should be developed and implemented to reduce the risk or impact of congestion. This should consider the following:

- Transportation of material to the Project site should occur only during daytime working hours. Rush hours should be avoided so as not to increase traffic congestion in congested public junctions;
- Consideration of worker bus timing and placement to avoid traffic jams;
- Warning and traffic signs should be posted throughout the site to prevent accidents and ensure speed restrictions are adhered to;
- Transport of heavy vehicles and heavy machinery (particularly panels and inverters from Aqaba) should avoid peak traffic congestion time (rush hours);
- All drivers should be suitably trained and licensed drivers and reminded to follow all Jordanian traffic regulations; and
- All vehicles, including trucks and buses, must be well-maintained.

GRIEVANCE MECHANISM

In order to minimise potential negative impacts from the Project activity and to maximise positive ones, a grievance mechanism as indicated within the accompanying SEP (Appendix E) should be enacted and followed on site

As also indicated in the SEP, non-technical summaries of the EIA in Arabic and full copies of the EIA will be made available in hard copies at local communities and it is recommended that electronic version are made available on the Project Company website.

WORKER RIGHTS

Risks to workers' rights will be managed through policies and procedures that are in line with AES' ethics policies and IFC PS2 on Labour and Working Conditions will need to be implemented. Wärtsilä and Project Company will be required to manage the workforce on the Project with appropriate consideration of:

- Human resource policies,
- Working conditions and terms of employment,
- Negotiation with workers' organisations (if any), ensuring the principle of non-discrimination and equal opportunity in employment processes and decisions is adhered too,
- A suitable non-discriminatory and non-retaliatory labour grievance mechanism,
- Protection of the workforce (e.g. commitments not to use child labour or forced labour),
- Implementation of a suitable plan and procedures,
- Managing third party workers' rights and reviewing supply chain workers' rights (with potential consideration of panel and inverter supply labour rights in particular- during supplier inspections it may be beneficial to undertake labour rights and environmental compliance reviews in parallel).

DISPOSAL OF SOLAR PANELS

It is recommended that, in the first instance, solar panel suppliers should be required contractually to remove, reuse and recycle broken panels. Such arrangements should ideally continue through the operational phase in order to avoid hazardous waste disposal given the lack of appropriate facilities within Jordan. Should this not be possible, it is recommended that the Project Operator and Wärtsilä liaise with other developers of solar parks within Jordan and determine whether cumulative reuse or recycling programme may be feasible. In the last instance disposal of the panels should be undertaken at the Swaqa Hazardous Waste Treatment Facility (or other licensed facilities if developed). The procedures for storage, handling transportation, and record keeping should be included in the respective environmental management plans.

By following the appropriate handling and disposal procedures impacts to local communities related to disposal of hazardous materials can be reduced to **minor negative**.

13.6.2 OPERATIONAL PHASE

EMPLOYMENT AND TRAINING OPPORTUNITIES

The Project is expected to create both permanent and temporary jobs for non-skilled workers. While operational employment is likely to be limited, similar recruitment policies as indicated within Section 13.6.1 should be considered for operations. Maintenance contractors would ideally be required to incorporate ‘local content' with respect to local employees within their bids for work on the Project to ensure employment benefits are maximised for the local community. It is understood that local recruitment drives or initiatives can be enacted in cooperation with the Labour Directorate in the Amman Governorate.

SUPPORTING THE LOCAL COMMUNITY

The corporate social responsibility (CSR) programme or community investment initiatives currently undertaken by the Project Company for IPP1 and IPP4 power plants should be reviewed in light of the comments received in the stakeholder engagement activities for the proposed Project. Following this a cumulative strategy for all projects (including solar projects) should be considered and developed to take account of suggestions made within these meetings.

While work will be necessary to fully realise the benefits of community initiatives, it is anticipated that these will result in indirect **positive** impact to the local communities. The availability of a public grievance mechanism should also be advertised (also see Stakeholder Engagement Plan) in order to allow any complaints to be raised.

LAND PRICES

Based on the feedback from the local communities, it is recommended that consideration be given to the Project Company (or local authority) potentially employing an independent value (or potentially two separate valuation companies to average valuations) in order to assess the land values prior to construction of the Project, for land immediately adjacent to the facility. Post-construction valuation would then need to be undertaken to identify the impact, if any, to land prices as a result of the Project. In order to establish whether this exercise is warranted it may be necessary to request cadastral map from local authority in order to identify plots of land adjacent to the proposed site. Subject to the ownership findings, consideration should be given to whether it may be beneficial to set up an independent committee to identify whether compensation is warranted by the Project Company, particularly given the site was originally cleared in 2010 by the Ministry of Finance (and whether any compensation was provided at that time by the Ministry).

In case a negative correlation between the operational development and the land values is identified, there may be need for consideration of appropriate compensation or equivalent community investment initiative in order to avoid cash payments with respect to precedence.

Discussions with NEPCO should also be held with respect to the assessment process undertaken for the transmission line if non-public land/existing rights of way is anticipated for use. Any assessment/compensation for the transmission line should be in accordance with national expropriation laws where applicable and consideration of Performance Standard 5- land acquisition and involuntary resettlement.

13.7 CUMULATIVE IMPACTS

13.7.1 CONSTRUCTION

Although employed workers may be at risk of exposure to standard occupational and health risks associated with construction activities, these should be appropriately minimised through the implementation of appropriate health and safety procedures and training.

13.7.2 OPERATION

No significant cumulative impacts to the health of employees or local community are expected to occur as a result of this Project given the lack of discharges or emissions associated with solar power generation.

13.8 RESIDUAL EFFECTS

Following the implementation of all required mitigation measures, it is expected that residual impacts will be positive for the local community with the introduction of renewable energy as well as increased potential for jobs, training and community initiatives.

13.9 SUMMARY OF IMPACTS

A table summarising the impacts arising from the Project on the socio-economy is presented in Table 13-14.

Table 13-14 Summary of Socio-economic impacts and mitigation

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive / Negative	P/T	D/I	ST/MT/LT		Major, Moderate, Minor, Negligible
Construction and Decommissioning							
Employment and training opportunities for the local community members	Minor to Moderate	Positive or negative	P	D	MT	→ Prioritise employment of local community members for skilled and unskilled labour employment opportunities through development of recruitment policy. → Understand or cater to the local training platforms → Grievance mechanisms should be in place for public members to raise concerns throughout the construction phase. → The contact details and procedures of the grievance mechanism should be appropriately publicised with contact details made easily available.	Moderate positive
Land use value	Minor to Moderate	Negative	P	D or I	MT to LT	→ Consideration of cadastral map of owners around the site. Should it be appropriate, consider appointment of independent land valuer(s) to value community land prior to Project development with post-construction valuation to be enacted in order to consider land valuation change if any and whether any compensation/equivalent community initiative is warranted.	Minor
Local business prosperity	Minor	Positive	T	D	MT	→ As far as practicably possible, purchasing requirements should be fulfilled locally with contractors required to account for 'local content' in preference.	Moderate

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive / Negative	P/T	D/I	ST/MT/LT		Major, Moderate, Minor, Negligible
Grievances as a result of construction activities on site	Minor	Negative	T	D	MT	→ Grievance mechanism should be in place for public members to raise concerns throughout the construction phase. → The contact details and procedures of the grievance mechanism should be appropriately publicised with contact details made easily available.	Negligible
Community initiatives	Minor	Positive	T	D and I	MT	→ Review comments received within stakeholder engagement for solar plant and consider within initiatives for IPP1/IPP4 in order to develop combined approach	Moderate
Added pressures to the local road network and contribution to traffic congestion	Minor	Negative	T	D	MT	→ Grievance mechanisms should be in place for public members to raise concerns throughout the construction phase. → The contact details and procedures of the grievance mechanism should be appropriately publicised with contact details made easily available.	Negligible
Operational Phase							
Employment and training opportunities for local community members	Minor	Positive	P	D	LT	→ Employment with relation to the operation of the Project should focus on employing local community members if possible through ‘local content’ provisions within tender documents. → Consideration of recruitment policy for operations to highlight local community employment in preference	Moderate

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive / Negative	P/T	D/I	ST/MT/LT		Major, Moderate, Minor, Negligible
						→ Training opportunities should be assessed and supplemented as appropriate.	
Impact to land value	Minor	Negative	P	D	LT	→ The baseline for local land value should be assessed and reported. A follow-up assessment should be undertaken in order to assess the impact of the Project upon local land value.	Minor
Direct and indirect support of local economy and public facilities	Minor	Positive	P	D & I	LT	→ The Project will contribute positively to the local socio-economics through the focused local employment and purchasing initiatives. This is expected to have positive secondary impacts on the wider community areas.	Minor
Disposal of solar panels as hazardous materials	Moderate	Negative	Permanent	Direct	LT	→ Arrangement with panel supplier for reuse/recycling should be considered in preference. Liaison with other PV park developers within Jordan in order to identify whether shared resources for reuse/recycling may be appropriate/feasible; → Storage, handling and disposal procedures should be implemented as per the Operational Environmental Management Plan; and → Only appropriately licensed hazardous waste facilities should be used, and appropriate record-keeping, through the tracking of waste transfer receipts, should be maintained.	Minor

14 CULTURAL HERITAGE AND ARCHAEOLOGY

14.1 INTRODUCTION

This Chapter reviews the baseline conditions and the potential impacts upon known and unknown archaeological and cultural heritage sites, resulting from the construction and operation of the proposed Project. An archaeology and cultural heritage assessment was undertaken as part of the environmental and social impact assessment of the Project

14.2 BASELINE

14.2.1 EXISTING CONDITIONS

For the Manakher solar PV Project, the local consultant, RSS, reviewed the Middle Eastern Geodatabase for Antiquities (MEGA-Jordan), which is a geographic information system (GIS) for the inventory and management of archaeological sites at a national level. Other sources used during the baseline study include consultations with the Department of Antiquities (DoA), and the libraries of American Center of Oriental Research (ACOR) and British Council for Research in Levant (BCRL).This database is maintained by the Department of Antiquities (DoA) in Jordan. In addition, the archaeological specialist, Dr Waheeb from RSS, visited the Ministry of Tourism and Antiques of Jordan to request to review any other available archaeological data for the Project site. At the time of writing the EIA, no additional information had been provided.

The closest identified archaeological sites are identified in Table 14-1 and Figure 14-1. A site assessment report as per DoA records for each of the identified sites has been included within Appendix F of this EIA report for reference.

Table 14-1 Identified archaeological sites

Heritage Site	Features and Information	Site Area (m^2)	DoA Overall Condition Rating	Approximate Distance from the Project Site	Photograph
Khirbet el Madhuna	→ Scattered flint from Modern, Roman, Iron Age I, Iron Age II, Byzantine, Middle Bronze, Islamic, and unknown periods	13,798	Fair	Located 340m north-west of the Project boundary.	
Qaser al Madonah	→ Scattered flint from Modern, Roman, Iron Age I, Iron Age II, Byzantine, Middle Bronze, Islamic, and unknown periods → Tower → Stone circle → Stone fences	17,014	Fair	Located 1.17km north of the Project boundary.	
El Naslah	→ No records	2,038	Unknown	Located 920m west of the Project boundary.	Site was not identifiable during the baseline walkover.
Nasle	→ Scattered flint from Iron Age III → Isolated structure from unknown period	199	Unknown	Located 960m west of the Project boundary.	Site was not identifiable during the baseline walkover.

The closest archaeological site, being the Khirbet el Madhuna site, is approximately 340m from the north-western corner of the site as shown in Figure 14-1. Archaeological finds at the Khirbet el Madhuna site included 12 elements, primarily consisting of flint scattered on the ground surface (no excavations) from a range of periods, as indicated within Table 14-1. Previously it is thought that site was a large fortified structure situated in the plains of Beidha village. This site is dated back to Iron Age II in addition to extensive settlements during the Islamic period.

The Qaser al Madonah site, located 1.17km north of the Project site, dates back to the Iron II period with apparent Ammonite features. The site built of large undressed limestone blocks, and has strong connection with the nearby Khirbh (Khirbet Madonah), more than two stories of buildings were noticed possibly used for settlement and agricultural activities, the site severely suffered from destruction especially the eastern parts where the walls collapsed and the stones tumbled toward the Wadi.

Both the En Naslah and the Nasle archaeological sites identified by the DoA were unable to be located onsite during the baseline walkover.

The DoA recommends that a 25m buffer zone around archaeological sites is established and that no activities are undertaken within this buffer zone (MEMR Advisory, CRA, 2011). As the closest identified site is located 340m from the Project boundary, the proposed solar development does not encroach into the buffer zone. Notwithstanding this direct footprint, the identified archaeological site will need to be considered within the site's CEMP and mitigation measures will need to be in place to ensure no construction activities or workers encroach this buffer zone.

Figure 14-1 Identified archaeological sites within the vicinity of the Project site

In addition to the desktop review of historical archaeological finds, three RSS archaeological specialists, including the archaeological specialist, Dr Waheeb, visited the Project site and undertook a walkover in 2017. The study team investigated the proposed site in the Manakher area in addition to the surrounding area of the site. The investigation was conducted on foot, hence survey members walked at a distance of 20-30m from each other.

No intrusive excavations were undertaken as part of this assessment given that the solar site has previously been cleared by Ministry of Finance in 2010 and minimal excavations are expected as part of the construction works. The purpose of the walkover was to identify features of cultural and archaeological significance such as:

- Shards of pottery and flints;
- Settlement remains;
- Graveyards and burial sites; and
- Other surface finds.

The survey was conducted on 8 January 2017 over two days. The survey considered the Project site in addition to an extended zone of 1km surrounding the Project boundary. The Project site is considered heavily disturbed following the extensive clearance/grading that has taken place.

Figure 14-2 and Figure 14-3 show the current conditions of the Project site. During the walkover, the specialists did not identify any sites or surface-located artefacts of archaeological or cultural heritage significance. Notwithstanding the absence of artefacts on the surface, consideration of chance-finds during the Project's excavations will still need to be accounted for within the site's CEMP.

	
Figure 14-2 Overview of existing site conditions	**Figure 14-3 Overview of existing site conditions**

14.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

14.3.1 ASSESSMENT METHODOLOGY

The assessment will rely on a cumulative understanding of each identified sensitive receptor based on:

- → Existing status: the current level of protection associated with the relevant authority's categorisation/classification;
- → Historical significance: significance of the receptor may be enhanced by existing records or prior investigations, as well as sites associated with defined historical areas or events;
- → Group value: a receptor's value can be enhanced by association to known archaeological or culturally significant spread over an area, whereby the value of the group as a whole is prioritised;
- → Rarity: rarity of a feature may dictate value over the existing conditions; and
- → Vulnerability: assessment of the existing level of threat to the receptor.

Construction phase impacts will be assessed based on direct and indirect consequences of demolition, excavation and construction activities with reference to technical environmental assessments of noise, air quality, landscape and visual, and design of the Project as presented throughout this report.

Operational phase impacts of the Project will follow the same assessment methodology as utilised for the construction phase impacts. Reference will be made to various technical environmental assessments, including noise, air quality, landscape and visual as well as final design of the Project as presented throughout this report.

14.4 IMPACT ASSESSMENT

14.4.1 IMPACTS DURING CONSTRUCTION AND DECOMMISSIONING

Due to the nature of the works, the impacts associated with decommissioning are anticipated to be the same as during the construction phase.

Identified archaeological sites in the area are outside of the Project site boundary. As it is expected that the construction corridor will be bound by the same site limits, it is not anticipated that any of the sites identified through the DoA database (MEGA) will be directly affected by construction activities of the Project.

DoA records published on the MEGA website indicate that concerns with deterioration or status of the identified sites include vulnerability to theft or trespassing. Construction activities in the area will attract, both directly and indirectly, a more consistent presence of people in and around the Project site. Although it does not appear that these sites are identified or demarcated in anyway, direct impacts through unauthorised interactions with the identified sites would represent **moderate to major adverse** impact.

Sites with identified archaeological finds at surface or above ground structures (such as at Maduna site) may be susceptible to increased and windblown dust from construction activities. However, it should be noted, as per the air quality assessment in Section 7 that baseline conditions are such that background PM_{10} levels are typically naturally elevated. Additionally, as the site is already graded, clearance activities are expected to be minimal, with dust emissions being primarily related to minor excavation works and vehicle movements on site. As a result, the impact of dust onto known archaeological sites is expected to be **minor**.

It is not anticipated that the construction works associated with the Project will produce significant vibration impacts based on the anticipated methodologies to be employed. As such, the indirect impacts of vibration onto archaeological features, including structures or elements on the ground surface, are expected to be **negligible**.

Construction work including excavations and ground clearance have potential to impact unidentified archaeological sites and elements. Similarly, consideration will need to be made to ensure storm water collected/runoff from the site does not detrimentally affect offsite locations. Construction activities may directly affect these by disturbing, removing and destroying remains. Damage and disturbance to unidentified archaeological remains will result in an impact severity of high, and an impact significance of **major adverse**.

14.4.2 IMPACTS DURING OPERATION

Any impacts upon superficial and buried archaeological remains would have occurred during the construction phase of the Project and therefore the operational impacts are predicted to be neutral or **negligible**.

14.5 MITIGATION

14.5.1 DESIGN

As no direct impact through contact or overlapping in the site area and sensitive receptors have been identified, consideration for an alternative location is not required.

No indirect impacts from the operational phase of the Project are not anticipated to be significant and therefore no design mitigation or changes have been suggested for this Project.

14.5.2 CONSTRUCTION AND DECOMMISSIONING

If any suspected or potential archaeological artefacts or remains are identified during the construction phase, all works will be ceased immediately and DoA informed and consulted prior to progression of further works on site. An archaeological watching brief and chance finds procedure will be required and has been included within the accompanying CEMP.

The intention of the archaeological watching brief would be to record and facilitate the investigation of any finds of archaeological and cultural significance. The watching brief includes the following requirements:

- → Any chance finds or suspected evidence of archaeological and/or historical materials would be immediately reported by any of the construction workers, or other parties involved in the construction phase and all works should be stopped immediately, until further notice;
- → Relevant departments, such as DoA or accredited agents should be contacted immediately who will be able to provide advice on the need for further investigations (by the DoA) and any further actions arising from the finds. Contact details for the DoA are as follows: Jebel Amman Street, Sultan Al Atrash, P.O. Box 88, Amman, Tel: +962 464 4320;
- → Any unexpected finds of cultural or archaeological value should not be removed without first consulting the DoA specialists.

The requirements of the watching brief form a component part of the CEMP and all construction staff will be instructed to be aware of the importance of contacting the nominated Environmental Manager should they uncover any remains of unknown provenance.

Consultation with the DoA by Wärtsilä throughout the construction period to ensure that any cultural and heritage assets are adequately protected in-situ, where appropriate, through the implementation of specific controls and a watching brief.

Article 15-" 18 " which relates to archaeological law in Jordan indicates that: *Any person not having an excavation permit who discovers, finds or knows of the discovery of any antiquities shall announce the discovery to the Director or the nearest Public Security Centre during ten days from the date of discovery, finding or knowing of the discovery of such antiquities. The Director may, subject to the approval of the Minister, pay to the one who discovered or found the antiquities appropriate cash reward pursuant to this Law.*

Although the likelihood of finding any artefacts is low, as per the law above Wärtsilä is required to be aware that if an item of archaeological significance is discovered they are required to notify the DoA.

The Contractor shall seek the written approval of the DoA before the removal of any chance find building, foundation, structure, fence and other obstruction over 50 years old, any portion of which is close to the site. All designated salvageable material shall be removed, without causing unnecessary damage, and in sections or pieces, which may be readily transported, and shall be started by the contractor at approved locations, for later use or possession of the department of Antiquities.

If any site found during construction and will be damaged by construction activities, the DoA will assess the discovered remains and may carry out an emergency salvage excavation. salvage excavation means archaeological excavation conducted during construction phase it should be conducted only when an archaeological site is found by accident (chance find) during construction. Given the short time available for a salvage excavation, this type of work should be avoided.

Following implementation of the mitigation measures presented above, the residual impact of the construction of the Project is expected to be of **negligible** significance.

14.5.3 OPERATION

There is no requirement for mitigation measures to be implemented during the operational phase of the Project.

14.6 CUMULATIVE IMPACTS

14.6.1 CONSTRUCTION

The proposed transmission line, which will be under the responsibility of NEPCO, will need to be assessed in accordance with national requirements with respect to archaeological finds. The Project Company will also be expected to initiate dialogue with NEPCO to stress that the assessment for the transmission line will also need to account for international (IFC) standards. While the anticipated transmission towers (or underground cable) are unlikely to uncover new artefacts given limited excavations there will still be a requirement for NEPCO (or the transmission line contractors) to enact a watching brief for these works.

14.6.2 OPERATION

There are no expected cumulative impacts during the operation phase of the Project.

14.7 RESIDUAL EFFECTS

All predicted impacts are amendable to mitigation. Following the implementation of recommended mitigation measures through the enforcement of the CEMP, the residual impacts during the construction phase are considered to be **negligible**.

14.8 IMPACT SUMMARY

A summary of the impacts associated with the Project on cultural and archaeological sites are shown in Table 14-2.

Table 14-2 Summary of archaeological and cultural heritage impacts and mitigation

Description of Likely Significant Impacts	Significance of Impacts					Summary of Mitigation / Enhancement and Monitoring Measures	Significance of Residual Impacts
	Major, Moderate, Minor, Negligible	Positive / Negative	P/T	D/I	ST/MT/LT		Major, Moderate, Minor, Negligible
Construction and Decommissioning							
Disturbing, damaging or destroying identified archaeological remains directly and indirectly during construction.	Major	Negative	P	I&D	ST	→ Implementing an archaeological watching brief and chance find procedure to immediately alert a DoA representative of any features of interest. → Review storm water drainage immediately after significant rainfall events to ensure runoff does not negatively impact (flood/erode) offsite areas	Minor
Unsupervised excavation works could damage and destroy unknown and unidentified sites or archaeological remains.	Major	Negative	P	D	ST		Minor
Operation							
Storm water runoff impacting offsite areas through erosion or flooding	Minor to Moderate-	Negative	P or T	I	ST to LT	→ Review storm water drainage immediately after significant rainfall events to ensure runoff does not negatively impact (flood/erode) offsite areas	Negligible

15 HEALTH AND SAFETY

15.1 INTRODUCTION

This Chapter provides an overview of the main occupational health and safety and community health and safety hazards of the Project. The mitigation measures to be implemented are also described. While it is anticipated that the Project will be required to adhere to national Jordanian labour/occupational health and safety requirements (including such elements as ensuring availability of appropriate medical facilities subject to number of workers on site) and develop an appropriate health and safety plan to be enacted on site, this Chapter has been primarily prepared with consideration of the following IFC PS's and IFC / World Bank Group EHS Guidelines including:

- IFC PS 2: Labour and Working Conditions (2012);
- IFC PS 4: Community Health, Safety and Security (2012);
- IFC / WB EHS General Guidelines (2007); and
- IFC / WB EHS Guidelines for Electric Power Transmission and Distribution (2007).

15.2 OCCUPATIONAL HEALTH AND SAFETY

15.2.1 CONSTRUCTION

The Contractor will be responsible for the health and safety of all personnel onsite during construction. A Health, Safety and Environment (HSE) Plan will be prepared by the Contractor for the construction works prior to commencement of any construction activities onsite. The HSE Plan will need to be prepared in accordance with the IFC / World Bank Group EHS General Guidelines 2007 and relevant Jordanian standards and submitted to the Project Company for review and approval prior to construction works commencing onsite. Detailed method statements will be necessary to be developed and provided by Wärtsilä for all major construction activities with due consideration of health and safety risks and management of these risks.

The main envisaged occupational health and safety hazards associated with the construction of the Project are shown in Section 3.

Table 15-1 Potential occupational health and safety hazards during construction

Project Activity	Health and Safety Hazard	Description of Impact	Mitigation
Solar Farm	Exposure to dust	Dust will be generated from earthworks, general construction activities and dust track out / wind blow from deliveries.	• Dust suppression techniques such as sheeting stockpiles and limiting speed to minimise dust from vehicle movements will be implemented. • Limiting earthworks during periods of high wind. • Personal protective equipment (PPE) such as dust masks will be used where dust levels are excessive.
	Working with rotating machinery and moving equipment	There is the potential for rotating machinery and moving equipment to cause injury to workers.	• Appropriate safety devices to be used for machinery with exposed moving parts.
	Falling objects during panel installation or personnel falls from height	There is the potential for workers to be struck by falling objects or fall from platforms/frames during the installation of the solar panel components.	• Appropriate PPE will be provided free of charge to all workers on site. • Ensure appropriate working-at-height training and protection equipment applied during frame and panel installation
	Exposure to chemicals	There is potential for workers to be exposed to chemicals present in construction chemicals such as solvents or oils or materials in electrical components.	• Chemical hazards labelled appropriately to national and internationally recognised standards such as Material Safety Data Sheets (MSDS). • Workers will be trained in the use of the available information (such as MSDSs), safe work practices and appropriate use of PPE.
	Accident involving transportation or Project plant	Vehicle and plant movements on site could lead to an accident involving a collision or accident with a member of staff.	• Visually confirm that vehicle speeds are restricted to less than 30kph on hard packed material or 15kph on loose packed material on site. • Provide appropriate PPE without charge for all workers on site. • Have bleepers and banksmen for when vehicles are reversing. • Ensure banksmen are employed to assist vehicles reversing/entering a main road.

Project Activity	Health and Safety Hazard	Description of Impact	Mitigation
Underground Cables	Exposure to Dust	Dust will be generated from earthworks, general construction activities and dust track out / wind blow from deliveries.	• Dust suppression techniques such as sheeting stockpiles and limiting speed to minimise dust from vehicle movements will be implemented. • PPE such as dust masks will be used where dust levels are excessive.
	Exposure to Electrical Hazards from the Use of Tools and Machinery	Workers will be exposed to electrical hazards from the use of tools and machinery during the installation of the underground cables.	• Hand power tools and electric cords and cables will be checked for frayed or exposed cords. • During maintenance devices will be locked and tagged out. • Warning signs will be used to identify energised electrical devices and lines. • Electrical equipment will be double insulated / grounded where appropriate.
	Live Power Lines	Workers will be exposed to occupational hazards from contact with live power lines during the installation of the underground cables.	• Live power lines will be deactivated and grounded prior to work commencing on the lines. • Trained and certified workers will be employed. • Live-wire work will be conducted in accordance with specific safety and insulation standards.

15.2.2 OPERATION

The Developer will be responsible for the health and safety of all personnel onsite during operation. An Occupational Health and Safety Plan (OHS) will need to be prepared by the Developer prior to operation. The OHS Plan should be prepared in accordance with IFC / World Bank Group EHS General Guidelines (2007) and Jordanian regulations and guidelines.

During operation, the occupational health and safety hazards of the proposed Project are predominantly associated with maintenance activities and are anticipated to be the same as those outlined for construction in Table 15-1.

15.2.3 DECOMMISSIONING

It is anticipated that the operational life of the Project will be approximately 20-30 years. After this time, the solar panel structure, underground cables and associated facilities will most likely be removed and the area will be reinstated to its original form.

During decommissioning, the occupational health and safety hazards of the Project site, underground cables and associated facilities are anticipated to be the same as those outlined for construction in Table 15-1.

15.3 COMMUNITY HEALTH AND SAFETY

It is anticipated that the health and safety of local communities will not be affected during construction and operation of the Project due to the distance of the Project site from the nearby villages and communities. However, as there are small communities, workers from surrounding plants and farms with people who live close to the Project site, therefore their health and safety requires consideration.

15.3.1 CONSTRUCTION

The potential community health and safety hazards associated with the construction of the Project and associated facilities are shown in Table 15-2.

15.3.2 OPERATION

The potential community health and safety hazards associated with the operation of the Project and associated facilities are shown in Table 15-3. There are no anticipated impacts associated with the underground cables during operation.

15.3.3 DECOMISSIONING

The potential community health and safety hazards associated with the decommissioning of the solar farm and underground cables are anticipated to be the same as those outlined for construction shown in Table 15-2.

Table 15-2 Potential community health and safety hazards during construction and decommissioning

PROJECT ACTIVITY	HEALTH AND SAFETY HAZARD	DESCRIPTION OF HAZARD	MITIGATION
Solar Farm	Public Accessibility	The Project site will not be accessible to the public; the Project site will be fenced and will have security. However if someone was to access the site there would be safety risks associated with the installation of the solar panels and the movement of vehicles onsite.	• Public safety information will be posted on information boards and will include emergency contact details. • Safety signs will be installed at the entrance to the access roads. • Gates will be installed at the entrance to the site. • Security fencing will be erected around the perimeter of the site. • Security guards should be appropriately trained with appropriate protocols in the use (of lack of use) of force • Wärtsilä should make reasonable inquiries to investigate the employment records and other available records, including any criminal record, of individuals or firms employed for security • Security incidents on the site should be appropriately recorded and investigated (in corporate with appropriate public service) and corrective actions enacted
	Dust	Dust will be generated from earthworks and general construction activities.	• Dust suppression techniques such as sheeting stockpiles and limiting speed to minimise dust from vehicle movements will be implemented. • Dust suppression methods shall be disused further within the CEMP.
	Communicable Disease	There is the potential for communicable diseases due to labour mobility.	• Health awareness training will be provided to the workers during construction.
Underground Cables	Dust	Dust will be generated from earthworks and general construction activities.	• Dust suppression techniques such as sheeting stockpiles and limiting speed to minimise dust from vehicle movements will be implemented. • Dust suppression methods shall be disused further within the CEMP.

PROJECT ACTIVITY	HEALTH AND SAFETY HAZARD	DESCRIPTION OF HAZARD	MITIGATION
	Falling in trenches Should the general public enter the site during these works there is potential for people to fall within the trenches. • Appropriate signs and fencing shall be erected.		

Table 15-3 Potential community health and safety hazards during operation

PROJECT ACTIVITY	HEALTH AND SAFETY HAZARD	DESCRIPTION OF HAZARD	MITIGATION
Project site	Public Accessibility	Potential access of the site by public	• Public safety information will be posted on information boards and will include emergency contact details. • Safety signs will be installed at the entrance to the access road. • Security fencing will be erected around the perimeter of the site with controlled access gates and security guards.
Transmission lines	Electrocution	Electrocution hazards are related to direct contact with the transmission lines or contact with tools, vehicles, ladder or other devices that are in contact, should one be exposed.	• Responsibility of NEPCO but it is anticipated that signs will be installed along the transmission route outside the Project site to prevent public contact with potentially dangerous equipment. • Grounding conducting objects will be installed near the transmission lines to prevent electrocution.
	Noise	There is the potential for noise in the form of buzzing around the transformers within the plant.	• Due to the distance of the solar plant equipment from residential receptors no noise impact is anticipated (see section 8. Therefore, no mitigation is proposed.

16 ENVIRONMENTAL, HEALTH AND SOCIAL MANAGEMENT SYSTEM

16.1 SOCIAL MANAGEMENT SYSTEM – STAKEHOLDER ENGAGEMENT PLAN

In order to ensure that stakeholders in the Project- which includes local communities, government entities and other interested parties- are provided sufficient opportunities to raise their issues or concerns during the Project's lifecycle, effective and appropriate stakeholder communications are a key tool within the planning and development process.

Appendix G provides the full and complete stakeholder engagement plan for the proposed Project, identifying previous engagement and future engagement/disclosure activities in addition to a grievance plan for the Project site. The stakeholder engagement plan (SEP) provides the mechanism for these communications.

16.2 STAKEHOLDER ENGAGEMENT PLAN OBJECTIVES

The SEP has been developed with the following key objectives:

- Clarify previously undertaken consultations for the Project;
- Provide an appropriate mechanism to understand and manage stakeholder expectations in line with the Project's risks and opportunities;
- Building upon existing stakeholder mechanism(s) for IPP1 and IPP4 for future communications; and
- Provide a suitable grievance mechanism to allow stakeholders to express their concerns with Project activities during lifetime of the plant.

It is noted that the proposed developers are key shareholders in the IPP1 and IPP4 power plants approximately 2km southwest of the Project site. Due to their proximity, these thermal power plants effectively manage community engagement as one entity in order to ensure what are often common issues are resolved together. As a result of the common owners, communities in the local area in particular are likely to consider the proposed Project as part of the overall project portfolio rather than as an individual project necessarily. Inputs to this SEP with respect to the Project have therefore considered the existing stakeholder engagement mechanism in place at IPP1 and IPP4 and have involved the existing community liaison officer at the same sites. It is worth highlighting, however, that with respect to the potential impacts of a solar park on a local community, these differ considerably from thermal power plants, with limited negative impacts associated with the proposed Project particularly during the operational phase.

The general principles of effective stakeholder engagement as considered within the IFC International Finance Corporation (2007): '*Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets*' have also been considered within the development of this SEP as noted within Figure 16-1.

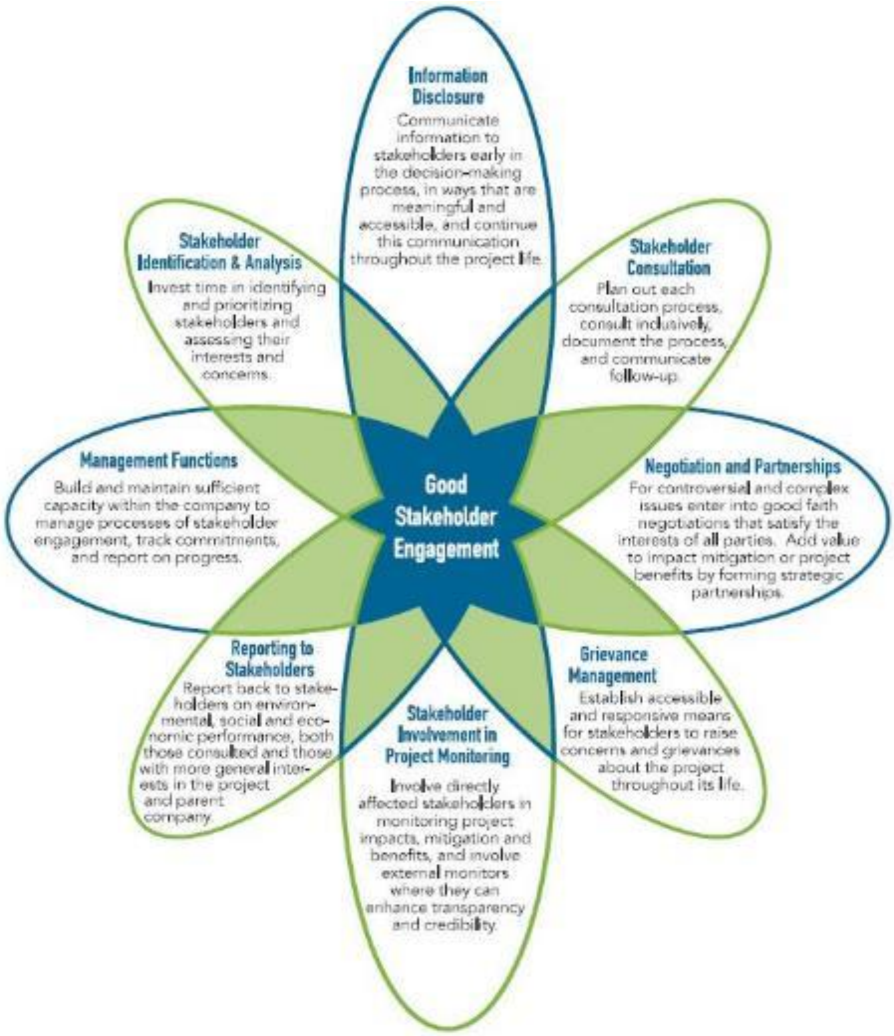


Figure 16-1 Good stakeholder engagement as per IFC Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets (2007)

16.3 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

A Construction Environmental Management Plan (CEMP) for the proposed Project has been developed and is presented within Appendix D.

The CEMP provides a mechanism to manage the anticipated impacts of construction activities upon the environment and proposes a framework for pollution control and best practice measures that shall be adopted during the construction phase of the Project in order to avoid, minimise, or offset likely impacts in the areas of, and surrounding the, proposed construction Project footprint area.

The CEMP serves to ensure that the regulatory and site-specific requirements applicable at the national level are met, and serves as a clear and auditable indication as to how those requirements are implemented throughout the construction phase of the Project.

16.3.1 OBJECTIVES

In line with the MoE's commitment to environmental protection, the primary objective of the CEMP will be to provide a clear direction on the requirements of the construction contractor and all subcontractors in their activities: each requirement is measurable and enforceable; hence, any non-compliance can be identified and addressed swiftly.

The primary objectives of the CEMP are defined as follows:

- Prescribe an overall management structure with clearly defined environmental accountabilities and responsibilities;
- Identify environmental aspects and associated impacts during the construction phase of the Project;
- Define objectives and targets for environmental and social management of the construction activities;
- Provide mandatory induction training, toll box talks, and specialist training to the workforce;
- Develop a set core of emergency preparedness procedures and associated emergency management plans;
- Define the communication and consultation protocols for liaison with local communities and regulatory authorities on environmental and social matters;
- Establish an internal audit program in order to identify any discrepancies between the requirements of the CEMP and future working practices;
- Prescribe a mechanism for recording and reporting environmental and social concerns, improvement, complaints or incidents; and
- Ensure compliance with all regulatory and other requirements prevailing in Jordan.

16.3.2 ISO 14001 MODEL

One of the most widely used environmental management systems, developed by the International Standards Organisation (ISO), is the ISO14001 standard for environmental management of activities. The standard provides a logical framework within which to prepare and develop the CEMP. The structure of a typical Environmental Management System (EMS) certified to ISO 14001 is illustrated by Figure 16-2.

Figure 16-2 ISO 14001 Structure

16.4 OPERATIONAL ENVIRONMENTAL MANAGEMENT PLAN

The Project Company will prepare an Operational Management Plan (OEMP) which incorporates the operational elements of the CEMP. The OEMP is a site-specific plan that will be developed to ensure that environmental management practices designed to eliminate and control environmental impacts are implemented during operation.

16.4.1 STRUCTURE

The structure of OEMP will clearly demonstrate the intent of the plan and will, at a minimum, have the following sections:

- Distribution List;
- Project Description;
- Environmental Management;
- Environmental Impacts;
- Environmental Mitigation Measures; and
- Monitoring and Auditing.

The OEMP will provide environmental control plans, environmental monitoring programme and training programs.

16.5 MONITORING AND REPORTING

16.5.1 CONSTRUCTION

During construction, daily site inspections will be undertaken by the HSE Manager or their representative. The construction environmental monitoring program is provided in Appendix D. A weekly site inspection report will be produced by the HSE Manager or their representative.

During construction, an environmental monitoring report will be produced every month by the Contractor and will be submitted to the Project Company on a regular basis (suggested a minimum of a quarterly basis subject to construction schedule) and all lenders regardless of their categorisation and requirement. If requested by the MoE, the environmental monitoring reports will also need to be submitted to them. A summary of the monitoring plans discussed within the CEMP which are to be implemented onsite is shown in Table 16-1.

Table 16-1 Monitoring requirements for the Project construction activities

Item	Type of Monitoring	Body responsible for scheduling monitoring	Body/person responsible for undertaking monitoring	Frequency of monitoring
1	Weekly Environmental Inspections	Contractor	HSE Manager	Weekly
2	Visual Dust Monitoring	Contractor	HSE Manager	Daily
3	Air emissions from point sources and/or mobile sources;	Contractor	HSE Manager	Daily
4	Noise Monitoring	Contractor	HSE Manager	Weekly (Section 6.1.3.2)
5	Excavated Material Monitoring	Contractor	HSE Manager	Daily (Section 6.1.3.4)
6	Archaeology	Contractor	HSE Manager	Ad-hoc and random by DoA
7	Waste Monitoring	Contractor	HSE Manager	Each occasion that waste is transferred from site

16.5.2 OPERATION

During operation, daily site inspections and specific monitoring programs will be undertaken by the HSE Manager. The anticipated operation environmental monitoring programme is provided in Table 16-2. A weekly site inspection report will be produced by the HSE Manager or their representative.

During the post-construction period (time frame still to be decided), an environmental monitoring report will be produced every 6 months by the operation and maintenance (O&M) Contractor and submitted to the Project Company for subsequent submission to lenders (or at frequency required by lenders if different). Thereafter, annual reports including environmental monitoring and compliance will be issued to those lenders that require these reports based on their categorisation and monitoring requirements. If requested by the MoE, the environmental monitoring reports will also be submitted to them.

Table 16-2 Minimum anticipated operational monitoring programme

Environmental Component	Monitoring Activity	Monitoring Parameters	Monitoring Locations	Monitoring Frequency	Responsibility	Timeframe
Geology, soils and groundwater	**Solar Farm** • Visual observation and assessment **Associated Facilities** • Visual observation and assessment of the substation and transmission line	• Spills • Compliance with the hazardous materials and chemicals handling and storage procedure of the OEMP	• Hazardous materials and chemicals storage facilities	Daily	O & M Company	During Operation
Waste	**Solar Farm** • Visual observation and assessment **Associated Facilities** • Visual observation and assessment	• Compliance with construction waste management plan of the OEMP	• Temporary waste facility	Daily	O & M Company	During Operation
Cultural heritage / archaeology	**Solar Farm** • Visual observation and assessment **Associated Facilities** • Visual observation and assessment	• Compliance with the OEMP	• Cultural Heritage and Archaeological Sites near the Project area.	During maintenance work	O & M Company	During Operation
Occupational health and safety	**Solar Farm** • Visual observation • HS Documentation review **Associated Facilities** • Visual observation	• Injury and mortality records onsite • Compliant register	• Site Wide	Daily	O & M Company	During Operation

Environmental Component	Monitoring Activity	Monitoring Parameters	Monitoring Locations	Monitoring Frequency	Responsibility	Timeframe
	• HS Documentation review					
Community health and safety	**Solar Farm** • Visual observation • HS Documentation review • Grievance mechanism **Associated Facilities** • Visual observation • HS Documentation review • Grievance mechanism	• Injury and mortality records onsite • Complaint register	• Site-wide, access gate and through community liaison officer	Daily	O & M Company	During Operation

17 CONCLUSIONS AND RECOMMENDATIONS

Following the undertaking of the EIA for the Project, assuming the suggested mitigation measures are appropriately applied, it is considered that the proposed Project will not give rise to unacceptable impacts on the environment or local communities, when considered against the existing baseline of the surrounding area or in combination with the other thermal plants in the area.

The Project assessment has allowed for what is considered an appropriate level of engagement with local communities and government agencies and it is envisaged that this engagement and disclosure will continue throughout the development of the Project in parallel with the community engagement measures undertaken by IPP1 and IPP4 given the common owner and shared issues perceived by the communities.

The main feedback of the proposed Project following community engagement has generally been positively framed and included increased employment opportunities and anticipated increased levels of community investment initiatives (linked to IPP1/IPP4 corporate social responsibility type initiatives). However, the engagement also identified that there are perceived issues with potential land values around the site (although different communities identified that it could either raise or lower land values) and potential legacy community issues associated with the development of thermal power plants in the general area. Care will need to be taken to ensure that grievances when raised are appropriately dealt with and it is envisaged that community expectations will have to be carefully and actively managed in particular by the Project Company. Lessons learnt from experiences on IPP4 are expected to play a key role for this aspect.

Appendix A

SCOPING REPORT

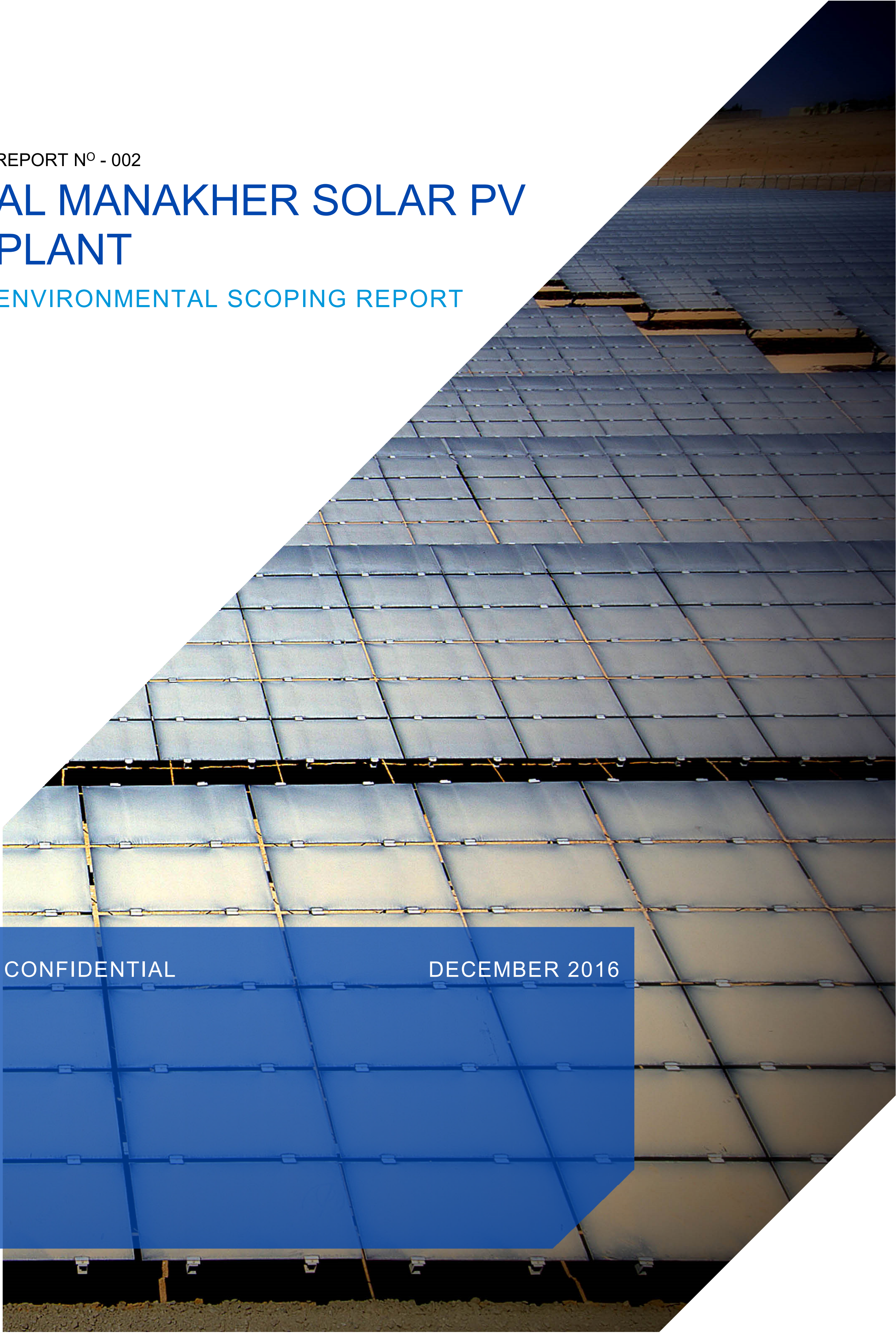
APPENDIX A-1

SCOPING REPORT

REPORT Nº - 002

AL MANAKHER SOLAR PV PLANT

ENVIRONMENTAL SCOPING REPORT



CONFIDENTIAL

DECEMBER 2016

AL MANAKHER SOLAR PV PLANT

ENVIRONMENTAL SCOPING REPORT

AES

Confidential

Project no: 52001890
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ABBREVIATION LIST

ABBREVIATION	DEFINITION
CEMP	Construction Environmental Management Plan
dB	Decibels
DoA	Department of Antiquities
EBRD	European Bank for Reconstruction and Development
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
EMS	Environmental Management System
EPC	Engineering, Procurement and Construction
FAA	Federal Aviation Authority
GDP	Gross Domestic Product
IFC	International Finance Corporation
ILO	International Labour Organisation
ISO	International Organisation for Standardisation
IUCN	International Union for Conservation of Nature
Km	Kilometres
MCM	Million cubic meters
MEMR	Ministry of Energy and Mineral Resources
MoE	Ministry of Environment
MoH	Ministry of Health
MW	Mega Watt
NEXI	Nippon Export and Investment Insurance
OEMP	Operational Environmental Management Plan
OHS	Occupational, Health and Safety
OHTL	Overhead Transmission Line
O&M	Operations and Maintenance
OPIC	Overseas Private Investment Corporation
PEA	Preliminary Environmental Assessment
PM	Particulate Matter
PPE	Personal Protective Equipment
PS	Performance Standard
PV	Photovoltaic
SEP	Stakeholder Engagement Plan
SMBC	Sumitomo Mitsui Banking Corporation
ToR	Terms of Reference
TSP	Total Suspended Particulates
WBG	World Bank Group
WHO	World Health Organisation

EXECUTIVE SUMMARY

BACKGROUND

This Environmental Scoping report has been prepared by WSP | Parsons Brinckerhoff for AES Jordan (“the Developer”) in association with Royal Scientific Society of Jordan, a locally registered environmental consultant.

AES Jordan, in consortium with Mitsui and Company Ltd, is seeking permission to construct and operate a solar photovoltaic (PV) farm of up to 50 MW at a site approximately 2-3 km east of the existing IPP4 Al-Manakher tri-fuel power plant in Jordan.

In order to obtain environmental authorisation for the proposed Al Manakher Solar PV Plant (“the Project”), AES is required to complete an appropriate Environmental (and Social) Impact Assessment (EIA or ESIA) and Environmental and Social Management Plan (ESMP). These are to be completed in accordance with Jordanian environmental requirements and international best practice, including the World Bank and International Finance Corporation (IFC) Performance Standards (PS), in addition to other potential lenders’ requirements including Overseas Private Investment Corporation (OPIC), Nippon Export and Investment Insurance (NEXI) and Sumitomo Mitsui Banking Corporation (SMBC).

The ESIA, when completed, will need to be approved, not only by the organisation(s) potentially involved in financing the project, but primarily through the Ministry of Environment (MoE) in Jordan, the authority responsible for environmental permitting.

An initial preliminary environmental assessment (PER) and Terms of Reference (ToR) Report was produced by WSP | Parsons Brinckerhoff in 2015. It is understood that this Report was not reviewed by MoE until the Project had been granted ministerial approval. It is understood that the Project has successfully been granted cabinet approval within Jordan during the fourth quarter of 2016 and, following this achievement, AES are now required to complete an environmental impact assessment (EIA) for the Project as part of the regulatory process.

This Scoping Report provides an overview of the Project and identifies the key environmental issues which will need to be assessed in accordance with MoE requirements and anticipated international lender requirements. A separate and accompanying ToR report has been developed in parallel with this Scoping Report; both reports are to be considered as separate; however they are written as complementary reports in accordance with the MoE submission requirements.

During the preparatory work undertaken in 2015, AES Jordan, the developer, invited a representative group of stakeholders (35 in total), which were approved by the MoE, to a scoping session to discuss the Project in Amman in November 2015. Of the 35, 17 representatives from 14 stakeholder groups attended. Attendees and key points discussed within this meeting are provided within the appendices, taking into account the issues discussed within the accompanying ToR as appropriate.

PHOTOVOLTAIC TECHNOLOGY AND GENERATION OF ELECTRICITY

Solar energy facilities use photovoltaic (PV) technology to convert solar energy to electricity. This form of energy production leads to much smaller quantities of greenhouse gases over its operational lifecycle when compared to conventional power sources such as coal-fired power stations, The main source of emission is largely associated with cleaning activities or panel production or disposal. The operational phase of the solar facility does not produce other pollutants commonly associated with fossil fuel combustion such as carbon dioxide (CO_2), sulphur dioxide (SO_2), nitrogen oxides (NO_x) or particulate matter (PM).

COMPONENTS OF THE PV MODULES

The PV cells are devices that are comprised of semiconductor materials that convert sunlight directly into electricity. When solar cells absorb sunlight, free electrons are created at positive/negative junctions. If the positive and negative junctions of the solar cell are connected to Direct Current (DC) electrical equipment, electricity is generated.

GENERIC ISSUES GENERATED BY PV TECHNOLOGY

PV technology consists of PV panels that are designed to maximise absorption of light and minimise reflections. PV technology is deployed in two main forms:

- Roof-mounted panels providing electricity to buildings; and
- Stand-alone 'farms' of up to several thousand panels, supplying electricity to the grid.

PV panels are constructed from specially treated low-iron glass, designed to minimise reflection and maximise transmission of light through the glass.

PV panels are low rise structures, with varying development standards but most commonly the panels are restricted to a height of fourteen (14) feet. PV panels do not generate sufficient electromagnetic energy to act as a source of electromagnetic interference other than at very short range and in the immediate vicinity of the panels. Transformer units at PV panel sites may generate electromagnetic fields in their immediate vicinity; the impact of this can be addressed through shielding, filtering and suppression measures.

The potential for glint (a momentary flash of bright light) and glare (a reflection of bright light for a longer duration) caused by sunlight reflected off the panels is one of the few issues associated with the operation of PV panels. According to the US Federal Aviation Authority (FAA), glint and glare as reflection is a common phenomenon, especially off bodies of water or in the form of glare from the sun itself. However, it is mainly a concern for projects which are sited in close proximity to airports.

PROJECT OVERVIEW

The Government of Jordan is promoting the generation of renewable energy by adopting a renewable energy strategy. The strategy has set a 10% renewable energy target by 2020. The Renewable Energy and Energy Efficiency Law permits the Ministry of Energy and Mineral Resources (MEMR) to request proposals for the development of renewable energy projects.

The Project site is located within the Sahab District in the Amman Governorate, approximately 2.5km north east of the Levant Power Plant (IPP4) which was built, and is operated by, AES Jordan. The Project site is government-owned and has a proposed footprint of 498,000 m^2. The nearest residential properties are in Al-Manakher village, located approximately 2-3km to the south west of the Project boundary.

With the exception of the existing IPP1, 3 and 4, there is no industries in the immediate vicinity of the Project site. The Project site is clear of structures and has been subject to recent earthworks by the Ministry of Land. There is very sparse indigenous vegetation on-site and the Project site is not known to contain any sensitive flora or fauna.

To the south and east of the Project site, there are a limited number of temporary agricultural dwellings belonging to Bedouin families. These groups use the land primarily for grazing livestock.

The power produced by the Project will be purchased under a power purchase agreement (PPA) with NEPCO who will also be responsible for the construction of the transmission line between the proposed Al Manakher site and the substation at IPP4 (approximately 2km along the roadway).

OBJECTIVES OF THE REPORT

The primary objective of this report is to ensure that the key environmental and social issues associated with the proposed Al Manakher Solar PV Plant are identified at an early stage, so that the necessary mitigation and management measures can be incorporated into the project design. The accompanying terms of reference (ToR) report also sets out the proposed ToR for the EIA.

It is noted that, typically international lenders denote these studies as ESIAs for Projects, stressing that social aspects should also be appropriately considered in addition to environmental. While this report uses the terminology 'EIA' throughout in order to be consistent with Jordanian MoE terminology; the assessment has considered the requirements of the lender banks and can be considered an 'ESIA' with respect to the lenders.

OVERVIEW OF KEY IMPACTS AND ASSESSMENT METHODOLOGIES

AIR QUALITY

Construction phase impacts will be largely generic in nature and will be primarily associated with exhaust emissions and dust/particulate matter associated with construction traffic, excavations, levelling, mixing of raw materials, open storage of raw materials and stationary source emissions. While there may be some fugitive dust and debris during construction and panel cleaning (if compressed air is used), these will be highly localised, having a negligible impact on the surrounding air quality.

The most recent air quality monitoring undertaken within the vicinity of the Project site was at the nearby IPP4 site in 2011. The monitoring results gathered indicated that the ambient air quality does not exceed the World Bank / IFC EHS Guideline for NO_2, or Interim Target 1 for SO_2. One exceedance of Interim Target 1 for PM_{10} was observed during the monitoring period, which may be attributable to the region's high levels of particulate.

As also identified within the approved ESIA prepared for IPP4, there are no other known major sources of air pollution within the general area of the Project site; therefore, air quality at the Project site is expected to be within national and international ambient limits. During operation, no significant air quality impacts are anticipated, as the PV panels will not emit any emissions or pollutants.

NOISE

Noise will also be generated during construction, installation and, to a much lower extent, during any required maintenance activities. The principal activities associated with the generation of noise during construction include:

- Site preparation;
- Civil works;
- Construction; and
- Operation of on-site equipment.

The PV plant designer is required to install the equipment according to the requirements of the manufacturer to ensure it can operate within its design parameters and to prevent excessive (audible) noise.

Solar PV systems are static generators of electricity; hence, during operation PV modules do not generate any audible sound. However, inverters need cooling by fans or air conditioning, which can generate some levels of noise. Noise is not expected at night when PV generation is off; any noise emitted at night as a result of the Project will be associated with the limited security movements on site. Noise intensity is correlated to the inverter power and to its design characteristics.

Noise levels from the construction and operation of the facility will predominantly be considered as qualitative, subject to the sensitive receptor locations and quantitatively (using the CadnaA noise modelling software if appropriate). The outcomes of the noise assessment will be compared to the existing baseline noise levels and against the Jordanian requirements and the World Bank Group EHS standards with the main aim to determine the likely impacts with particular reference to nearby sensitive receptors.

WASTE AND HAZARDOUS MATERIALS MANAGEMENT

Generation of solid waste as a result of the Project will only occur during the construction, installation and decommissioning stages. Small quantities of waste materials will be produced at the installation stage as the PV cell modules are packaged for transportation and handling, together with damaged panels from of transit or installation.

During construction, any spoil generated onsite (likely to be relatively limited as land clearance / improvement works have already been undertaken) will be reused as fill material for earthworks on site (e.g. bank construction and landscaping). Any material not required will be removed and disposed of offsite to appropriate facilities ideally for reuse or disposal by a licensed waste contractor.

The options for waste management including the reuse of waste, recycling and offsite disposal will depend upon the locally available infrastructure. The status of available waste management infrastructure at a local and regional level will be considered within the EIA (where information is publicly available).

The quantity and composition of the waste streams generated during construction and operational phases of the proposed Project will be estimated. It is anticipated that this process will be considered further through the development of waste management plans by the EPC Contractor within the accompanying detailed Construction Environmental Management Plan (CEMP) and operator within the Operational Environmental Management Plan (OEMP).

SOIL, HYDROLOGY AND WATER QUALITY

During construction, potential impacts to soil, geology and groundwater on and beneath the Project site may occur due to:

- Excavation for foundations, temporary site compound, onsite roads and crane pads;
- Onsite machinery;
- Overhead / underground cable laying;
- Change in drainage patterns due to construction of new roads; and
- Surface water run-off from construction areas and wastewater from facilities onsite.

Solar PV panels will require periodic cleaning to maintain efficiency in power generation. At present, it is envisaged that the cleaning will be undertaken through the use of soft brushes and without the use of water. This has the considerable advantages of saving water in a country with poor water resources, in addition to minimising potential impacts to soil and groundwater.

During operation, potential impacts from the Project site on water resources are unlikely although they may occur as a result of accidental spills and leaks of fuel and oil from maintenance activities.

The EIA will consider the source of water to be used for construction and operational activities as well assessing programmes for water use minimisation, water treatment, water reuse and disposal options. Issues associated with water use and local water resources will be based on baseline information gathered during site visits in order to confirm existing drainage, local wadis and potential receptors for spills.

The proposed methodology for the management and disposal including potential reuse of the wastewater streams from the construction and operational phases will also be assessed against local and international standards and recognised best practices.

TERRESTRIAL ECOLOGY

The ecological studies undertaken for the nearby IPP4 site assessed the direct and indirect impacts of construction, operation and decommissioning phases of the Project on the terrestrial biological environment. The ecological studies included consideration of the Bio-Geographical Zone in which the PV Solar Project is also located with respect to the presence of fauna and flora. No significant impacts were identified within the IPP4 development and with the land already having been cleared at the PV site. Notwithstanding this, the EIA will seek to confirm the surrounding flora and fauna in the area through a combination of walkovers by ecologists and consideration of available information. Potential impacts on ecology can include habitat loss, fragmentation, impacts on designated areas and disturbance or displacement of protected or vulnerable species. The baseline survey will be undertaken to ensure that potential impacts on undisturbed natural habitat or sensitive habitats are identified early on and key receptors of relevance to each site. The EIA will also determine whether the scope of impacts may have changed due to landscape and biodiversity changes since the last study was undertaken.

Vegetation control is an important task for solar PV power plants during operations. Vegetation (for example, long grass, trees or shrubs) has the potential to shade the modules and reduce performance. Prudent grounds keeping can also reduce the risk of soiling on the modules from leaves, pollen or dust. However, as the site has already been cleared by the Ministry of Finance, biodiversity is likely low, this issue is expected to be insignificant.

SOCIO-ECONOMIC

The Project is located to the east of Amman in the Sahab District near Al-Manakher village. The Project site lies in a sparsely populated area. The nearest residential properties are within the Al-Manakher village to the south west the Project boundary although several other villages lie within 0-6 km of the site and which may have an interest in the Project. There is some evidence of both arable and livestock activity in the local area including olive plantations, wheat crops and goat herds, but this is on a small scale only and the area is not one which is dominated by significant agricultural landholdings. The land considered for the PV site is fully owned by the government (Ministry of Finance) and has already been cleared so impacts upon agricultural land are expected to be minimal.

WORKER WELFARE

During construction, it must be ensured that the labour and working conditions are of an acceptable standard. In order to fully recognise the local benefit of the plant, emphasis will need to be placed on hiring and training local workers. The proposed EPC Contractor (Wärtsilä) previously worked on the IPP4 project and had a local employment policy, with workers living in their own accommodation and being transported to site. It is anticipated that a similar arrangement will take place for the proposed Project.

If any housing is provided it must be adequately designed with adequate sanitary and safety facilities. Overall, in assessing worker welfare standards as relates to proposed housing facilities, consideration will be given to local legislation and international best practice; in particular, the requirements of the Jordanian Labour law. Similar to the construction phase, a potentially positive economic impact will result from any local employment created by the operational phase of the proposed Project although manpower requirements during construction are likely to be low.

An established grievance mechanism that the developer will be necessary as part of the Environmental and Social Management System (ESMS) and Stakeholder Engagement Plan (SEP).

CULTURAL, HERITAGE AND ARCHAEOLOGY

Following an initial site reconnaissance, it is deemed that the proposed footprint area and its immediate vicinity do not support any archaeological or cultural features and, as noted previously, the site has already been cleared and levelled by the Ministry of Finance; however a review of available information will be undertaken in the course of the EIA process.

The EIA will subsequently identify the main activities during the construction phase of the proposed project that may have the potential to impact upon buried archaeological remains including but not limited to excavation activities. This exercise will be complemented by the establishment of watching brief guidance.

No impacts during the operational phase of the proposed project are expected.

LANDSCAPE AND VISUAL

The proposed Project footprint area supports a wider area land already dedicated to electricity generation, with several thermal power plants present in the general vicinity. Impacts associated with the construction phase of the proposed Project may result from unsightly construction areas or activities. General site management, appropriate hoarding and landscaping could be used to improve the aesthetics of the overall construction site. Glint or glare will be addressed during design (selection of anti-reflection modules, siting of modules etc.); therefore, it is not considered a significant impact during operation.

The EIA will assess the planned construction activities and project design that may negatively impact on the landscape character or value.

The solar PV arrays proposed will be subject to review to identify if glint or glare is expected and identify measures to minimise and / or avoid the impacts. The review will consider the panel alignment and angle expected (initially anticipated that the panels will be aligned facing south (180°) at an angle of 15-20 degrees to the horizontal).

Where appropriate, consideration will be made across an entire year with identification of the key receptors, which may be impacted upon, through a combination of satellite review, consultations and site walkovers.

CONSTRUCTION AND OPERATIONAL ENVIRONMENTAL MANAGEMENT PLANS

One of the most widely used environmental management systems, developed by the International Organisation for Standardisation (ISO), is the ISO 14001 standard for environmental management of activities, services and products.

Within the EIA, framework construction and operational environmental management plans will be provided which will provide the basic structures of management plans on site, incorporating the fundamentals of typical Environmental Management Systems (EMS) certified to ISO 14001. It is anticipated that the EPC and operation and maintenance (O&M) contractors will be respectively responsible for further developing the construction and operational environmental management plans prior to commencing work on these phases. All management plans are considered to be 'live' documents and will necessitate regular review and updating. .

CONCLUSION / EIA NEXT STEPS

Following review (and subsequent approval) of the Scoping and accompanying ToR by MoE, WSP | Parsons Brinckerhoff in collaboration with RSS, will initiate the EIA process, as outlined within the ToR. This will be undertaken with consideration of applicable Jordanian laws and regulations primarily in addition to international best practices such as IFC Performance Standards and lender banks' (including OPIC, NEXI and SMBC) requirements are fully met. Where standards differ between national and international standards, the most stringent standards will be applicable.

1 INTRODUCTION

This Scoping report and accompanying Environmental and Social Impact Assessment Terms of Reference (ToR) report, which will be submitted in accordance with this document, has been prepared by WSP | Parsons Brinckerhoff (WSP | PB) with inputs from Royal Scientific Society (RSS) for AES. It has been developed to initiate the environmental permitting process associated with the proposed Al Manakher Solar PV Plant, herein referred to as the Project, in Jordan.

1.1 PROJECT TITLE AND PROJECT PROPONENT

AES, in consortium with Mitsui and Company Ltd, is seeking permission to construct and operate a solar photovoltaic (PV) farm of up to 50 MW at a site approximately 2-3 km from the existing IPP4 Al-Manakher tri-fuel power plant in Jordan.

In order to obtain environmental authorisation for the proposed Project, AES is required to complete an appropriate Environmental Impact Assessment (EIA) (termed an environmental and social impact assessment (ESIA) by lenders in order to highlight the social assessment required) and Environmental and Social Management Plan (ESMP) for construction. These are to be completed in accordance with Jordanian environmental requirements and international best practice, including the World Bank and International Finance Corporation (IFC) Performance Standards (PS), in addition to other potential lenders' requirements including NEXI, SMBC and OPIC. The EIA, when completed, will need to be approved, not only by the organisation(s) potentially involved in financing the project, but primarily through the Ministry of Environment (MoE) in Jordan, the authority responsible for environmental permitting.

1.2 SCOPING AND TOR CONSULTANT

WSP | PB has been appointed by AES to undertake the EIA for the Project in accordance with Jordanian EIA requirements and international lender banks.

WSP | PB has extensive experience working on power and energy projects in the Middle East including the preparation of ESIAs for wind projects in Jordan such as the Fujeij Wind Farm. WSP | PB has contracted RSS, a registered environmental consultant with the Ministry of Environment (MoE), as the subcontractor to the EIA.

TEAM COMPOSITION

The EIA team will comprise of technical specialists from WSP | PB and RSS in the following disciplines:

- Terrestrial Ecology;
- Soils, Geology and Groundwater;
- Noise;
- Air Quality;
- Waste;
- Landscape and Visual;
- Cultural Heritage / Archaeology;
- Transportation;

- Socio-economics and Stakeholder Engagement; and
- Occupational, Health and Safety.

1.3 OBJECTIVES OF THE SCOPING AND TOR

The primary objective of the Scoping and accompanying ToR report is to ensure that the key environmental and socio-economic impacts associated with the proposed Project are identified at an early stage; in order for them to be appropriately considered within the assessment and allow the necessary mitigation and management measures to be incorporated into the project design.

The Scoping process follows the guidelines set out by the Jordanian EIA law and has been prepared according to local and social requirements and in accordance with international best practice.

The Scoping and accompanying ToR report have the following primary objectives:

- The identification of the key environmental and socio-economic constraints and opportunities associated with the proposed Project;
- The determination of the primary environmental and socio-economic issues to be discussed within the EIA and scoping out of issues which are unlikely to be significant;
- The identification of relevant local, national and international environmental and social standards;
- The identification of relevant environmental planning policies and existing facilities which may conflict with the proposal;
- The identification and evaluation of the baseline environmental conditions in order to provide a basis for assessing the incremental impacts of the proposed Project including existing and future environmental and social impacts;
- The establishment of assessment criteria for each of the environmental and socio-economic impacts;
- The identification of further required studies, modelling, investigations and environmental and social assessment for the study area; and
- The identification of any additional regulatory approval and government policies that would need to be addressed within the EIA.

1.4 THE STRUCTURE OF THE SCOPING REPORT

The Scoping Report is divided into the following Chapters:

- Executive Summary;
- Chapter 1 – Introduction;
- Chapter 2 – Project Description;
- Chapter 3 – Legal Framework and Environmental and Social Standards;;
- Chapter 4 – Stakeholder Consultations;
- Chapter 5 - Preliminary Environmental and Social Assessment; and
- Chapter 6 – Project Alternatives.

In addition, the Scoping and accompanying ToR reports are structured around the following components outlined in Table 1-1 and addresses the requirements outlined in Section 3.4.1.4.5 in MEMR's "Instruction and Requirements for Proposal Preparation and Submission (IRPP) for PV Power Projects -Transmission Grid Connected".

Table 1-1 Scoping and ToR Chapters which Address MEMR IRPP Requirements

MEMR IRPP CONTENT REQUIREMENTS	PEA CHAPTERS WHICH COVER IRPP REQUIREMENTS
Identification of the key environmental constraints and opportunities	■ Chapter 5: Preliminary Environmental and Social Impact Assessment
'Scoping' out of any issues unlikely to be significant	■ Chapter 4: Stakeholder Consultations ■ Chapter 5: Preliminary Environmental and Social Impact Assessment
Identification of relevant local, national and international environmental standards and legal requirements	■ Chapter 3: Legal Framework and Environmental and Social Standards
Identification of relevant environmental planning policies	■ Chapter 3: Legal Framework and Environmental and Social Standards
Identification of the existing facilities and other proposals for the area which may conflict with the proposals	■ Chapter 2: Project Description ■ Chapter 7: Project Alternatives
Identification and evaluation of the baseline environmental conditions in the area to provide a basis for assessing the incremental impact of the development including existing pollution levels and nuisances	■ Chapter 5: Preliminary Environmental and Social Impact Assessment
Establishment of assessment criteria for each of the environmental issues	■ ToR
Identification of areas where data required for the study is lacking or insufficient	■ Chapter 5: Preliminary Environmental and Social Impact Assessment and ToR
Identification of further required studies, modeling, investigations and environmental assessment for the study areas	■ ToR
Identification of any additional regulatory approval and government policies that need to be addressed	■ Chapter 3: Legal Framework and Environmental and Social Standards

1.5 PUBLIC CONSULTATION AND STAKEHOLDER ENGAGEMENT

SCOPING SESSION AND FINDINGS

In response to MoE's request, a scoping session was held on 5 November 2015 in Amman. AES Jordan. The Developer, invited a representative group of stakeholders (35 in total), approved by the MoE, to this scoping session. Of the 35, 17 representatives from 14 stakeholder groups attended. A list of the attendees is attached as Appendix 1 - A1. WSP | PB, with support from the appointed sub-consultant RSS, facilitated the session.

Feedback from the scoping session is provided in Appendix 1 – A2. The key findings of the scoping session have been incorporated into the identification of key receptors and the determination of potential environmental and social impacts outlined in Chapter 5 of this report. These will be addressed during the baseline surveys/specialist studies to be undertaken as part of the EIA.

Chapter 4: Stakeholder Consultations in this report provides a detailed description of the scoping session including feedback and findings obtained from the attendees.

DEVELOPMENT OF A STAKEHOLDER ENGAGEMENT PLAN

Stakeholders will be consulted on an on-going basis during the EIA process and issues and concerns will be recorded and incorporated into the process for evaluation. The format for this on-ongoing consultation will be in the form of a Stakeholder Engagement Plan.

An outcome of the ESIAs for the IPP1 and IPP4 are the development of project-specific Stakeholder Engagement Plans (SEP). These SEPs were prepared based on scoping and consultations that were undertaken for each project. The SEP for IPP4 (as outlined in the project's ESIA) recommended that the Sponsor establish a Community Liaison Committee and undertake a number of community related initiatives.

During the scoping session in November 2015, the mayor of Al Manakher village confirmed that a Committee was established and some of these initiatives are ongoing. In order to build on these existing initiatives, it is considered that the SEP for the Project will need to take account of the existing SEPs for IPP1 and IPP4 and ensure that consultations, ongoing engagement (and community initiatives) as appropriate complement the existing strategies currently being undertaken.

The Developer will engage with the MoE to discuss whether the option to develop one SEP to cover the three power plants as opposed to an additional Project specific SEP is advisable. The SEP will be included as an Appendix to the EIA.

2 PROJECT DESCRIPTION

2.1 OVERVIEW

The Government of Jordan is promoting the generation of renewable energy by adopting a renewable energy strategy. The renewable energy strategy has set a target of achieving 10% of total generation capacity within Jordan being through renewable sources by 2020. The Renewable Energy and Energy Efficiency Law permits the Ministry of Energy and Mineral Resources (MEMR) to request proposals for the development of renewable energy projects. Following the cabinet approval of the Project, AES Jordan will submit this Scoping and the accompanying ToR report to MoE, the regulatory agency responsible for environmental approval.

2.2 PROJECT SITE DESCRIPTION

2.2.1 PROJECT SITE LOCATION

The Project site is located within the Sahab District in the Amman Governorate, approximately 2.5 km northeast of the Levant Power Plant (IPP4) built and operated by AES Jordan. The site has a proposed footprint of 498,000 m^2 of government-owned land (refer to Figure 2-1). The nearest residential properties are in Al-Manakher village to the south west of the Project boundary, although two other communities reportedly are present (following discussions with AES community liaison personnel at IPP4) within approximately 10 km who may also have interests in the project.

With the exception of the existing IPP1, 3 and 4 (refer to Figure 2-1); there is no industry in the immediate vicinity of the Project site. The site is clear of structures and has been subject to recent earthworks by the Ministry of Finance. There is very sparse indigenous vegetation on-site and the Project site and surrounding area are not known to contain any sensitive flora or fauna.

To the south and east of the Project site, there are a limited number of agricultural dwellings belonging to Bedouin families. These groups reportedly use the land primarily for grazing livestock.

Figure 2-1 Proposed Project Site Location and OHTL Interconnection and Cable Routing

2.2.2 KEY SENSITIVE RECEPTORS

As described above, the proposed Project footprint area has already been cleared and prepared by the Ministry of Finance, and is located within a wider area which has been planned for electricity generation.

The nearest existing anthropogenic receptors, other than personnel employed on the adjacent power plant facilities, would be the permanent residents of the near by Al Manakher village and offices for workers currently employed for IPP1 and 4.

Following a site reconnaissance, desk based review and scoping session, the following key sensitive receptors (refer to Table 2-1) and potential impacts associated with the construction and operational phases of the proposed project have been identified.

Table 2-1 Key Receptors and associated impacts

RECEPTOR	POTENTIAL CONSTRUCTION IMPACTS	POTENTIAL OPERATION IMPACTS
Residents at Al Manakher and other communities	→ Disturbance from construction traffic and staff → Noise and air quality impacts associated with construction activities on the residents of Al Manakher → Increased revenue for local businesses due to retail activities → Increased demand for local services → Potential employment opportunities	→ Social impacts associated with the presence of Plant personnel
Construction workers	→ Health and Safety Risks → Recruitment and Employment → Worker Welfare → Exposure to noise and air pollutant emissions	→ None identified
Al Manakher Plant personnel	N/A	→ Health and Safety Risks → Worker Welfare → Exposure to noise pollutants
Terrestrial habitats and associated flora and fauna	→ Contamination events impacting on the terrestrial ecology → Damage to flora located on the adjacent areas → Dewatering activities (if necessary) may reduce groundwater level outside of the project footprint area, impacting on the ability of local species to source water from this resource	→ Potential positive impacts associated with landscaping provisions providing suitable terrestrial habitat
Soil and groundwater	→ Contamination events impacting on ground and groundwater quality	→ Contamination events impacting on ground and groundwater quality

RECEPTOR	POTENTIAL CONSTRUCTION IMPACTS	POTENTIAL OPERATION IMPACTS
Socio-economic	→ Positive socio-economic impacts through employment opportunities for local community members and skills transfer	→ Positive socio-economic impacts through employment opportunities for local communities, skills transfer and power supply

2.3 DESCRIPTION OF THE PLANT

The proposed PV solar plant is designed to have a capacity of approximately 40 - 50 MW. The final capacity of the solar PV plant will be confirmed during the detailed design stage although will be contained within the defined Project site boundaries. The PV modules will be located throughout the project site and will be arranged to maximise solar gain. Approximately 22 inverters (numbers to be confirmed) will be utilised at the site in order to convert the electricity from direct current (DC) to alternating current (AC).

The entire Project site will be fenced and internal access roads will be constructed to allow access during operation for washing and maintenance of modules. In addition, there is no onsite storage of electricity proposed at the Project site; all electricity generated will be transmitted to the substation adjacent to the IPP4 project site for use and/or distribution to the electricity network.

2.3.1 PROJECT LAYOUT

Figure 2-2 illustrates the general layout of the proposed Project in relation to the existing power plant facilities, including IPP1, 3 and 4. The site was selected based on several criteria including:

- Solar resource;
- Available area;
- Topography;
- Land use;
- Local regulations/land use policy and zoning;
- Geotechnical conditions;
- Accessibility;
- Grid connection;
- Module soiling; and
- Financial incentives.

PHOTOVOLTAIC TECHNOLOGY AND GENERATION OF ELECTRICITY

Solar energy facilities use photovoltaic (PV) technology to convert solar energy to a useful form such as electricity or heat. This technology produces significantly smaller quantities of greenhouse gases over its lifecycle compared to conventional fossil fuel-fired power stations. The operational phase of the solar facility does not produce other pollutants commonly associated with fossil fuel combustion such as: carbon dioxide (CO_2), sulphur dioxide (SO_2), nitrogen oxides (NO_x) mercury and particulate matter (PM).

COMPONENTS OF THE PV MODULES

Solar or PV cells are devices comprised of semiconductor materials that convert sunlight directly into electricity. When solar cells absorb sunlight, free electrons are created at positive/negative junctions. If the positive and negative junctions of the solar cell are connected to DC electrical equipment, current is generated for use. It is anticipated that the PV panels will be monocrystalline modules, sourced from a ‘Tier 1’ supplier (e.g. considered as ‘preferred supplier’ by international lenders due to quality of panels produced, financial stability and other ‘bankability’ criteria understood to comprise JA Solar, with inverters to be provided by ABB). The panels will be on a fixed mounting with no trackers, minimising the moving parts to be utilised within the design.

Figure 2-2 General Layout of the Project Site and Existing Infrastructure

GENERIC ISSUES GENERATED BY PV TECHNOLOGY

PV technology consists of PV panels, which are designed to maximise absorption of light and minimise reflections. PV technology is deployed in two main forms:

- Roof-mounted panels providing electricity to buildings; and
- Stand-alone 'farms' of up to several thousand panels, supplying electricity to the grid.

PV panels are constructed from specially treated low-iron glass, designed to minimise reflection and maximise transmission of light through the glass.

Standards vary but most commonly, the panels in a solar plant are restricted to a height of fourteen (14) feet. PV panels do not generate sufficient electromagnetic energy to act as a source of electromagnetic interference other than at very short range and in the immediate vicinity of the panels. Transformer units at PV panel sites may generate electromagnetic fields in their immediate vicinity though this is typically addressed through standard shielding, filtering and suppression measures.

The potential for glint (a momentary flash of bright light) and glare (a reflection of bright light for a longer duration) caused by sunlight reflected off the panels is one of the few issues associated with the operation of PV panels. According to the US Federal Aviation Authority (FAA), glint and glare as reflection is a common phenomenon, especially off bodies of water or in the form of glare from the sun itself.

2.3.2 PLANT DESIGN CRITERIA

The design of the proposed Solar PV Plant will be in accordance with internationally recognised engineering standards and practices in order to ensure efficient, high reliability, maintainability and availability of the complete plant, with panels being provided by a Tier 1 supplier.

The mounting system has not yet been finalised for the Project, although the panels will have a single axis and non-tracking.

SELECTION OF SOLAR CELLS

PV cell technologies are broadly categorised as either crystalline or thin-film. Crystalline silicon (c-Si) cells provide high efficiency modules and are sub-divided into mono-crystalline silicon (mono-c-Si) or multi-crystalline silicon (multi-c-Si). Mono-c-Si cells are generally the most efficient, but are also more costly than multi-c-Si. Thin-film cells provide a cheaper alternative, but are less efficient. There are three main types of thin-film cells: Cadmium Telluride (CdTe), Copper Indium (Gallium) Di-Selenide (CIGS/CIS), and Amorphous Silicon (a-Si).[1] The Project will utilise monocrystalline panels.

The performance of a PV module will decrease over time due to a process known as degradation. The degradation rate depends on the environmental conditions and the technology of the module.

2.3.3 ELECTRICAL INTERCONNECTION

The proposed solar PV project shall be connected to the IPP4 site via four (4) AC power circuits operating at 15 kV and up to 15 MW (AC) each at the point of connection. The Overhead

[1] Utility-Scale Solar Photovoltaic Power Plants: A Developer's Guide, IFC, 2015.

Transmission Line (OHTL) shall be routed from the Project site to IPP4 along the shoulders of the east-west paved road (refer to Figure 2-2). The OHTL shall be routed underground within IPP4 site into the existing switchgear facility.

The OHTL shall conform to all applicable regulations, be installed on concrete or steel poles and of double circuit configuration with a ground conductor and fibrotic communications.

2.4 EXISTING PROJECT STATUS

The proposed Project will be developed using an Engineering, Procurement and Construction ("EPC") model. The EPC Contractor is likely to be Wärtsilä, the contractor who also recently completed the IPP4 project works.

3 LEGAL FRAMEWORK AND ENVIRONMENTAL AND SOCIAL STANDARDS

3.1 REGULATORY BODIES

3.1.1 MINISTRY OF ENVIRONMENT

Article 13 of the Environmental Protection Law No. 52 of 2006 is the main regulation related to the protection and preservation of the environment within Jordan.

Law No. 52 empowers the Ministry of Environment (MoE) to ask any new establishment that may have potential impacts on the environmental to prepare an EIA, also known internationally as an ESIA.

The terms EIA and ESIA are used interchangeably within this report, although the term EIA has been preferentially used in consideration of Jordanian terminology. With respect to the contents of EIA and ESIAs these are considered comparable, with ESIAs simply highlighting that social aspects are a key consideration within the assessment process (and is the acronym often used within lender bank requirements for projects). The MoE has issued the EIA by-law (No. 37, 2005) which includes the procedures for conducting an EIA in Jordan. The law gives the MoE responsibility to review and approve the ToR and EIA study reports.

3.1.2 RELEVANT GOVERNMENT AGENCIES

The following government agencies also play a role in providing permits required to construct and operate the project:

- Department of Antiquities;
- Water Authority;
- Department of Land and Survey;
- Ministry of Housing and Public Works;
- Ministry of Energy and Mineral Resources;
- Ministry of Labour; and
- Directorate of Civil Defence.

3.2 EIA PERMITTING PROCESS

Projects are passed to the EIA Directorate and submitted to a central licensing committee that consists of representatives of the relevant governmental authorities such as the MoE, Ministry of Health (MoH), Ministry of Water (MoW) and Ministry of Agriculture (MoA). An approval from the committee is required for licensing, the approval of which may have conditions attached, before the relevant authorities can grant permission.

The Project proponent is required to comply with article (3) of the Environmental Protection Law (No. 52, 2006) and with the Jordanian Environmental Impact Assessment (EIA) Regulations (No.37, 2005). The regulation states that all industrial projects should conduct an EIA study and the level and type of the EIA study will be decided by the MoE. A scoping session is required to prepare the ToR. This Regulation also states that the EIA review period for the MoE is 45 calendar days.

The findings of the EIA study will be presented in an EIA Report for submission to the MoE and relevant financial institutions. The EIA Report will consider alternatives to the Project including site location and layout, potential impacts and recommended mitigation measures for the project.

3.3 RELEVANT ENVIRONMENTAL LEGISLATION

The following Jordanian laws and regulations on environmental and social matters are most applicable to the Project:

Table 3-1 Jordanian Laws and Regulations

CATEGORY	LAW AND REGULATION
General	■ Exemption of Renewable Sources of Energy Systems and Apparatus and Energy Efficiency Bylaw (No. 10, 2013) (tax exemptions) ■ Renewable Energy and Energy Efficiency Law (No. 13, 2012) ■ Environmental Protection Law (No. 52, 2006) ■ Environmental Impact Assessment By-Law (No. 37, 2005) ■ General Electricity Law (No. 64, 2002) ■ Regulation of the Organisation and Administration of the Ministry of Energy and Mineral Resources (No. 26.1985)
Terrestrial Ecology and Ornithology	■ Nature Protection Regulations (No. 52, 2006) ■ Natural Reserves and Parks Bylaw (No. 29, 2005) ■ Jordanian Agricultural Law (No. 44, 2002)
Geology, Soils and Groundwater	■ Water Resource Protection By-Law (No. 85, 2011) ■ Drinking Water Resources Protection Guidelines (2006) ■ Soil Protection Regulations (No. 25, 2005) ■ Underground Water Monitoring By-Law (No. 85, 2002) ■ Water Authority Law (No. 18, 1988)
Noise and Vibration	■ Guidelines for Prevention of Noise (2003)
Air Quality	■ Ambient Air Quality (No. 1140, 2006) ■ Air Protection By-law (No. 28, 2005)
Waste	■ Management of Solid Waste Regulations (No. 27, 2005)

CATEGORY	LAW AND REGULATION
	▪ Management, Transport and Handling of Harmful and Hazardous Substances Regulations (No. 24, 2005) ▪ Instructions for Hazardous Waste Management and Handling (2003) ▪ Instructions for Management and Handling of Consumed Oil (2003)
Cultural Heritage / Archaeology	▪ Archaeology Law (No. 21, 1988)
Transportation	▪ Traffic Law (No. 49, 2008) ▪ Management, Transport and Handling of Harmful and Hazardous Substances Regulations (No. 24, 2005)
Socio-economics	▪ Labour Law (No. 14, 2004)
Health and Safety	▪ Public Health Law (No. 47, 2008) ▪ Civil Defence Law (No. 18, 1999)

3.4 LAWS AND STANDARDS RELATED TO LABOUR AND WORKING CONDITIONS

3.4.1 LABOUR LAW NO.14 OF 2004

The legal framework is mainly comprised of the Jordanian Labour Law of the year 1996 and its amendments. This Code repeals the Labour Code of 1960, and all amendments made thereto and governs labour affairs in Jordan.

The provisions of the law apply to all employees and employers as defined by Article 2 of the Law. Based on ratified Conventions, amendments to the labour law were adopted on 28 August 2002. These amendments concern:

→ The extension of the coverage of the labour law to some categories of workers in the agriculture sector;

→ Establishment of private employment offices organizing the recruitment of foreign domestic workers and control of these offices by labour inspectors. This will extend the control by the Ministry of Labour of the recruitment and working conditions of these workers;

→ The protection of workers from dismissal due to economic and technical factors by adoption of detailed regulation;

→ The regulation of working hours; and

→ The inter-relation between employers and workers' organisations.

The following Acts are also applicable:

→ Regulation No. 23 of 1966, as amended, issuing rules governing the public service defines individual labour relations, paid leave, compensation, temporary assignment and termination of service;

- Order of Minister of Labour to establish committees to study the cases of termination or suspension of contracts of employment on the basis of the provisions of section 31 of the Labour Code. This Order establishes committees in each governorate where there is a Directorate for work and employment, so as to study the cases of termination of contracts of employment for undetermined periods or cases of suspending such contracts for economic or technical reasons as provided for in section 31 of the Labour Code;
- Act No. 36 of 1997 concerning work permit fees for non-Jordanian workers, issued under Article 12 of the Labour Code of 1996. This Act provides for the fees to be paid by the employer for the delivery of work permits;
- Act No. 56 of 1996 concerning labour inspection, promulgated under Article 7 of the Labour Code;
- Industrial accidents and occupational diseases instructions of 1993. Instructions issued by the social security authority which prescribe the procedures to be observed in the event of such an accident, and provide for medical assistance to victims and financial compensation for disability resulting from an industrial accident or the contraction of an occupational disease; and
- Act No. 19 of 2001 on Social Security. This law provides for the establishment of the General Social Security Institution, which should provide social insurance for all workers under sixteen with certain exceptions (seafarers, domestic servants, agricultural workers). It deals also with labour injuries and occupational diseases, old age, disability and death benefits.

3.4.2 INTERNATIONAL LABOR ORGANISATION (ILO) CONVENTIONS

In addition, the ILO has a number of fundamental conventions to which Jordan has ratified and will apply to the Project including:

- Forced Labour Convention, 1930 (No. 29);
- 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);
- Minimum Age Convention, 1973 (No. 138); and
- Worst Forms of Child Labour Convention, 1999 (No. 182).

Jordan has not currently ratified the convention entitled '*Freedom of Association and Protection of the Right to Organise Convention*', 1948 (No. 87).

3.4.3 INTERNATIONAL STANDARDS FOR WORKERS' ACCOMMODATION

There are no comprehensive international regulations relating to worker's accommodation; however, there are legal and regulatory instruments and guidance in place such as those developed by the IFC and EBRD. The two institutions developed guidance material in August 2009 on *Workers' Accommodation: Processes and standards.*

The guidance note provides practical guidance on application of the appropriate policies related to provision of housing or accommodation for workers by employers, including minimum standards for the accommodation and the issues that arise from the planning, construction and management of such facilities.

The Guidance covers several stages to the process of addressing issues raised by workers' accommodation, including:

- Assessing whether housing is needed for the project and if so, what sort;

- Assessing impacts on local communities and planning mitigation of potential negative impacts; and
- Awareness of the national and local regulatory framework.[2]

ILO Recommendation 115 on Worker's Housing (1961) also provides guidance on what is expected from employers who provide housing to their employees and specified a number of housing standards.

3.5 INTERNATIONAL ENVIRONMENTAL AND SOCIAL PERFORMANCE STANDARDS AND GUIDELINES

The EIA will take into consideration International Financial Institution (IFI) Environmental and Social Standards and Good International Industry Practice (GIIP) for the development of the Project with the objective of producing an EIA compliant with both Jordanian and key lender requirements, these are described in more detail below.

EQUATOR PRINCIPLES

The Equator Principles (EP) consist of ten principles relating to environmental and social assessment and management. In addition, they include reporting and monitoring requirements for Equator Principles Financial Institutions (EPFIs). The EP set a financial industry benchmark that have been adopted by financial institutions for determining, assessing and managing environmental and social risk in projects. The Equator Principles were updated in 2013 and are now more colloquially known as EP III.

The EPs apply globally and to all industry sectors. The ten EPs address the following topics:

- EP1 - Review and Categorisation;
- EP2 - Environment and Social Assessment;
- EP3 - Applicable Environmental and Social Standards;
- EP4 - Environmental and Social Management System and Equator Principles Action Plan;
- EP5 - Stakeholder Engagement;
- EP6 - Grievance Mechanism;
- EP7 - Independent Review;
- EP8 – Covenants;
- EP9 - Independent Monitoring and Reporting; and
- EP10 - Reporting and Transparency.

IFC PERFORMANCE STANDARDS

For non-designated countries, which includes Jordan, the Equator Principles require the implementation of the associated IFC Performance Standards (PS), with the most recent iteration published in 2012[3] in addition to the World Bank Group Environmental, Health and Safety (EHS)

[2] http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:R115

[3] http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/performance+standards/environmental+and+social+performance+standards+and+guidance+notes

Guidelines. The eight PS comprise the following requirements that projects seeking finance from institutions signed onto the Equator Principles should comply with the following:

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

Compliance with the IFC performance standards in the assessment will not only ensure a socially and environmentally sustainable project but it is also envisaged that it will facilitate financing.

WORLD BANK GROUP ENVIRONMENTAL, HEALTH, AND SAFETY GUIDELINES

The General EHS Guidelines, 2012 is a technical reference document containing general and industry-specific examples of good international industry practice. The General EHS Guidelines contain guidance on environmental, health, and safety issues that are applicable across all industry sectors.

World Bank Group (WBG) EHS Guidelines include provisions for:

- Environment
  - Section 1.1 Air Emissions and Ambient Air Quality
    - Fugitive Sources
    - Mobile Sources - Land-Based
  - Section 1.3 Wastewater and Ambient Water Quality
  - Section 1.6 Waste Management
  - Section 1.7 Noise
- Occupational Health and Safety
  - Section 2.1 General Facility Design and Operation
  - Section 2.2 Communication and Training
  - Section 2.3 Physical Hazards
  - Section 2.7 Personal Protective Equipment
  - Section 2.9 Monitoring
- Community Health and Safety
  - Section 3.2 Structural Safety of Project Infrastructure
  - Section 3.4 Traffic Safety
  - Section 3.7 Emergency Preparedness and Response
- Construction and Decommissioning
  - Section 4.1 Environment
  - Section 4.2 Occupational Health and Safety

- Section 4.3 Community Health and Safety

No referenced sector-specific guidance has been published to date by the World Bank with respect to solar projects, although consideration will need to be made to relevant ancillary infrastructure guidelines as noted below. Where national and international guidelines differ, the Project will be required to adhere to the most stringent standard.

OTHER LENDER REQUIREMENTS

It is understood that, provisionally, Overseas Private Investment Corporation (OPIC), Sumitomo Mitsui Banking Corporation (SMBC) and Nippon Export and Investment Insurance (NEXI) have been identified as potential lenders to the project and the EIA will need to take account of the following requirements in addition to the EPs and IFC PS:

- Overseas Private Investment Corporation (OPIC) Environmental and Social Policy Statement (2010)4;
- OPIC Environmental Guidance on Renewable Energy – Solar Projects (2012)
- NEXI- Environmental Checklist: 15. Other Electric Generation[5]; and
- NEXI, Guidelines On Environmental And Social Considerations In Trade Insurance, 2015.

SMBC are understood to be an Equator Principles financial institution and effectively govern project financing decisions under the guidelines of the IFC Performance Standards and associated EHS Guidelines.

GUIDELINES RELATED TO ANCILLARY FEATURES

Other guidelines relevant to ancillary infrastructure (i.e. access roads, worker camps, transmission lines) include applicable provisions for:

- WBG EHS Guidelines for Electrical Power and Distribution; and
- ILO Recommendation 115 on Workers' Housing (1961).

[4] https://www.opic.gov/sites/default/files/consolidated_esps.pdf

[5] http://nexi.go.jp/en/environment/pdf/ins_kankyou15e.pdf

4 STAKEHOLDER CONSULTATIONS

4.1 SCOPING EXERCISE

REQUIREMENTS FOR SCOPING

For a project of this type in Jordan, it is a MoE requirement that an appropriate level of stakeholder engagement is undertaken, involving a range of parties with an interest in the environmental and social impacts associated with the Project. The MoE requires that a developer undertake a scoping session to obtain stakeholder views and concerns regarding the Project during its initial stage. Similarly, stakeholder engagement is a key element expected by the lender banks.

The objective of this scoping session is to inform stakeholders of the proposed development, the potential impacts and benefits associated with the Project's construction and operation, and the approach to be used to manage these impacts. The scoping session provides stakeholders with an opportunity to make comments and/or raise issues of concern. Questionnaires are used to obtain feedback to incorporate into the ToR and PEA.

OBJECTIVES OF SCOPING

Undertaking consultation at an early stage in the development of a Project is typically of most value particularly with respect to key authorities, statutory bodies, affected communities and other relevant stakeholders[6]. This is valuable in the assessment of project viability and may guide and increase the efficiency of the development process. Early consultation can also inform the design process to minimise potential environmental and social impacts and maintain overall sustainability of the project.

The principle objectives of scoping are to agree on the proposed site and:

- Identify the key environmental and socio-economic issues to be included in the EIA;
- Identify the legal requirements and framework for the Project over the course of its lifetime;
- Identify the relevant component studies to establish the relevant baseline for the Power Project;
- Finalise the proposed ToR; and
- Understand the concerns of the local community and stakeholders.

OUTLINE OF THE SESSION

In response to MoE's request, an official scoping session was held on 5 November 2015 at the Holiday Inn in Amman in accordance with MoE EIA Regulations. AES Jordan invited a representative group of stakeholders (35 in total), approved by the MoE, to the scoping session. A list of the invitees is attached as Appendix 1 – A1.

AES Jordan with support from WSP | PB and RSS delivered a presentation detailing the proposed project activities, facility and processes. Graphics and diagrams were included in the presentation,

[6] IFC, "Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets," 2007

which highlighted the importance of the Project, the potential environmental and social impacts, and the proposed methodology for the EIA. A copy of the presentation is attached as Appendix 1 – A2.

Participants were given the opportunity to provide their concerns in writing which were used to prepare the Scoping assessment. Appendix 1 – A3 contains a copy of the questionnaire that was provided to individual stakeholders prior to the session.

4.2 STAKEHOLDER IDENTIFICATION AND CONSULTATION

Of the 35 original invitees, 17 representatives from 14 stakeholder groups attended. A list of the attendees is attached as Appendix 1 – A4 and the Attendee Sign in Sheet is attached as Appendix 1 – A5.

FEEDBACK FROM THE SCOPING SESSION

In general, stakeholders had a positive reaction to the proposal due to the benefits the plant will provide and the fact that it is clean energy with minimal environmental impact. A summary of the key environmental and social issues raised by participants from the scoping session is provided in Appendix 1 – A5.

These key issues have been incorporated into the identification of key receptors and the determination of potential environmental and social impacts and methodologies within this Scoping report and accompanying ToR. These will be considered further during the baseline surveys/specialist studies and impact assessments undertaken during the EIA stage.

Stakeholders will be consulted on an on-going basis during the EIA process and any issues and concerns will be recorded and incorporated into the process for evaluation. The approach for this on-ongoing consultation will be in the form of a Stakeholder Engagement Plan (SEP).

DEVELOPMENT OF A STAKEHOLDER ENGAGEMENT PLAN

An outcome of the ESIAs for the IPP1 and IPP4 projects were project-specific SEPs. These were prepared based on scoping and consultation that were undertaken for each project. The SEP for IPP4 (as outlined in the project's ESIA) recommended that the Sponsor establish a Community Liaison Committee to perform the following:

- Monitor noise in the village and identify locations where noise should be measured.
- Commit to provide houses with solar water heaters in 2012 and investigate the potential for installing solar panels to generate electricity in 2013.
- Carry out investigation and repairs where appropriate in relation to cracks in houses reported by the villagers, which have occurred during IPP1 construction and follow for IPP4, where relevant.
- Commit to provide adequate notification and opportunity of employment during construction for suitably experienced men and women.
- Commit to fund a scholarship scheme – 1 person a year to attain diploma and relevant skills to advance education to attain suitable skills required for power plant operation.

During the scoping session held in November 2015, the Municipal chief of Al Manakher confirmed that a Committee was established and some of these initiatives are ongoing. In order to build on these existing initiatives, it is anticipated that the stakeholder engagement plan will complement the existing IPP1 and IPP4 SEPs and build on them where necessary. With AES owning all three sites, it is expected that communities and stakeholders will consider the projects as effectively one entity and any issues or concerns on one project may be reflected in community attitudes to other plants..

It is anticipated that further discussion on this aspect may be beneficial between the MoE, the Developer and lender banks to identify the preferred approach. The SEP will be an Appendix to the EIA.

5 PRELIMINARY ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

The following Chapter describes the national and international requirements for the environmental and social assessment of the Project, the existing baseline data available and including consideration of constraints to data collection, and review the anticipated environmental and social impacts associated with the construction, operation and decommissioning of the Project.

Components to be covered within the EIA include:

- Air quality
- Noise emissions
- Waste management
- Soil, hydrology and water quality
- Terrestrial ecology
- Landscape and visual
- Cultural heritage and archaeology
- Occupational, health and safety
- Cumulative Impacts
- Analysis of Alternatives
- Mitigation and Monitoring Plans

The accompanying ToR describes the approach and methodology that will be used to address the potential impacts and recommended mitigation and management plans. However, detailed mitigation and monitoring measures will be provided in the EIA.

Relevant baseline information has been considered from existing studies including:

- IPP4 Project ESIA for AES (AES, 2012); and
- IPP3 Project ESIA for KEPCO (Parsons Brinckerhoff, 2013).

5.1 AIR QUALITY

5.1.1 ENVIRONMENTAL REQUIREMENTS

NATIONAL REQUIREMENTS

Impacts on air quality will be assessed against applicable ambient air quality standards. The Jordanian Ambient Air Quality Standards (JS: 1140, 2006) describe the concentration limits for a range of pollutants in the ambient air. The pollutants of potential concern from this project are Particulate Matter <10 microns (PM_{10}), Particulate Matter <2.5 microns ($PM_{2.5}$) and Total Suspended Particulates (TSP) during construction. The JS: 1140/2006 parameters for these pollutants are shown in Table 5-1.

Table 5-1 JS: 1140/2006 Ambient Air Quality Standards for Pollutants of Concern

POLLUTANT	AVERAGING PERIOD	MAXIMUM LIMIT	NUMBER OF EXCEEDANCES
Particulate Matter 10 (PM_{10})	24 hours	120µg/m^{3} *	3 times during any consecutive 30 days in a year
	Annual	70µg/m^{3}	-
Particulate Matter 2.5 ($PM_{2.5}$)	24 hours	65µg/m^{3}	3 times during any consecutive 30 days in a year
	Annual	15µg/m^{3}	-
Total Suspended Particulates (TSP)	24 hours	260µg/m^{3}	3 times during any consecutive 30 days in a year
	Annual	75µg/m^{3} (geometric average)	-

INTERNATIONAL GUIDELINES

World Bank EHS Guidelines state that emissions from projects shall not result in pollutant concentrations in the ambient air that reach or exceed the relevant ambient air quality guidelines and standards. This is achieved by applying the national legislated standards, or, in their absence, the World Health Organisation ("WHO") Guidelines or other internationally recognised sources such as the United States Environmental Protection Agency ("US EPA"). Whilst national ambient air quality standards exist WHO Ambient Air Quality Standards (referenced in WBG EHS Guidelines) for SO_2, NO_2 and PM_{10} are outlined in Table 5-2.

Table 5-2 World Bank/IFC Ambient Air Quality Standards for SO_2, NO_2 and PM_{10}

POLLUTANT	AVERAGING PERIOD	IFC EHS GUIDELINES - µG/M3
NO_2	1-hour Annual	200 40
SO_2	10-mn 1-hour 24-hour Annual	500 125 (interim target 1) 50 (interim target 2) 20 -
Inhalable suspended particles (PME) or PM_{10} (IFC)	24-hour Annual	150 (Interim target 1) 100 (interim target 2) 75 (interim target 3) 70 (interim target 3) 50 (interim target 3) 30 (interim target 3) 20

5.1.2 EXISTING BASELINE CONDITIONS

The most recent monitoring undertaken near the Project area was in 2011 for the IPP4 project. The monitoring findings indicated that the ambient air quality near the IPP4 project site does not exceed the more stringent World Bank / IFC Guideline for NO_2 or Interim Target 1 for SO_2. One exceedance of Interim Target 1 for PM_{10} was observed during the monitoring period, although it is considered that this is likely a result of high natural particulates given the arid conditions as is prevalent in this region.

A summary of the results of the monitoring compared against the WBG EHS Guidelines are presented in Table 5-3.

Table 5-3 Summary of Ambient Air Quality Results against WBG EHS Guidelines ((µg/m3)

POLLUTANT	AVERAGING PERIOD	MAXIMUM VALUE	AVERAGE VALUE	WORLD BANK GUIDELINE EXCEEDANCE	INTERIM TARGET EXCEEDANCE
NO_2	1 hour	33.5	6.9	0	-
SO_2	24 hour	111.1	8.2	2	0
PM_{10}	24 hour	975	115	20	3
$PM_{2.5}$	24 hour	18.2	14.5	0	-

According to the ESIA prepared for IPP4, there are no known major sources of air pollution for particulates in the general area. This will be confirmed during the site walkovers for the proposed Project.

5.1.3 POTENTIAL IMPACTS

CONSTRUCTION PHASE

Solar PV systems are passive electric power generation systems. There is no combustion activity that would generate emissions to air. In fact, solar PV systems provide a benefit for the environment as they lead to a reduction of CO_2 emission over the life cycle of the project when compared to other, more traditional methods of power generation.

Construction phase impacts will be largely generic in nature and primarily associated with exhaust emissions and particulate matter/dust raised by construction traffic, excavations, levelling, mixing of raw materials, open storage of raw materials and stationary source emissions.

While there may be emission of some fugitive dust during construction, it will be highly localised in nature and for a very limited period of time without any expected significant impact on the surrounding air quality.

The predominantly sandy and arid environment in Jordan tends to contribute significantly to construction dust and particulate matter emissions. However, as the Project site has already been cleared and levelled by the Ministry of Finance, it is expected that, in this instance there will be less soil movements necessary during the construction period than typical greenfield' sites.

Vehicle movements on unpaved roads could also be a cause of fugitive dust emissions where not adequately controlled. In addition, emissions from vehicles, while unlikely to be significant as low numbers of vehicles are expected, may have localised impacts.

OPERATIONAL PHASE

Panel cleaning, will generate a small and localised release of dust, having a very limited impact on the surrounding air quality. During operation, no direct air quality impacts are anticipated from the PV panels as they do not emit any pollutants.

5.2 NOISE EMISSIONS

5.2.1 ENVIRONMENTAL REQUIREMENTS

JORDANIAN NOISE EMISSION CRITERIA

The project will be assessed in accordance with the lowest day-time and night-time noise levels provided in Table 5-4. The noise assessment will be undertaken in accordance with the Jordanian Guidelines for Prevention of Noise (2003).

Table 5-4 Noise Emission Limits - Jordanian Guidelines for Prevention of Noise (2003)

AREA	HIGHEST PERMISSIBLE L_{AEQ} (DBA)	
	Day (06:00 - 21:00)* Day (07:00 – 20:00)**	**Night (21:00 - 06:00)* Night (20:00 – 07:00)****
Residential areas in villages	50	40
Industrial and commercial	75	65

* Daylight saving time
** Winter time

The predicted noise levels will then be compared to the noise limits in the Jordanian Regulations to assess the level of noise impact from the project. If the predicted operational noise levels from the project exceed the Jordanian noise limits at sensitive receptor locations, then appropriate mitigation measures will be identified.

INTERNATIONAL REQUIREMENTS

In addition, noise emissions from the proposed Al Manakher Solar PV project would also be required to comply with the operational noise criteria as set out within the WBG General EHS Guidelines (2007), detailed within Table 5-5.

Table 5-5 Noise Emission Limits - WBG General EHS Guidelines Noise Limits (2007)

RECEPTOR	MAXIMUM ALLOWABLE HOURLY MEASUREMENTS L_{AEQ} (DBA)	
	Day (07:00 - 22:00)	**Night (22:00-07:00)**
Residential	55	45
Industrial commercial	70	70

The General EHS Guidelines criteria for noise emissions from industrial premises stipulate that, '*Noise impacts should not exceed the levels presented in Table 5-6 or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site*'.

5.2.2 EXISTING BASELINE CONDITIONS

In 2011, noise and vibration baseline monitoring was undertaken for the IPP4 boundary and for Noise Sensitive Receptors (NSRs) in close proximity to the IPP4 Project.

NOISE LEVEL FINDINGS FOR NOISE SENSITIVE RECEPTORS

Short-term monitoring was undertaken at the nearest residential noise sensitive receptor in Al Manakher village. Applicable noise limits were a maximum day-time L_{Aeq} of 55 dB and maximum night time L_{Aeq} of 45 dB. Continuous noise measurements were undertaken at Al Manakher village School over a period of 24 hours for 3 days with a measurement period of 60 minutes. The applicable noise limit for Al Manakher Village School was a maximum day time L_{Aeq} of 45dB. Results indicated that noise levels at the NSRs exceeded ambient regulatory noise limits.

NOISE LEVEL FINDINGS WITHIN THE IPP4 BOUNDARY

Applicable noise limits for the project boundary were a maximum day time L_{Aeq} of 70dB and maximum night time L_{Aeq} of 65 dB. Findings indicated that noise levels were within the limits.

There are no known major sources of noise within the Al Manakher project boundary or in the immediate vicinity, with road noise expected to be the major contributor to the noise environment. This will be confirmed during the ambient noise monitoring survey.

5.2.3 POTENTIAL ENVIRONMENTAL IMPACTS

CONSTRUCTION PHASE

Solar PV systems are static generators of electricity; hence during operation, PV modules do not generate any audible sound. However, inverters used for switching DC to AC sometimes need cooling by fans or air conditioning which can be a source of noise during their operation. However, noise is not expected at night when PV generation is off. Noise intensity is correlated to the inverter power and to its design characteristics.

Noise will also be generated during construction/installation and, to a much lower extent, during maintenance activities. Noise generating activities during the construction phase would include, but not be limited to, the following: site preparation, civil works, construction and on-site equipment. This will have a temporary impact on the surrounding environment with key consideration to be made to the surrounding isolated properties, although it is initially expected that larger communities such as Al Manakher village are too far from the site to suffer from any noise impacts.

The PV plant designer is required to install the equipment according to the requirements of the manufacturer to ensure it can operate within the allowed temperatures and to prevent excessive (audible) noise. Minimum guarantee levels are expected to be adhered too at distances from equipment and at the boundary level before the installation will be accepted.

OPERATIONAL PHASE

The operational phase of the proposed project will involve the generation of noise, but this will be limited in nature, confined predominantly to panel cleaning and any noise associated with security movements around the site and potential inverter noise. However, the overall impacts of such noise would be minimal and are envisaged to be below relevant thresholds of significance.

For operational noise, it will be obligatory to demonstrate compliance against the relevant environmental criteria imposed by the MoE. Due regard will be given to future development plans when undertaking the assessment of noise impacts.

5.3 WASTE AND HAZARDOUS MATERIALS MANAGEMENT

5.3.1 ENVIRONMENTAL REQUIREMENTS

NATIONAL REQUIREMENTS

There are a number of Jordanian laws and regulations pertinent to the management of solid, liquid and hazardous waste for which the Project will need to be in accordance with. These include:

- Environment Protection Law No. 52 of 2006 and related regulations which sets the direct responsibilities for the Ministry of Environment and sets overarching principles for environmental protection;

- Solid waste management regulation No. 27 of 2005 which demands general requirements in terms of manpower, equipment, monitoring, container management, separation of hazardous wastes, documentation, and final treatment or disposal control;
- Waste oil handling and management instructions of 2003 which provides the licensing requirements and documentations for generators, transporters, and treatment and the technical requirements for generators, transporters;
- Hazardous waste handling and management instructions of 2003 which provides the licensing requirements and documentation for generators, transporters, and treatment/disposal;
- Municipalities Law No. 13 of 2011 and amendments (latest No. 7 of 2012) which sets municipal responsibilities including municipal cleaning, waste collection, and disposal;
- Nuisance prevention and waste collection fees for Greater Amman Municipality No. 83 of 2009 which determines the different types of nuisances and municipal control measurement, including the municipal responsibilities for waste collection, transport, treatment, and disposal, and the attached fee system; and
- Instructions for the Management and Handling of Consumed Oil (2014) as it related to the disposal of liquid waste.

The disposal of liquid waste will be in accordance with MoE's instruction for Management and Handling of Consumed Oil (2014).

The assessment will also take into consideration the Renewable Energy and Energy Efficiency Law No. 13 of 2012 and the principles and objectives of Jordan's *Electronic and Electrical (EE) Waste Management Policy*. The EE Waste Management Policy addresses known EE-waste in accordance with the management of harmful and hazardous materials and with circulation no. 24/2005. At present, it is understood that the policy is still in draft and has not been approved.

INTERNATIONAL REQUIREMENTS

The national standards for waste management are complemented by the IFC Standards, as Section 1.6 of the IFC General EHS Guidelines (2007), titled 'Waste Management'. These are applicable to all projects that generate, store or handle any quantity of waste. Section 1.5 includes requirements associated with Hazardous Materials Management.

The waste management guidelines state that facilities, which generate and store wastes should adopt the following mitigation measures:

- Establish waste management priorities at the outset of activities;
- Establish a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes;
- Avoid or minimize 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 recycled, recovered or reused, identify means of treating, destroying, and disposing of it in an environmentally sound manner.

The IFC Guidelines also provides guidelines for the segregation of waste into a hazardous and non-hazardous classification system and the adoption of appropriate management measures associated with the generation and segregation of the diverse waste streams.

The removal and repair of the PV panels during the operational life of the plant is the responsibility of the EPC and O&M contractors who will be required to adopt best practice guidelines such as those of the European Union. At present, it is understood that PV panels are considered as hazardous waste within Jordan and will need to be dealt with and disposed of appropriately. With a number of solar PV plants in the process of being developed in Jordan, it is considered that some level of central liaison (government or developer led) between different developers may be necessary in order to address the waste panel issue. Ideally, a similar arrangement to that instigated in Europe whereby producers are responsible for financing the take-back and disposal of the modules would be preferred.

5.3.2 EXISTING BASELINE CONDITION

The Project site is located within 2-3 km of other power plants (IPP1 and 4) and Al Manakher village. Neither the power plants nor the village produces significant amounts of solid waste. Waste is mainly domestic and comes from Al Manakher village and labourers working in the plants.

The vast majority of solid waste generated by construction projects in Jordan is collected and disposed of in landfills. The closest landfill to the project site is understood to be Gabawi landfill. At present, recycling is not taking place.

5.3.3 POTENTIAL ENVIRONMENTAL IMPACTS

CONSTRUCTION PHASE

The construction and installation of a solar PV system as proposed will inevitably generate solid waste. Waste PV modules may be expected at the installation stage due damage during transportation or mounting stages.

During construction, it is anticipated that the limited spoil generated onsite will be reused as fill material for landscaping (e.g. bank or earth bund construction). Any surplus material not required will be removed and disposed or reused off-site by a licensed waste contractor..

Access roads will be constructed using interlocking rock / stone as a base material and will be paved using gravel. Concrete will be sourced locally where feasible to minimise impacts on the local road network.

It is anticipated that limited liquid or hazardous wastes will be generated during construction. The Contractor will be required to remove all waste material after the installation. With the implementation of best management practices in the handling of waste material during construction, there should be minimal to no impact to the environment from waste generation.

OPERATIONAL PHASE

SOLID WASTE

During operation, a small quantity of solid waste from cleaning and maintenance operations (cleaning wipes, rags, used parts etc.) is envisaged. There will be some sewage generated from the limited personnel based on-site (security and operational staff) and periodic visits by maintenance contractors. It is anticipated that the sewage will be collected in a septic tank before disposal offsite at suitable receiving facilities by a licensed waste contractor.

LIQUID WASTE

During operation, given the fixed point no tracking installation that liquid wastes will be extremely limited and may include small volumes of hydraulic oil and general municipal waste generated by the workforce. These will be removed and treated or disposed of by a licensed waste contractor.

In addition, waste could occur during the plant operation stage due to need for module replacement. At present, there are no recycling facilities for E-waste in Jordan; although it is understood that there are plans to take this initiative forward.

DECOMMISSIONING PHASE

End-of-life PVs will be the main source of solid waste from the decommissioning of a solar PV plant. Particular attention needs to be placed on submitting PV modules for suitable waste treatment, according to the type of module (e.g. monocrystalline).

The estimated life-span of a solar panel is typically between 20 and 30 years. Recycling PV materials, especially the aluminium, silver, and rare earth materials, presents unique challenges since they require multiple technologies and variations within specific types of recycling technologies to completely separate the PV module components. At present, such advanced recycling processes do not exist in Jordan. Waste is transported to government-approved landfills.

5.4 SOIL, HYDROLOGY AND WATER QUALITY

5.4.1 ENVIRONMENTAL REQUIREMENTS

NATIONAL REQUIREMENTS

The EIA will take appropriate account of Soil Protection Regulations (No. 25, 2005). The EIA will be in compliance with Groundwater Control Regulations (No. 85, 2002) and the Drinking Water Resources Protection Guidelines (2006).

The EIA will also need to be in accordance with the Water Authority Law (No. 18, 1988) which prohibits pollution of any water resources (directly or indirectly) under the control of the Water Authority of Jordan (WAJ) and with the Water Resource Protection By-Law (2011) which protects groundwater and surface water by implementing three protection zones. The first protection zone is also known as the water source buffer zone which is followed by two additional protection zones (ground basins and recharge zones).

INTERNATIONAL REQUIREMENTS

Sector-specific guidance documents on pollution prevention good practices produced by the IFC are relevant to the proposed Project compriseWorld Bank Group General Environmental Health and Safety ("EHS") Guidelines.

5.4.2 EXISTING BASELINE CONDITION

GROUNDWATER AQUIFER SYSTEMS

The Amman – Zarqa basin is divided into two parts. The eastern part is located to north east of Wadi Zarqa that flows to the west, and a western part extending to the west of Wadi Zarqa that flows to the east. The groundwater aquifers in the basin are indicated in **Error! Reference source not found.**.

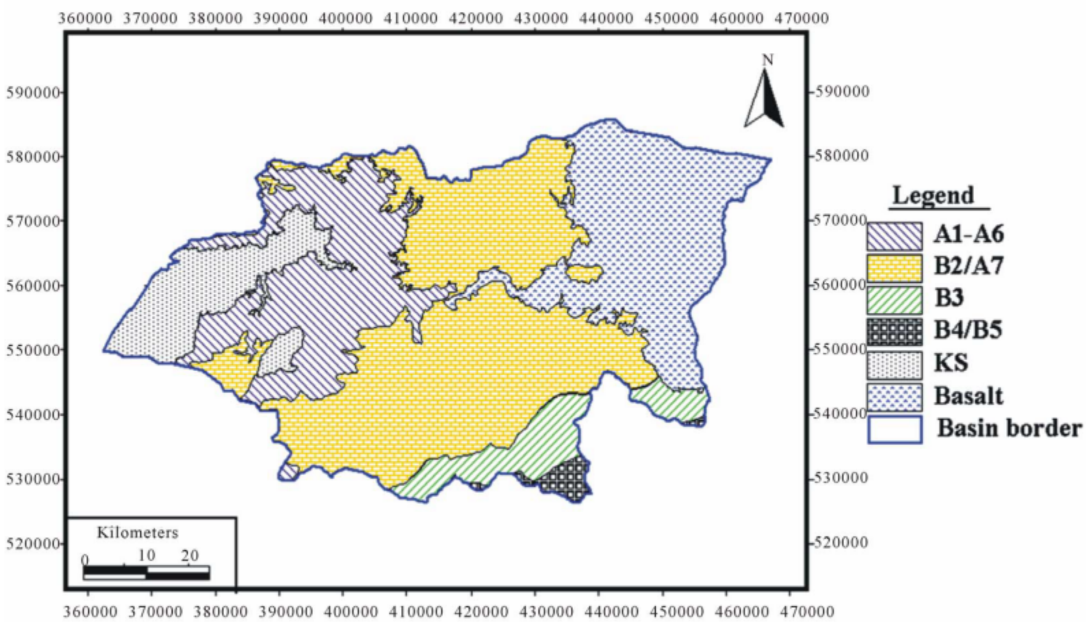

Figure 5-1 Hydrogeological map of the Amman-Zarqa Basin[7]

The average renewable groundwater quantity in the basin is approximately 88 million cubic meters (MCM)/Year, of which approximately 35 MCM/Year return to the surface as base flow in the Zarqa River. The remaining 53 MCM/Year is pumped through wells distributed over the basin area (refer to Table 5-6).

Table 5-6 Drilled Wells Close to Project Area

Well Name	Well ID	Coordination		Well Depth	Altitude	Aquifer	S.W. Level	Yield
		East	North					
AL1789	Madouneh 1	1146260	253930	203	58	148.3	B2/A7	810
AL1797	M.Hamlan 3	1146180	251470	220	66	169.3	B2/A7	836
AL1807	M.S.Kurdi	1144200	252200	350	-	-	B2/A7	875
AL3433	Al-Manakher 1	1143700	253170	421	5	218	2/A7, A4	880
AL3503	Madouneh 1A	1146000	254100	359	16	158	B2/A7, A4	812

The direct recharge to the basin comes from precipitation, floodwater flows and infiltration resulting from irrigation activities. The contribution of domestic, industrial and irrigation activities in groundwater recharge is estimated to be approximately 40 MCM per Year. The groundwater quality in the basin is affected by various factors such as over pumping, inflows of wastewater and leaching of solid wastes.

[7] *Source: A GIS-Based Drastic Model for Assessing Aquifer Vulnerability in Amman-Zerqa Groundwater Basin, Jordan, Abdulla M. Al-Rawabdeh et al, May 2013*

The basin consists of two main aquifers in the Project area. These are the deep Hummer formation (A4) and the shallow complex consisting of Wadi Sir Amman silicified unit (B2/A7). These two aquifers are related to the Upper Cretaceous Hydraulic System and Upper Cretaceous Hydraulic Aquifer.

Studies undertaken estimate the total recharge of this aquifer based on the flow-net analysis of groundwater is approximately 5 MCM per Year.

SURFACE WATER RESOURCES

There are three main sources of surface water within Jordan including springs; treated wastewater and dams. These resources are all found around the Amman-Zarqa Basin and are some distance (greater than 4 km) from the Project site.

Flash floods are reported to occur within the vicinity of the site, but these are currently not directly exploited water resources. Consideration will need to be made, however, of suitable storm water management on site.

5.4.3 POTENTIAL ENVIRONMENTAL IMPACTS

CONSTRUCTION PHASE

It is anticipated that a small amount of water will be required each day for general construction and hygiene purposes (brought in by bowser / tanker). This water will also be required for road construction and for dust suppression/wheel-washing facilities if required. The potential for groundwater pollution due to the disposal of surface water and wastewater will be assessed within the EIA.

During construction, potential impacts to the soils, geology and groundwater of the project site will likely occur due to the following:

- Excavation for foundations, temporary site compound, onsite roads and crane pads;
- Onsite machinery;
- Overhead / underground cable laying;
- Change in drainage patterns due to construction of new roads; and
- Surface water run-off from construction areas and wastewater from facilities onsite.

In addition, the two most common photovoltaic (PV) cell technologies, monocrystalline and polycrystalline cells, are constructed of silicon (glass), aluminium (frame) and copper (wiring), and do not contain embedded heavy metals or other potentially toxic substances. Thin-film photovoltaic modules may contain heavy metals such as cadmium or telluride; however, there is little to no evidence of any toxic leaching from these types of solar modules.

OPERATIONAL PHASE

Solar PV panels also require periodic cleaning to maintain efficiency in power generation (refer to Figure 5-2 and Figure 5-3**Error! Reference source not found.**).

It is understood that the proposed method for the Project will comprise dry brush cleaning and no water will be used during the conventional cleaning cycle. More difficult residue may require trace amounts of mild biodegradable household cleaner. Some fraction of residual detergent and/or wash water residues could theoretically reach site drainage channels; the amounts are so small that any impact is unlikely.

All cleaning operations will still need to be planned and managed carefully, in order to avoid dust impacts or waste water.

Figure 5-2 Module cleaning Using Brush Trolley[1]

Figure 5-3 Module cleaning Using Dust Broom

During operation, there may also be potential impacts from the Project site due to be spills / leaks of fuel and oil from maintenance activities. It is envisaged that the designer will define the cleaning procedure that is most adequate for the layout of the PV system and that this will be contained within O&M Manual for the technology adopted, particularly with respect to oil spill clean-up procedures. Given the limited oils expected on site due to the panel design type, this issue is expected to be insignificant.

5.5 TERRESTRIAL ECOLOGY

5.5.1 ENVIRONMENTAL REQUIREMENTS

NATIONAL REQUIREMENTS

The EIA will take appropriate account of Jordanian Agricultural Law (No. 44, 2002) concerning the protection of birds and wildlife and their management and trade and also consider the potential for the project to impact on Natural Reserves and Parks in accordance with the Natural Reserves and Parks Bylaw (No. 29, 2005).

INTERNATIONAL REQUIREMENTS

The EIA will also take into consideration the relevant international best practices for ensuring protection of biodiversity including IFC's Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources (2012).

Performance Standard 6 requires the following:

"The risks and impacts identification process…should consider direct and indirect project-related impacts on biodiversity and ecosystem services and identify any significant residual impacts. This process will consider relevant threats to biodiversity and ecosystem services, especially focusing on habitat loss, degradation and fragmentation, invasive alien species, overexploitation, hydrological changes, nutrient loading, and pollution.

As a matter of priority, the client should seek to avoid impacts on biodiversity and ecosystem services. When avoidance of impacts is not possible, measures to minimize impacts and restore biodiversity and ecosystem services should be implemented'.

5.5.2 EXISTING BASELINE CONDITION

The ecological studies undertaken for IPP4 assessed the direct and indirect impacts of construction, operation and decommissioning phases of the Project on the terrestrial biological environment. The ecological studies included consideration of the Bio-Geographical Zone in which the PV Solar Project is located with regard to fauna and flora. The findings of the IPP4 survey, which are considered, are generally reflective of the area that the Al Manakher development also lies within are summarised below.

FLORA

The Project site exists in the Mediterranean Biogeographic Zone, which is restricted to the highlands of Jordan extending from Irbid in the north to Ras Al-Naqab in the south. The altitude of this Biogeographic Zone ranges from 700 to 1750m above sea level with rainfall typically ranging from 300 to 600 mm per year.

The Project area is represented within one major defined ecosystem namely the Scrap and Highland Ecosystem. This consists of escarpments, mountains, hills and undulating plateaus which extend mainly from Irbid in the north to Ras Al Naqab in the south, and from the Rift Valley region in the west to the Badia in the east. More than 80 percent of Jordan's cities and villages are located within this Biogeographic Zone.

FAUNA

The main groups of animals in the Project area are likely to be mammals and birds.

Mammals in the project area could include those found in the two Zoogeographic Zones: the Mediterranean Zoogeographic Zone and the Saharo / Sindian Zone (also referred to as the Saharo-Arabian and Irano-Turanian Phytogeographic region by Zohary (1973)).

MEDITERRANEAN ZOOGEOGRAPHIC ZONE

This is a distinct sub-region within the Palearctic Region (European Origin) and includes mountain areas that extend from the north of Jordan to the Al Naqab Mountains in the south. Important mammals found in the Mediterranean Zoogeographic Zone are outlined in Table 5-7.

Table 5-7 Important mammals in the Mediterranean Zoogeographic Zone[8]

Family	*Scientific name*	*Common name*	*Status*
Erinaceidae	*Erinaceus concolor*	Common Hedgehog	Insufficient data
	Hemiechinus auritus	Long-eared Hedgehog	Insufficient data
Soricidae	*Corcidura suaveolens*	Lesser white-toothed shrew	Vulnerable
Canidae	*Canis aureus*	Golden jackal	Vulnerable
	Canis lupus	Grey Wolf	Nationally threatened
Felidae	*Felis caracal*	Caracal	Nationally endangered
	Felis silvestris	Wild Cat	Vulnerable
Herpestidae	Hepestes ichneumen	Egyptian mongoose	Vulnerable
Hyaenidae	*Hyaena hyaena*	Striped hyena	Nationally threatened
Mustelidae	*Martes foina*	Rock Marten	Nationally threatened
	Meles meles	Common Badger	Nationally threatened
	Vormela peregusna	Marbled Polecat	Vulnerable
Procaviidae	*Procavia capensis*	Hyrax	Nationally threatened
Spalacidae	*Spalax leucodon*	Mole Rat	Vulnerable
Hystricidae	*Hystrix indica*	Indian crested porcupine	Vulnerable

SAHARO-SINDIAN ZONE

The Saharo-Sindian Zone is located to the east of the mountain ranges, extending from south of Jordan to north east of the country in Mafraq area. It is another sub-region within the Palearctic Region (European Origin) and includes the Sahara Desert and the Arabian Desert. Important mammals found in the Saharo / Sindian Zone are outlined in Table 5-8.

[8] The status of the species is defined as per the IUCN Red List which is the comprehensive assessment of the conservation status of the world's 5,488 mammal species. The list provides a set of criteria for determining the category in which species fall: http://jr.iucnredlist.org/documents/RedListGuidelines.pdf. *Insufficient data* (or Data Deficient) means there is insufficient information for a proper assessment of conservation status to be made and does not necessarily indicate that the species has not been extensively studied; but it does indicate that little or no information is available on the abundance and distribution of the species.

Table 5-8 Important mammals in the Saharo / Sindian Zoogeographic Zone

Family	*Scientific name*	*Common name*	*Status*
Erinaceidae	*Paraechinus aethiopicus*	Desert Hedgehog	Insufficient data
	Hemiechinus auritus	Long-eared Hedgehog	Insufficient data
Soricidae	*Corcidura suaveolens*	Lesser white-toothed shrew	Vulnerable
Canidae	*Canis aureus*	Golden jackal	Vulnerable
	Canis lupus	Grey Wolf	Nationally threatened
	Vulpes cana	Blanford's fox	Nationally endangered
	Vulpes rueppelli	Sand Fox	Nationally endangered
Felidae	*Felis caracal*	Caracal	Nationally endangered
	Felis silvestris	Wild Cat	Vulnerable
	Felis margarita	Sand Cat	On the verge of extinction
Hyaenidae	*Hyaena hyaena*	Striped hyena	Nationally threatened
Mustelidae	*Vormela peregusna*	Marbled Polecat	Vulnerable
	Mellivora capensis	Honey Badger	Nationally threatened
Procaviidae	*Procavia capensis*	Hyrax	Nationally threatened
Bovidae	*Capra ibex*	Nubian Ibex	Nationally endangered
Hystricidae	*Hystrix indica*	Indian crested porcupine	Vulnerable

While the species discussed in Table 5-8 have the potential to be present at the Project site with respect to the zoogeographical zone, in reality, given the previous site clearance by Ministry of Finance and lack of vegetation at the site it is expected that their presence is unlikely.

Nevertheless, the terrestrial ecology survey (see accompanying ToR) that will be undertaken on the Project site for the EIA will record incidental fauna species present.

BIRDS

Jordan has a wide diversity of bird habitat types due to its varied topography, climate and its bio-geographical location. More than 363 bird species have been recorded in Jordan of which more than 141 species are breeding birds. However, it is also noted that this number might increase with further research.

Jordan lies on the main route of bird migrations between Africa, Asia and Europe. Millions of birds are migrating over Jordan each year. These migratory species represent the majority of Jordanian avifauna. Important migrant species of bird are outlined in Table 5-9.

Table 5-9 Important migrant species of bird in Jordan

Family	*Scientific Name*	*Common Name*	*Status*
Ardidae	*Botaurus stellaris* 1	Great Bittern	Globally threatened
Accipitridae	*Aquila heliaca*	Imperial Eagle	Globally threatened
Rallidae	*Crex crex*	Corn Crake	Globally threatened
Accipitridae	*Buteo buteo*	Buzzard	Significant proportion of the world population
Accipitridae	*Pernis apivorus*	Honey Buzzard	Significant proportion of the world population
Accipitridae	*Aquila nipalensis*	Steppe Eagle	Significant proportion of the world population
Accipitridae	*Accipiter brevipes*	Levant Sparrowhawk	Significant proportion of the world population

Consideration of important birdlife areas (IBAs) and migration routes will also be necessary within the context of the EIA. An initial review of Jordanian IBAs has indicated the closest appears to be more than 90km east (Shaumari IBA) of the Project site. Similarly, as indicated within the assessment undertaken for IPP4, the Project site is not located on a migratory path. Notwithstanding this initial review, due consideration of this aspect will be made within the EIA.

5.5.3 POTENTIAL IMPACTS ON TERRESTRIAL ECOLOGY

CONSTRUCTION PHASE

There are no protected areas or areas of high value biodiversity within the Project site boundary. During construction, there will be a need to remove vegetation that exists on-site although the site is understood to have been comprehensively cleared by the Ministry of Finance. As a result, there is very limited potential for some impact on ecology.

In addition, studies undertaken for IPP3 and 4 would suggest that Project site does not contain any flora species that are protected or important therefore the potential impact is considered to be negligible.

OPERATIONAL PHASE

Vegetation control and ground maintenance are important scheduled tasks for solar PV power plants. Vegetation (for example, long grass, trees or shrubs) has the potential to shade the modules and reduce performance. Prudent ground maintenance can also reduce the risk of soiling on the modules from leaves, pollen or dust. However, as the biodiversity has been identified not of high ecological value, this impact is considered to be negligible. Any vegetative landscaping installed around the site will need to take into account the water scarcity and ensure that the vegetation is indigenous to the area.

5.6 SOCIO ECONOMIC

5.6.1 SOCIO-ECONOMIC REQUIREMENTS

NATIONAL REQUIREMENTS

Criteria used to assess socio-economic impacts of the project will be based upon Jordan’s specific regulations and standards, predominantly Labour law (No 8, 2002).

This Law also stipulates that the project will comply with Article (78) related to Occupational Health and Safety (OHS) and provides essential precautions and arrangements to protect the workers from hazards, including the provision of Personnel Protective Equipment (PPE).

Three criteria used to assess the significance of an impact include:

- **Intensity**, from low to high whether it generates little or significant change to the component;
- **Duration**, whether the time dimension of the impact is considered permanent, temporary or short-lived; and
- **Scope**, which describes the spatial dimension of the impact caused by an activity and can be limited, local or regional.

INTERNATIONAL REQUIREMENTS

The IFC Performance Standards place a significant emphasis on ensuring that the likely social and economic impacts of a project are identified and minimised and that this is clearly demonstrated and documented within the Project's assessment. The specific IFC Performance Standards associated with the proposed project are considered within:

- *Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;*
- *Performance Standard 2: Labour and Working Conditions; and*
- *Performance Standard 4: Community Health, Safety and Security.*

Performance Standard 2 determines the standard of care that must be taken with regards to the workers during the construction and operational phases of the proposed project. The Developer and appointed EPC Contractor shall ensure that the objectives are achieved and shall promote the fair treatment of workers, and safe and healthy working conditions.

Criteria for the socio-economic impact assessment will also be derived from IFC PS's and relevant guidance from IFC/ILO on Workers' Accommodation should it be provided.

5.6.2 EXISTING BASELINE CONDITION

DEMOGRAPHICS

The Project is located to the east of Amman in the Sahab District, designated as a major industrial area, near Al-Manakher village (refer to Figure 5-4) although, at present, industry is relatively limited, with the existing power projects at IPP1, IPP4 and IPP3 comprising the major developments.

The district is located southeast of Amman and includes the following ten localities and/or communities:

- Sahab;
- Al-Abdalyieh;
- Zmlet Al-Alia;
- North Khshafiyeh;
- South Khshafiyeh;
- Al-Manakher;
- Qa"afour;

- Al-Bayda;
- Rmaydan; and
- Al-Madouna.

Sahab accommodates the largest industrial estate in Jordan. The Abdullah II Ibn Al Hussein Industrial Estate (AIE) is approximately 12km south east of Amman comprising a total area of 4000 donum or 400 ha. In 2011, the population of Sahab District was estimated at 54.704 and the population of Al-Manakher village was estimated at 543.

There is some evidence of both arable and livestock activity in the area including olive plantations, wheat crops and goat herds, but this is on a small scale only and the area is not dominated by significant agricultural landholdings.

The Arab Gas Transmission Pipeline, which provides natural gas from Egypt to Jordan runs to the west of the site (and which is to be utilised by IPP4).

Updated developments and statistics, where available, will be obtained during the EIA.

Figure 5-4 Location of Project site in Sahab District

ECONOMY

The main sources of economy for communities in the region of the Project site include:

- **Agriculture** - Due to the scarcity of water resources, agricultural activities in Jordan are limited. In 2009, the agricultural sector contributed 3% to the country's gross domestic product (GDP). This was boosted by irrigation and technological advancements in farming methods, particularly drip irrigation. The workforce in the agricultural sector is estimated to be approximately 10% of the workforce at the national level. In 2010, the total planted area in Jordan was estimated at 553,990 acres.

  In regards to the Project site, there are a number of small farms in the general vicinity (<3 km) to the proposed location including a sheep market and camel farm. Alain Farm is located approximately 3km from IPP3.

- **Industrial sector** - Jordan is attractive for foreign investments in the Middle East primarily due to political stability and its central location in the region. Industry in Jordan is principally dominated by two main types:
  - Manufacturing - this includes: leather and footwear manufacturing; chemical industry; plastic industry; IT industry; furniture industry; food industry; packaging industry; and manufacturing of engineering technology. This sector contributes approximately 18%of the Jordanian GDP.
  - Mining - this sector contributes approximately 2.6% of the Jordanian GDP. In 2011, 21,207 industrial establishments were recorded in Jordan. This represents 48.5% of the country's industrial sector. Of these, 10,292 industrial establishments are located in the Amman Governorate.

    There are three Qualifying Industrial Zones (QIZ) in the Amman Governorate including: King Abdullah II Industrial Zone in the Sahab municipality; Qastal Qualified Zone in Jiza municipality; and, Tujma'at Industrial Zone in Sahab municipality.

LABOUR MARKET

The Jordanian economy is considered to be service-oriented with the services sector contributing approximately 66% to GDP and providing more than 80% of jobs in the kingdom. Industry contributes 31% to GDP, providing 18% of jobs, followed by agriculture with a contribution of 3%, providing 2% of jobs, as of 2011. More recent statistics will be sought, if available, within the EIA. The economy is dominated by small businesses where it is estimated that 92% of businesses employ from one to four persons and a further 7% employing five to 19 persons, making the share of businesses employing fewer than 20 persons 99% of all operating businesses in Jordan.

Although government figures show an average of 12.5% unemployment among Jordanians in the past decade, a recent study conducted by the International Labour Organization considered approximately 22% of locals were out of work in 2014, up from 14% prior to the Syrian crisis. The main impact of the increased Syrian labour market activity in Jordan has been downward pressure on wages in the informal economy.

5.6.3 POTENTIAL SOCIO-ECONOMIC IMPACTS

CONSTRUCTION PHASE

The main activities during construction will involve securing the site and transportation of personnel, materials and plant equipment. It is anticipated that a temporary facility area which will include staff offices and storage areas will be necessary on site during construction. No accommodation is expected on the Project site. The recent IPP4 development employed staff who were housed in their own accommodation and transported to site in communal buses. A similar situation is expected for the Al Manakher Project. The temporary facility area will require electricity and water supplies, which are expected to be provided by limited generators and water tankers.

During construction, labour and working conditions are to be of an appropriate standard and consistent with relevant legislation and applicable international standards set out by the IFC. Should worker accommodation be required, consideration of the appropriate standards will be necessary with respect to basic requirements in relation to space, water supply, adequate sewage and garbage disposal, protection against heat, cold, damp, noise, fire and disease-carrying animals, storage facilities, lighting and (as appropriate to size and location) access to basic medical facilities or personnel.

All employees will need to be given adequate occupational health and safety (OHS) training and be provided with the necessary OHS equipment and resources to avoid injuries and incidents.

WORKER WELFARE

Established (during IPP4 construction) employment processes with due consideration of local communities' employment are expected to be utilised during the Project construction phase. The process of employment and ensuring local communities employment is a priority will be further discussed within the EIA and policies provided by the EPC Contractor. Where necessary, it is anticipated that the policies will take into account potential improvements which have been identified during the IPP4 construction process and/or subsequently through existing communication channels.

It is understood that the estimated number of workers during construction will range up to 600 people during peak periods, which will include managers, engineers and technicians. Work opportunities and recruitments for unskilled labour from the surrounding area will increase, although a number of foreign workers with respect to potential managerial positions within the EPC Contractor's organisation are anticipated. The workforce will increase the demand for local services in the surrounding area such as health services and food supplies.

Within the assessment of worker welfare standards as they relate to proposed housing facilities, consideration will be given to local legislation and international best practice; in particular, the requirements of the Jordanian Labour law. Reference will also be made to best practice standards including IFC/ILO guidance for workers housing and accommodation and IFC PS2.

OPERATIONAL PHASE

A positive economic impact is envisaged from local employment created by the operation of the Al Manakher project, although these will be confined to a much reduced work force present on-site during this period in comparison with the construction phase. Whilst the effects will be smaller in nature, they will be more prolonged as the operational phase is considerably longer than the operational phase.

During operation, there will be an increase in the demand of local services. Local businesses such as food suppliers, transportation companies and service providers will benefit from the Project.

During operation, there will be a need to ensure that adequate security provisions are put in place. There is the potential for theft of operating plant and equipment during the operational phase. Security solutions are required to reduce the risk of theft and tampering. These security systems will need to satisfy the insurance provider requirements and include at minimum-security fences, CCTV cameras, sensors, warning devices, security staff, and alarm centres. Due consideration of the local residential developments will be necessary within the security planning with respect to privacy issues.

5.7 CULTURAL, HERITAGE AND ARCHAEOLOGY

5.7.1 CULTURAL, HERITAGE AND ARCHAEOLOGY REQUIREMENTS

NATIONAL REQUIREMENTS

The EIA will take appropriate account of Archaeology Law (No. 21, 1988). This Law requires a project location to be free from any archaeological materials, before any excavations commence, in order to avoid any penalty defined by this law. With the ground clearance having already been undertaken by the Ministry of Finance, it is anticipated that there is little chance of impacting or uncovering additional artefacts.

Impacts on legally protected and internationally recognised areas of importance for cultural heritage features shall also be considered. Preparing zone of visual influence (ZVI) maps and preparing wire-frame images and photomontages from key viewpoints will be considered to inform both the assessment and the consultation processes.

INTERNATIONAL REQUIREMENTS

IFC Performance Standard 8: Cultural Heritage recognises the importance of cultural heritage for current and future generations. Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to ensure that clients protect cultural heritage in the course of the project lifecycle, with the primary objectives to:

- *"Protect cultural heritage from the adverse impacts of project activities and support its preservation";* and
- *"Promote the equitable sharing of benefits from the use of cultural heritage*".

5.7.2 EXISTING BASELINE CONDITIONS

According to the ESIA carried out for IPP4 which is considered to be appropriate for reference within the general project site context, during the Department of Antiquities walkover undertaken in 2011 for IPP3, the surveys indicated the following sites exist within the proximity of Madouna, Al Gabawi and Al Manakher. The sites included:

- Tal Al-Manakher;
- Al-Madouna Castle (Locally known as Khirbet Al-Madouna 2);
- Al-Madouna Palace (Locally known as Qaser Al-Madouna); and
- Water Reservoir (Locally known as Al-Berkeh).

The identified archaeological sites are situated approximately 10km or more from IPP3 Project site. With the IPP3 site located approximately 7 km east of the Project site, it can be considered that the Project site is not located close to any archaeological sites protected by Jordanian Legislation (Archaeology Law (No.21, 1988)) although watching briefs will still be necessary during any excavation works.

5.7.3 POTENTIAL IMPACTS

CONSTRUCTION PHASE

There is the potential for buried or concealed archaeological remains to be damaged, if found to be present, during the construction phase of the proposed project, particularly during excavation and grading activities. To avoid potential damage, the EPC contractor will ensure that Chance Find procedures are in place and that any sites of cultural importance are clearly demarcated.

OPERATIONAL PHASE

Impacts upon cultural heritage and archaeology are not expected during the operational phase of the proposed Project.

5.8 LANDSCAPE AND VISUAL ASSESSMENT

5.8.1 LANDSCAPE AND VISUAL ASSESSMENT REQUIREMENTS

NATIONAL REQUIREMENTS

There is no known Jordanian legislation for landscape and visual impact of solar power plants or glint or glare as a result of PV module reflection.

INTERNATIONAL REQUIREMENTS

In the absence of specific guidelines with the IFC PS, the visual impact of the project will be assessed with consideration of the United Kingdom (UK) Guidelines for Landscape and Visual Impact Assessment (LVIA) Revision 3.

In addition, the EIA will take into consideration guidance provided by WBG General EHS Guidelines to assess the landscape character during siting and evaluation of visual impacts from relevant viewing angles. Specific assessment from critical viewpoints with renderings may also be appropriate.

GLINT AND GLARE

Typically, glint and glare is considered during the planning and design phase.

The main reference point on this issue is the US Federal Aviation Administration which is implementing a web-based tool, Solar Glare Hazard Analysis Tool (SGHAT), which predicts energy production and the potential for solar glare and ocular impacts from an array of photovoltaic panels.

The use of this tool is required by the Federal Aviation Administration for solar energy installations proposed at federally obligated airports in the United States (Notice 78 FR 63276 in the Federal Register). With no nearby airports or flight paths, it is not expected that this tool will be necessary within the context of aircraft considerations.

5.8.2 EXISTING BASELINE CONDITIONS

Topography in the area is typical of the Highlands Topographic Region in which the Project site is located. The Highlands Topographic Region extends from Um Qais in the north passing through the Ajlun Mountains, the hills of Amman and Moab Regions, and the Edom Mountains Region.

Many creeks and wadis drain from these hills from north to south and lead to the River Jordan, Dead Sea and Wadi Araba. The southern highlands are higher than those in the north, though they are home to fewer species of vegetation types that also have a lower density.

The Project site comprises of north / west shallow slopes of Al Manakher hills that are crossed by small wadis as a result of rainfall drainage towards the south.

Satellite images of the Project site from April 2008 illustrate that the proposed site was originally arable land and was cleared by the Ministry of Finance. The site is not within any aviation routes and there are no nearby airports.

5.8.3 POTENTIAL IMPACTS

CONSTRUCTION PHASE

Visual impacts associated with solar PV projects typically concern the appearance of the solar modules and their interference with the character of the surrounding landscape, particularly to nearby residential communities. Additionally, sometimes reflection from the module surfaces, either glint (quick reflection) or glare (longer reflection) exacerbates visual impacts from a project.

Impacts associated with the construction phase of the proposed project may result from unsightly construction areas or activities. General site management, appropriate hoarding and landscaping could be used to improve the aesthetics of the overall construction site.

Associated facilities such as necessary OHTL and internal access site roads will need to be minimised, steep slopes avoided, erosion control measures, and re-vegetation procedures implemented.

Glint and glare is mostly an issue for aircraft and has less adverse effects on residential areas. Nonetheless, glint or glare will be assessed during design (selection of anti-reflection modules, siting of modules etc.); therefore, it is not a likely impact during construction.

OPERATIONAL PHASE

The proposed Project footprint area supports a wider area land already dedicated to electricity generation, with several thermal power plants present in the general vicinity. Impacts associated with the construction phase of the proposed Project may result from unsightly construction areas or activities. General site management, appropriate hoarding and landscaping could be used to improve the aesthetics of the overall construction site. Glint or glare will be addressed during design (selection of anti-reflection modules, siting of modules etc.); therefore, it is not considered a significant impact during operation.

The EIA will make an assessment of the planned construction activities and project design that may negatively impact on the landscape character or value.

The solar PV arrays proposed will be subject to review to identify if glint or glare is expected and identify measures to minimize and/or avoid the impacts. The review will consider the panel alignment and angle expected (initially anticipated that the panels will be aligned facing south (180°) at an angle of 15-20 degrees to the horizontal).

Where appropriate, consideration will be made across an entire year with identification of the key receptors which may be impacted upon, through a combination of satellite review, consultations and site walkovers.

5.9 OCCUPATIONAL, HEALTH AND SAFETY

5.9.1 OCCUPATIONAL, HEALTH AND SAFETY (OHS) REQUIREMENTS

NATIONAL REQUIREMENTS

The project will need to be assessed for compliance with Article No (13) and Article No. (14) of the Civil Defence Law (No. 18, 1999). The EPC and O&M contractors will be required to coordinate with the Civil Defence administration for the use and storage of chemicals and hazardous materials where appropriate.

The project shall also take appropriate account of Public Health Law (No. 47, 2008). This Law is concerned with the protection of public health by setting out laws concerned with the disposal of hazardous waste.

For access roads and OHTL, the EIA will need to consider Jordanian Traffic Law (No. 49, 2008) and Management, Transport and Handling of Harmful and Hazardous Substances Regulations (No. 24, 2005).

INTERNATIONAL REQUIREMENTS

In addition, the EIA shall take appropriate account of WB / IFC General EHS Guideline for Community Health and Safety (2007). These Guidelines address project activities taking place outside the project boundary, impacts that may arise during the operation of a project and impacts beyond the life of the Project.

International best practice safety standards will be used as prescriptions and test criteria as regards the following:

- Electrical Hazards: Dielectric withstands, Ground continuity, Accessibility, Cut susceptibility, Impulse voltage, Reverse current, Partial discharge;
- Mechanical Hazards: Module breakage;
- Thermal Hazards: Temperature test; and
- Fire Hazard: Fire resistance.

For the access roads and OHTL, the EIA will consider international standards for associated facilities provided in the WBG EHS Guidelines for Electrical Power and Distribution.

5.9.2 EXISTING BASELINE CONDITIONS

Relevant available documentation associated with the Environmental and Health and Safety Management System Manual of the EPC Contractor will be requested through interviews with management personnel in order to ascertain the level of existing management and implementation, and will subsequently be reviewed by WSP | PB. The review of documentation will ensure compliance with international best practice as outlined in the World Bank / IFC EHS guidelines.

5.9.3 POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS

CONSTRUCTION PHASE

Occupational health and safety is an issue that needs to be properly managed during construction in order to minimize the risk of preventable accidents leading to injuries and/or fatalities—there have been a number of fatal incidents in recent history at solar power plant construction sites around the world.

OPERATIONAL PHASE

Operation and Maintenance issues are mostly related to the safety of people and in particular in regards to the obligations of the Developer.

As far as environmental safety issues are concerned, Operation and Maintenance needs to address the following:

- Maintenance and cleaning recommendations, especially for utility scale solar projects; and
- Use of water and compressed air generation for cleaning.

The identification of suitable cleaning method is a choice of the EPC contractor and should ensure that the selection made is to avoid a decrease of the performance and the safety of the PV system.

5.10 CUMULATIVE IMPACTS

The cumulative impacts associated with the proposed solar PV Plant are expected to be associated with the extent of the proposed facility development as well as other developments in the area. The potential direct cumulative impacts associated with the Project are expected to be predominantly the potential visual impact on the surrounding area in addition to local employment considerations within the general area with particular respect to IPP 1 and IPP4 operated by the same company, AES.

The cumulative impacts will be considered in the detailed specialist studies to be undertaken during the EIA.

6 PROJECT ALTERNATIVES

6.1 INTRODUCTION

In accordance with best practice, the EIA will include an evaluation of feasible project alternatives. This section will aim to summarise the planning process that has been undertaken to underpin the current project design.

The alternative analysis will follow a matrix-based approach where various aspects (environmental, social, logistical and commercial) are assessed qualitatively by a team of experts.

6.2 SELECTION OF THE SITE

There are a number of advantages of the Project site, which make it suitable for solar power generation as follows:

- An existing transport infrastructure in particular the Zarqa to Sahab road that will readily accommodate construction traffic;
- Availability of sufficient land for the Project;
- Close proximity to the centre of electricity demand in Jordan (Amman) which is located approximately 30 km to the west;
- The site is located away from residential and populated areas; and
- Close to existing water, gas and transmission sources.

The types of project alternatives that will be considered in this assessment are outline below.

6.3 OVERVIEW OF PROJECT ALTERNATIVES

6.3.1 NO PROJECT ALTERNATIVE

The ‘no project’ alternative will be considered. This will evaluate the potential positive and negative effects of not proceeding with the planned Project.

6.3.2 DESIGN ALTERNATIVES

This will include possible alternatives for the design, construction and operation of the project. For example, alternative construction methodologies and phasing, alternative construction laydown areas and alternative designs.

7 PROPOSED METHODOLOGY FOR IMPACTS ASSESSMENT

7.1 INTRODUCTION

This section sets out the approach and methodology that will be adopted as part of the EIA process. This includes the approach to determine the existing environmental and socio-economic conditions, including identification of sensitive receptors, and the general methodology for the assessment of environmental and social impacts likely to be associated with the proposed project. Methodologies may differ between disciplines and where this is the case the deviation from the standard approach described below.

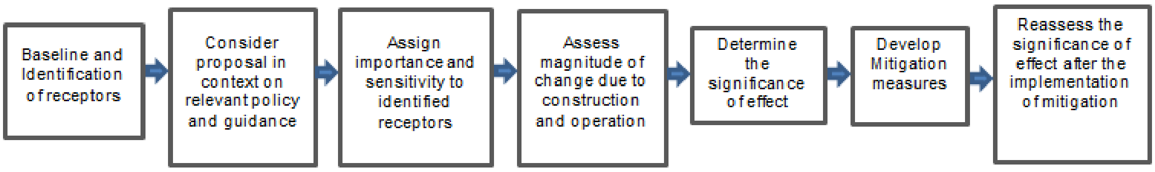

Figure 7-1 EIA process flow chart

The assessment of the potential impacts of both the construction and operational phases of proposed project will be based on a number of criteria, which are used to determine whether such effects are 'significant'. These significant criteria will include:

- Local, national and international legislation, regulations and standards;
- Relationship with national planning policies or drivers;
- Sensitivity of the local environment;
- Reversibility or irreversibility and duration of the impact;
- Inter-relationship, if any, between the impacts, otherwise known as cumulative impacts; and
- Outcomes of consultations with the MoE and other relevant stakeholders.

The significance of impacts reflects judgements as to the importance or sensitivity of the affected receptors and the nature, magnitude and duration of the predicted changes.

7.2 RECEIVING ENVIRONMENT

The sensitivity of the receptors or receiving environment to change should be determined using professional judgement and the consideration of existing designations and quantifiable data, where possible. Some examples are as follows:

- A proposed project site which is protected in accordance with The World Conservation Union (IUCN) criteria, international conventions such as RAMSAR, and species listed as Critically Endangered, Endangered or Vulnerable in the 2004 IUCN Red List of Threatened Animals and Critical habitats as defined by the IFC would have to be considered as more sensitive receptors than habitats which are severely modified, damaged or degraded or supporting a generic and common terrestrial habitat; and

- Residential areas would generally be considered more sensitive to noise and poorly controlled lighting from a construction site than industrial areas.

When evaluating the severity of environmental and social impacts, the following factors are taken into consideration:

- **Impact Magnitude**: The magnitude of the change that is induced (i.e. the percentage of a resource that is lost);
- **Impact Duration**: The time period over which the impact will last;
- **Impact Extent**: The geographical extent of the induced change;
- **Likelihood**: The likelihood that the event will occur during the project lifecycle; and
- **Regulations, Standards and Guidelines:** The status of the impact in relation to regulations (e.g. discharge limits), standards (e.g. environmental quality criteria) and guidelines.

TWO VARIABLE RISK MATRIX

Table 7-1 and Table 7-2 below outline respectively the impact severity and impact likelihood criteria, which would be used within the individual technical assessments.

Table 7-1 Impact Severity Criteria

IMPACT SEVERITY	DEFINITION
Slight	Where the development would cause perceptible improvement or deterioration to the existing environment.
Low	Where the development would cause noticeable improvement or deterioration to the existing environment.
Medium	Where the development would cause moderate improvement or deterioration to the existing environment.
High	Where the development would cause significant improvement (or deterioration) to the existing environment.

Table 7-2 Impact Severity Likelihood

IMPACT LIKELIHOOD	DEFINITION
Extremely unlikely	The event is very unlikely to occur under normal conditions but may occur in exceptional circumstances, e.g. emergency conditions.
Unlikely	The event is unlikely but may occur under normal conditions.
Low likelihood	The event is likely to occur during normal conditions.
Medium likelihood	The event is very likely to occur during normal conditions.
High likelihood	The event will certainly occur during normal conditions.

SIGNIFICANCE ASSESSMENT

The significance of each impact is subsequently determined by comparing the impact severity against the sensitivity of the receptor in the impact significance matrix provided by Table 7-3.

Table 7-3 Determining the significance of impacts

		Sensitivity of Receptor				
		Low	**Low-medium**	**Medium**	**Medium High**	**High**
Impact Severity	**No Change**	Negligible	Negligible	Negligible	Negligible	Negligible
	Slight	Negligible	Negligible	Negligible	Minor	Minor
	Low	Negligible	Negligible	Minor	Minor	Moderate
	Medium	Negligible	Minor	Moderate	Moderate	Moderate
	High	Minor	Moderate	Moderate	Major	Major
Negligible		Magnitude of change comparable to natural variation.				
Minor		Detectable but not significant.				
Moderate		Significant; amenable to mitigation and should be mitigated where practicable.				
Major		Significant; amenable to mitigation; and shall be mitigated.				
Critical		Intolerable; corresponds to a major impact, but not amenable to mitigation; alternatives must be identified – Project Stopper.				

The Critical Impact designation indicated in Table 8-3 above will be allocated in place of a Major Impact when mitigation for the Major Impact is not possible and the impact takes on a Critical Impact status where alternatives must then be considered.

MITIGATION, ENHANCEMENT AND ASSESSMENT OF RESIDUAL IMPACTS

Where significant impacts are identified, from moderate levels of significance and above, mitigation and enhancement measures will be identified to prevent, reduce or remedy any potentially significant environmental impacts which cannot be avoided or effectively reduced through changes to the construction or operational methodology. Such measures will need to be implemented during the construction phase or the operational phases or the proposed project by adopting the control hierarchy principles as illustrated by Figure 7-2.

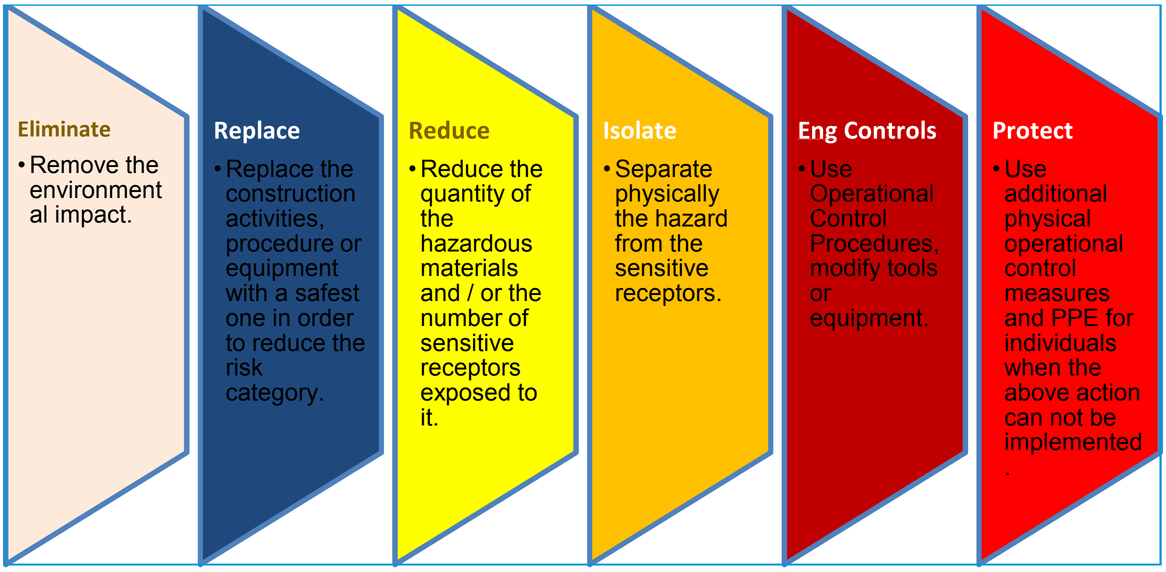

Figure 7-2 Control hierarchy principles

Each technical chapter of the EIA report will detail the measures recommended to mitigate any identified significant effects and any measures that may provide positive environmental effects.

7.3 CUMULATIVE IMPACTS

Where possible the cumulative impacts of the Al Manakher Solar PV Project will be considered within the EIA. Two types of cumulative impacts will have to be considered:

- **Type 1 Cumulative Impact**: the combined impacts of different environmental factors from a single development on a particular receptor, e.g. one residential property may experience a degradation in local air quality and an increase in noise levels as a result of a single development; and
- **Type 2 Cumulative Impact**: the combined effects of all developments within the area, e.g. impacts on air quality from one development may not be significant when considered alone, but may be significant in combination with other proposed developments or existing facilities.

7.4 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

One of the most widely used environmental management systems, developed by the International Organisation for Standardisation (ISO), is the ISO 14001 standard for environmental management of activities, services and products.

The structure of a typical Environmental Management System (EMS) certified to ISO 14001 is illustrated by Figure 7-3 below, and will provide a logical framework from which the CEMP will be tailored for the construction phase of the proposed project, so as to capture the initial environmental and social mitigation measures of the corresponding EIA.

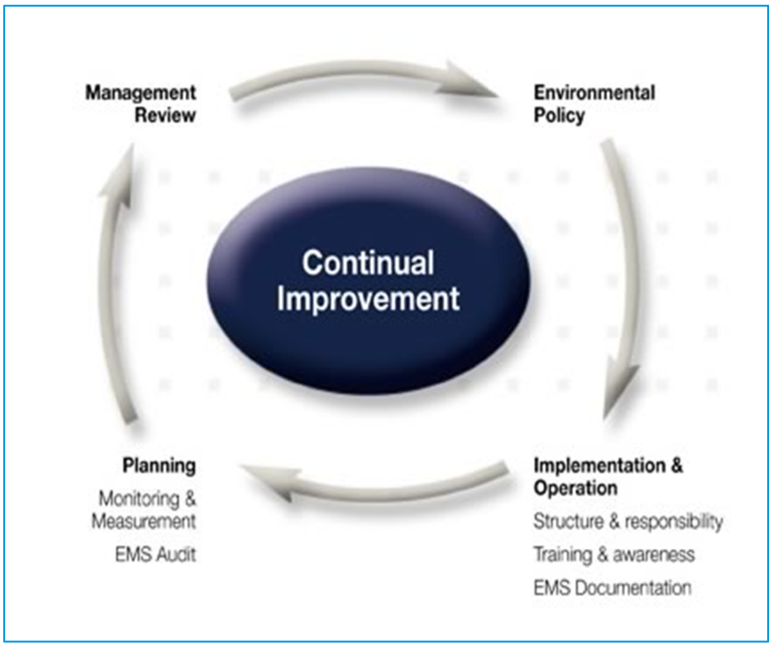

Figure 7-3 ISO 14001 model

A Construction Environmental Management Plan (CEMP) will be included within the EIA and will detail the environmental and social mitigation measures and associated monitoring activities which need to be implemented during the construction phase of the proposed project by all construction contractors.

In addition, the CEMP will provide a logical extension of the EIA and will ensure that recommendations contained within the EIA are implemented by the construction contractor and sub-contractors.

The CEMP will be designed to simultaneously ensure that the requirements of the MoE and international best practice are met and serve as a clear and auditable indication as to how they will be implemented during the construction phase of the project. For ease of reference and implementation, the CEMP will be divided into four components:

- Chapter I: Overview;
- Chapter II: Environmental Management System;
- Chapter III: Environmental Control Plans; and
- Chapter IV: Environmental Monitoring programme.

It is important that this document is referenced or incorporated into the EPC contract so that the construction contractor(s) can take appropriate steps that adhere to the mitigation strategy. Implementation of the ESMP is necessary to ensure that all national and lender-specific conditions related to environmental, health, safety and social impacts of the project are met. Contractor performance should be monitored and corrected as necessary.

7.5 OPERATION ENVIRONMENTAL MANAGEMENT PLAN

A framework Operation Management Plan (OEMP) will be included within the EIA which will provide a plan for the future development of detailed procedures by the operating company including the long-term objective of continual improvement in relation to environmental performance and the successful application of any pollution abatement technology associated with the project.

Proper OHS risk identification and management measures should be incorporated in every project's management plan and standard EPC contractual clauses

Monitoring of parameters during the operational phase of the project will be outlined in order to ensure that the impacts are evaluated correctly and that necessary mitigating measures are successfully implemented. Reporting requirements include performance, environmental, health and safety, and labour relations reporting.

SECURITY PLAN

A key component of the OEMP will be the development of a robust security plan which needs to be put in place, especially in areas where there may have been objections to the works or where unemployment or crime is an issue. The security arrangement for the site needs planning and adequate budgeting.

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6.	Motlaq Salama Al-Da'ajah	Local Community		
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12.	Dr. Asma' Al-Ghazawi	Ministry of Municipal Affairs	0777272008	
13.	Eng. Muna Al-Hababheh	Ministry of Industry, Trade and Supply	0799048281	
14.	Ameen Tahboub	Ministry of Health	0795146105	Tahboub_ameen@yahoo.com
15.	Dr. Mohammad Al-Harahsheh	Governor of Sahab	0799050701	
16.	Amjad Al-Momani	AES		
17.	Muna Musa	Energy and Minerals Regulatory Commission	0799783578	

APPENDIX A-4

ATTENDEE SIGN-IN SHEET

APPENDIX A-5

FINDINGS AND FEEDBACK FROM SCOPING SESSION

Organization – الجهة	Note	الملاحظة	#
Ministry of Environment – وزارة البيئة local community– المجتمع المحلي	conservation of Neighboring Pastures and plants during the construction and operation process.	المحافظة على المراعي المجاورة والمزروعات، ووضع اجراءات لعدم تأثر هذه المراعي خلال مرحلة التشغيل والانشاء	.1
Ministry of Environment – وزارة البيئة	Landscape and Visual impacts	عدم الإضرار بالمنظر الطبيعي	.2
Ministry of Environment – وزارة البيئة	Bio-diversity conservation	المحافظة على التنوع الحيوي	.3
Al-Manakher – مدرسة المناخر الأساسية Primary School	Due to the current situation in the region that affects Jordan, public schools are in need for support to fulfil their commitments, including Al-Manakher School (Kindergarten – 7th Grade) for Both Girls and Boys because there is No Boys school in the village. Additionally students are forced to walk 5 km to precede their education after the 7th grade.	نظرا للظروف التي تطرأ على الأردن نتيجة الأحداث المجاورة تحتاج المدارس في وزارة التربية إلى الدعم للوفاء بإلتزاماتها ومنها مدرسة المناخر وهي مدرسة من (الروضة – السابع) مختلطة لعدم وجود مدرسة ذكور في المنطقة. الطلبة بعد السابع يسيرون على الأقدام 5 كم.	.4
Al-Manakher – مدرسة المناخر الأساسية Primary School	There is a necessity to establish a boys school in the village	ضرورة وجود مدرسة ذكور	.5
Local community – المجتمع المحلي	Putting a Fence around the working area	وضع سياج حول منطقة العمل	.6
Local community– المجتمع المحلي	Use appropriatemethod to control the noise level.	وضع طرق مناسبة للسيطرة على الضجيج	.7
Al-Manakher – مدرسة المناخر الأساسية Primary School	Building of five Classrooms for the existing school in order to become a high school	بناء 5 غرف صفية لتصبح مدرسة المناخر ثانوية	.8
Al-Manakher – مدرسة المناخر الأساسية Primary School	The school is in need for Playgrounds/open areas/school supplies	المدرسة بحاجة ملاعب/ساحات/مظلة/لوازم مدرسية	.9
Al-Manakher – مدرسة المناخر الأساسية Primary School	Supporting Sakan Kareem (a Housing support Program for least opportune areas)	دعم سكن كريم	.10
Ministry of Environment – وزارة البيئة	Impact of construction activities on Public health.	أنقاض الحفر وتأثيرها على الصحة العامة	.11
Ministry of Environment – وزارة البيئة	Impact on archaeological sites (if there is any)	دراسة موضوع الآثار (في حال وجودها)	.12
Ministry of Environment – وزارة البيئة	The effects of floods and heavy rainfall on the project, and the mitigation measures to minimize these effects	تأثر المشروع من الفيضانات والأمطار الشديدة والإجراءات التخفيفية لحماية المشروع	.13
Ministry of Environment – وزارة البيئة Energy and – هيئة تنظيم قطاع الطاقة والمعادن Minerals Regulatory Commission local community– المجتمع المحلي	Impact of solar glare on the Main Roads, and on the local community	أثر الوهج الذي قد ينتج عن الخلايا الكهروضوئية على الطريق الرئيسية والسكان المحليين.	.14

.15	التخلص من الخلايا الكهروضوئية التي تعرضت للكسر	Disposal of broken photovoltaic cells in a proper method.	Ministry of Environment – وزارة البيئة
.16	التخلص من الخلايا الكهروضوئية بعد إنتهاءعمر المشروع	Disposal of photovoltaic cells at the decommissioning phase	Ministry of Environment – وزارة البيئة Ministry of Water and Irrigation – وزارة المياه والري
.17	عدم التأثير على الأودية إن وجدت	Impact on wadis, if there are any.	Ministry of Water and Irrigation – وزارة المياه والري
.18	إنشاء تحويلات لمجاري المياه	Constructing a detours for water flow basins	Ministry of Water and Irrigation – وزارة المياه والري
.19	حساب كمية الفيضانات التي يمكن أن تحدث وأثرها على تجريف التربة وقواعد اللوحات الشمسية إلى أي مدى يمكن أن تنجرف التربة تحت القواعد	Calculating the flood flow that might occurred, and the effects of these floods on soil erosion, and the basis of the photovoltaic cells, to what extent the soil erosion can happen under these basis	Ministry of Water and Irrigation – وزارة المياه والري
.20	الإنتباه إلى مخلفات العمال والإنشاء والتخلص منها بعد الإنشاء	Management of solid waste resulting from construction activities and from workers domestic use.	Ministry of Water and Irrigation – وزارة المياه والري Ministry of Health – وزارة الصحة
.21	تأثير حركة الشاحنات على حركة المرور في القرية و القرى المجاورة	Traffic and infrastructure impact on the village and on the nearby village.	Ministry of Water and Irrigation – وزارة المياه والري Local community – المجتمع المحلي
.22	أثر المخلفات الصلبة والسائلة والزيوت	Impact of solid wastes, wastewater and spilled Oils	Ministry of Water and Irrigation – وزارة المياه والري Ministry of Health – وزارة الصحة Local community– المجتمع المحلي
.23	جمع مخلفات العمل والتخلص منها بطريقة آمنة	Solid waste management	Ministry of Water and Irrigation – وزارة المياه والري Ministry of Interior – وزارة الداخلية Local community– المجتمع المحلي
.24	حوادث الطرق	Road Accidents	Ministry of Health – وزارة الصحة
.25	الأغبرة الناتجة من حركة السيارات	Generated dust from vehicle Activities	Ministry of Health – وزارة الصحة
.26	وضع طرق للسيطرة على الأغبرة الناتجة من عمليات البناء والحفر	Conducting proper Mitigation Measures for the generated dust from Construction and drilling activities	Ministry of Health – وزارة الصحة Energy and Minerals Regulatory Commission – هيئة تنظيم قطاع الطاقة والمعادن local community– المجتمع المحلي

Ministry of Health – وزارة الصحة Energy and – هيئة تنظيم قطاع الطاقة والمعادن Minerals Regulatory Commission	Noise impact on the nearest populated area and the nearest development areas (Projects), schools and worship houses	الضجيج ومستوياته ومدى تأثيره على أقرب التجمعات السكانية والمناطق التنموية القريبة (المشاريع)، المدارس والمساجد	27.
Ministry of Health – وزارة الصحة Ministry of Interior – وزارة الداخلية	The emergency measures in case of accidental breaking of cells components (Hazardous wastes)	في حال حدوث كسر لبعض المواد الداخلة في الصناعة مثل الخلايا كيفية التعامل معها	28.
Ministry of Health – وزارة الصحة	Medical examination for employees.	الفحوصات المهنية المراد إجراءها للعاملين (أولية ودورية)	29.
Ministry of Health – وزارة الصحة	Employees training and Awareness raising	التدريب والتوعية للعاملين	30.
Ministry of Health – وزارة الصحة	Guidance Signs for employees	اللوحات الإرشادية للعاملين	31.
Ministry of Health – وزارة الصحة	Personal protection equipment availability	الأدوات الوقائية وملابس العمل	32.
Ministry of Health – وزارة الصحة	Environmental Measures intended to be made ($PM_{2.5}$, PM_{10}, TSP)	القياسات البيئية المراد إجراءها ($PM_{2.5}$, PM_{10}, TSP)	33.
Ministry of Health – وزارة الصحة	Handling and Disposal of E-wastes	التعامل مع النفايات الإلكترونية والتخلص منها	34.
Energy and – هيئة تنظيم قطاع الطاقة والمعادن Minerals Regulatory Commission	The project should comply with the existing regulations and standard regarding the harmful impact coming out from the construction activities.	ضرورة اللإلتزام بالمعايير البيئية للأضرار الناتجية عن عمليات الإنشاء	35.
هيئة تنظيم قطاع الطاقة والمعادن – Energy and Minerals Regulatory Commission	Study the possibility of reusing cleaning wastewater from the photovoltaic cells, in order to be used by the project's management for green areas (irrigation) or for household use except drinking.	دراسة إمكانية تجميع مياه التنظيف على الألواح الشمسية لاستخدامها من قبل إدارة المشروع لدى المساحات الخضراء إن وجدت أو للاستخدام المنزلي عدا الشرب	36.
هيئة تنظيم قطاع الطاقة والمعادن – Energy and Minerals Regulatory Commission	Landscaping and rehabilitation of the project site to avoid forming of ponds inside the project area which might be dangerous for local community	إعادة طبوغرافية الأرض إلى الوضع الصحيح لتجنب تجميع المياه داخل المشروع وتشكل برك مائية قد تكون خطيرة على المجتمع المحلي	37.
Ministry of Interior – وزارة الداخلية	Stakeholder Engagement	إستمرار اللقاءات مع المجتمع المحلي	38.
Ministry of Interior – وزارة الداخلية Rangers – الإدارة الملكية لحماية البيئة Local community– المجتمع المحلي	Give priority for local community in terms of employment.	إعطاء الأولوية لأبناء المجتمع المحلي في فرص العمل	39.
Ministry of Interior – وزارة الداخلية Local community– المجتمع المحلي	Support the local community	التركيز على دعم المجتمع المحلي	40.
Rangers - الإدارة الملكية لحماية البيئة	Giving the local community special rates in terms of electricity fees	تخفيض فاتورة الكهرباء لسكان المجتمع المحلي	41.

APPENDIX A-6

PHOTOGRAPHS FROM THE SCOPING SESSION

1 Stakeholders - Scoping Session, Amman

2 Stakeholders - Scoping Session, Amman

3 AES Jordan Presenter - Scoping Session, Amman

Appendix B

TERMS OF REFERENCE REPORT

APPENDIX B-1

TERMS OF REFERENCE REPORT

REPORT N° 005

AL MANAKHER PV PLANT

EIA TERMS OF REFERENCE

CONFIDENTIAL

DECEMBER 2016

WSP | PARSONS BRINCKERHOFF

AL MANAKHER PV PLANT

ENVIRONMENTAL TERMS OF REFERENCE

AES

Confidential

Project no: 52001890
Date: December 2016

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1 EIA TERMS OF REFERENCE

1.1 INTRODUCTION

This Terms of Reference (ToR) report has been prepared by WSP | Parsons Brinckerhoff for AES Jordan (AES) Jordan (the Developer) in association with Royal Scientific Society (RSS) of Jordan, a locally registered environmental consultant.

A comprehensive environmental impact assessment (EIA) is required for the proposed Project in order to ensure that environmental and social issues are appropriately considered in the project design and management. Furthermore, an EIA is necessary with respect to Jordanian national legislative requirements, initiating the environmental permitting process by the Ministry of Environment (MoE) in order to secure an environmental approval.

This document, which should be considered in accompaniment with the subsequently submitted scoping report, sets out the Terms of Reference for the development of the EIA which will be completed proposed Al Manakher Solar PV Plant, herein referred to as the Project, in Jordan..

1.2 PROJECT BRIEF

The Government of Jordan is promoting the generation of renewable energy by adopting a renewable energy strategy. The strategy has set a 10% renewable energy target by 2020. The Renewable Energy and Energy Efficiency Law permits the Ministry of Energy and Mineral Resources (MEMR) to request proposals for the development of renewable energy projects.

In response to this strategy, the Developer, in consortium with Mitsui and Company Ltd, is seeking permission to construct and operate a solar photovoltaic (PV) farm of up to 50 MW at a site approximately 2-3 km east of the existing IPP4 Al-Manakher tri-fuel power plant in Jordan, which is also owned and operated by the Developer.

The Project site is government-owned and has a proposed footprint of 498,000 m^2. The nearest residential properties are in Al-Manakher village, which is located approximately 2-3 km to the south west of the Project boundary. The location and Project boundary is shown in Figure 1-1.

With the exception of the existing IPP1, 3 and 4 sites, there are no industries in the immediate vicinity of the Project site. The Project site is clear of structures and has been subject to recent earthworks by the Ministry of Land. There is very sparse indigenous vegetation on-site and the Project site is not known to contain any sensitive flora or fauna.

To the south and east of the Project site, there are a limited number of temporary agricultural dwellings belonging to Bedouin families. These groups use the land primarily for grazing livestock.

The power produced as a result of the Project will be purchased under a power purchase agreement (PPA) with NEPCO who will also be responsible for the construction of the transmission line between the proposed Project site and a substation at the IPP4 (approximately 2 km along the roadway).

Figure 1-1 Proposed Project Site Location and OHTL Interconnection and Cable Routing

1.3 EIA STRUCTURE

The EIA will include the findings of both the environmental and social assessments undertaken for the proposed Project. The EIA report will be required to meet specific national and international best practice guidelines including the following:

- Jordanian EIA Regulation No.37 of 2005, specifically Annexes 1-5; and
- IFC Performance Standards and Equator Principles.

In line with the above requirements, the EIA will specifically address the issues as identified in the accompanying Scoping report, and it is proposed that the associated structure of the EIA report would be as follows:

- Introduction;
- Overview of the Project;
- Relevant Legislation and Standards;
- Approach to the EIA;
- Description of the Baseline Environment;
- Technical Assessments including:
  - Assessment of Construction Impacts;
  - Assessment of Operational Impacts; and
  - Residual Impacts.
- Summary of Impacts & Mitigation;
- Conclusions and Recommendations;
- Construction Environmental Management Plan;
  - Construction Mitigation Measures;
- Operation Environmental Management Plan;
  - Operation Mitigation Measures; and
- Technical Appendices.

In addition, to complying with the requirements noted above, the EIA will also take full account of the requirements of the relevant IFC Performance Standards, which are considered best international practice and lender banks involved in the financing of the project are likely to require their consideration. It has been determined that the following main IFC Performance Standards will apply:

- *Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;*
- *Performance Standard 2: Labour and Working Conditions;*
- *Performance Standard 3: Resource Efficiency and Pollution Prevention;*
- *Performance Standard 4: Community Health, Safety and Security;*
- *Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources; and*
- *Performance Standard 8: Cultural Heritage.*

2 DETAILED ASSESSMENT OF ENVIRONMENTAL AND SOCIAL IMPACTS

2.1.1 INTRODUCTION

A number of environmental and social issues identified in the accompanying Scoping report require a detailed assessment to be undertaken. These studies will need to be undertaken by an appropriately qualified and experienced EIA Consultant that is familiar with both local and international environmental requirements. The assessment process in the EIA will be divided into three basic steps:

- Determination and evaluation of the current baseline conditions on the proposed Project site;
- Assessment of the extent, severity and significance of the impacts; and
- Assessment of appropriate, and cost effective, mitigation measures that could be implemented on the proposed project with the primary objectives to reduce the significance of the negative impacts and further enhance any positive impacts.

The following Section describes the proposed methodology for the assessment to be undertaken in the EIA of each of the environmental and social issues identified and described in Chapter 5 of accompanying submitted Scoping report.

2.1.2 AIR QUALITY

ASSESSMENT OF BASELINE CONDITIONS

A literature review of any available air quality studies for the area will be undertaken to provide or confirm initial information on background air quality. This will allow comparison against Jordanian standards, IFC and WHO standards to determine any existing exceedances.

A desk study to establish the location of any receptors in the vicinity of the Project site that may be sensitive to changes in air quality as a result of the proposals will also be undertaken. As the Project site has already been cleared by the Ministry of Finance, limited earthworks or soil movements are expected. These activities are considered the primary causes of air quality deterioration associated with such a project.

Due to the minimal emissions anticipated from this renewable Project and limited earthworks expected, few receptors and the high particulate levels encountered in the region, due to the arid conditions, no baseline monitoring is considered necessary or proposed.

CONSTRUCTION PHASE ASSESSMENT

The principle sources of emissions during construction will be dust generation through earthmoving and stockpiling and vehicle movements etc. together with exhaust emissions from construction vehicles, plant and other machinery and, if power is not supplied to the Project site, the use of generators.

To assess the impact of the construction phase, a qualitative assessment of the effects of dust / particulate generation on local air quality will be undertaken using recent publications and guidance and local meteorological data, taking account the distance and direction from the Project site to the nearest sensitive receptors locations.

OPERATIONAL PHASE ASSESSMENT

Daily operations of the Project will only involve primarily periodic maintenance and worker trips. Although emissions from these activities are expected, they would be minimal. Based on the nature of the Project and that the proposed Plant will not emit any pollutants, it is expected that operational activities will not impact adversely impact air quality.

The EIA will qualitatively consider potential vehicle movements during construction (e.g. security or maintenance vehicles), panel cleaning activities, with the ground substrate and existing conditions in order to identify the significance of limited dust impacts expected during operations.

2.1.3 NOISE EMISSIONS

ASSESSMENT OF BASELINE CONDITIONS

A review of the Project site layout plans will be undertaken and an infrastructure-specific construction noise and vibration assessment will be completed. During the site walkovers, identification of sensitive receptors (e.g. local farms/residences) will be made. The Project will be expected to comply with industrial facility noise standards at the boundaries and no more than a 3dB(A) rise at sensitive receptors although, in reality, very little noise is expected during operations so residential noise limits may be achievable.

In order to characterise the noise environment at the site, a combination of short-term monitoring (15 minute periods) will be undertaken at the four Project site boundaries and a longer term (up to 24-48 hours) noise meter will be deployed at the southern boundary (or closest feasible location) to more accurately gauge traffic noise. As a rural area with limited surrounding industries/receptors, the noise environment is not expected to significantly differ between weekday and weekend periods and is likely dominated by road noise on the southern boundary.

Sound level measurements will be conducted using a Rion NL-52 sound level meter. This is a precision “Class 1” integrating sound level meter conforming to British Standard BS EN 61672-2:2013 “*Electroacoustics. Sound level meters. Pattern evaluation tests*”. This meter records average sound levels over a set period (typically 15 minutes) and does not record audio (e.g. speech).

For the longer term monitoring period, the meter will be housed within environmentally protected plastic case with its own battery and a metal pole with a wind-shielded microphone sitting atop a steel pole. The sound level meter will be field-calibrated with an acoustic calibrator before and after each of the noise surveys and the microphones shall be placed at a height of 1.5 m to 1.8 m from ground level and at least 3.5 m away from any reflective surfaces. Monitoring will be undertaken in accordance with International Standard ISO 1996-1:2003 “*Acoustics -- Description, measurement and assessment of environmental noise -- Part 1: Basic quantities and assessment procedures*”,

CONSTRUCTION PHASE ASSESSMENT

A construction noise assessment will be conducted in accordance with international practice. Construction noise guidelines within Jordan are understood to comprise of restricting construction equipment which produces loud noises between 8 pm and 6 am, except in cases specifically approved by the MoE.

The methodology for the noise assessment generated by construction equipment will be predicted using British Standard BS 5228-1:2009+A1: 2014 “*Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*” (BS 5228-1).

The results of the construction noise assessment will be discussed in the EIA report, quantitatively as appropriate, identifying potential peak and average noise impacts at nearby receptors with Consideration of the Jordanian limits (Jordanian Guidelines for Prevention of Noise (2003)) in addition to the 3dB(A) increase limit specified in IFC will be made within the assessment.

Based on the results of the assessment, recommendations for noise mitigation will be provided where necessary for inclusion in the Construction Environmental Management Plan (CEMP).

OPERATIONAL PHASE ASSESSMENT

With very limited noise sources within an operational PV plant, a qualitative assessment will form the basis of the assessment of the Project for the operational period. Quantitative data from the equipment manufacturers/EPC Contractor will be used in order to characterise the plant (e.g. noise levels at 1m from equipment) and general information on the likely maintenance frequencies and associated vehicle movements will be utilised in order to identify potential impacts to the closest receptors and compliance with boundary noise limits. It is also expected that maximum guarantee levels at the site boundary and for equipment will form the basis for the EPC contractor’s proposal and these will be considered as appropriate within the assessment.

2.1.4 WASTE MANAGEMENT AND ENERGY EFFICIENCY

ASSESSMENT OF BASELINE CONDITIONS

A high level assessment of existing waste management infrastructures will be undertaken through a review of publicly information on Al Manakher and the Amman Governorate. The primary objective of the review will be to establish the availability, condition and capacity of the existing waste management facilities associated with transportation, recycling, treatment, disposal and recovery operations at local and regional level.

During the initial scoping session held in November 2015, the Ministry of Health (MoH) and MoE raised the concern of ensuring that proper methods are in place for end-of-life module disposal. Responding to this, during the EIA a review of the legal and regulatory framework for handling and disposal of e-waste will be reviewed in the context of the decommissioning of the plant and disposal of the solar PV panels. Further information sought from the EPC Contractor particularly related to whether any buy-back type arrangements are being provided by the panel suppliers. With a number of solar projects understood to be in various stages of development in Jordan, panel disposal/reuse will be a key issue for all projects. The baseline assessment will seek to characterise the potential projects being considered with respect to cumulative assessment of level of panels, which will potentially need to be dealt with on a regional/national level within the context of the proposed facility.

CONSTRUCTION PHASE ASSESSMENT

A construction phase waste inventory will be established to outline the predicted quantities of the various waste streams generated during the construction phase of the proposed Project and the associated intended management and disposal options.

The EIA will include the following tasks to determine the impacts of the Project:

- A review of local and national waste policies, legislation and guidance to confirm the minimum requirements for waste provision;
- Review of a logistics plan and waste handling strategy for the project; and
- Development of a waste management control plan, which will feed into the CEMP as part of the EIA.

The assessment will also identify the necessary measures that will need to be put in place in order for the Project to demonstrate compliance with local and international regulations.

The EIA will also identify these opportunities for the reduction, re-use, recycling and recovery of construction waste streams in the detailed CEMP.

OPERATIONAL PHASE ASSESSMENT

PV plants by their nature produce very limited waste. Waste is expected to comprise of limited domestic-type waste from operational staff and security and maintenance type materials such as used rags and other consumables. Panels are designed for >20 year operational life and are not expected to need disposal during the operational phase, outside of incidental damage or panel failure.

An operational phase waste inventory will be prepared which will outlines the predicted quantities of various waste streams generated by the operational phase of the proposed Project and the associated intended management and disposal options through consultation with the EPC Contractor and Owner. The predicted levels of waste generated will be reviewed against the likely disposal and reuse options available.

DECOMMISSIONING PHASE ASSESSMENT

Consideration of end-of-life module disposal and decommissioning of the constructed plant will be identified and discussed in the EIA.

2.1.5 SOIL, HYDROLOGY AND WATER QUALITY

ASSESSMENT OF BASELINE CONDITIONS

With water use for the Project expected to be largely limited during construction to watering down access roads and provision of potable water for workers, impacts to soil and hazardous materials are likely to be minimal; potential impacts to soil and hydrology are likely to be limited.

The assessment to be included in the EIA will include:

- Reviewing available soil and groundwater studies for the area surrounding the Project site;
- A desk study and Project site walkover in order to establish the location of any current or historic potential sources of contamination and/or receptors that may be sensitive to changes in soil and groundwater quality as a result of the construction or operation of the Project;
- Satellite imagery review and site walkover to identify of wadis, drainage channels on site;
- Reviewing the relevant legislation, guidance and local policy to ensure assessment against the relevant standards;
- Consideration of rainfall profile in area and likely stormwater volumes; and
- Consultation with Ministry of Water and Irrigation (MWI).

Information from site investigations undertaken by the client or contractor will be referenced in the EIA if available.

CONSTRUCTION PHASE ASSESSMENT

A qualitative risk assessment will be undertaken with regards to potential soil and groundwater contamination associated with the construction phase of the proposed Project. Where significant risks are identified, mitigation and management measures will be established for inclusion within the detailed CEMP.

OPERATIONAL PHASE ASSESSMENT

Where significant risks are identified, mitigation and management measures will be established for inclusion within the detailed OEMP, in addition, specific mitigation measures will be provided to identify the appropriate remediation actions to be taken during contamination events.

2.1.6 WASTEWATER AND WATER RESOURCES

ASSESSMENT OF BASELINE CONDITIONS

Existing water resources, wastewater collection and associated treatment systems will be considered and described within the EIA. The two main sources of surface water in the Project area are springs and dams, located within the Amman-Zarqa basin.

These surface water sources are limited to flash storms, which normally occur during the winter months. This storm water is not collected as it either evaporates or percolates into the ground. The average annual rainwater from 1980 to 2006 is approximately 233 mm and occurs during the winter months of October to March.

The nearest known water users are the communities from the Bedouin Settlement to the west, Alain Farm 800 m south of the Project site and Ghabawi Landfill 2.5k m north of the Project site. The only significant water consumer on an industrial scale in the area is anticipated to be IPP1, which is located 9 km west of the Project site.

CONSTRUCTION PHASE ASSESSMENT

An assessment of the requirements for water will be established within the EIA, in addition to wastewater disposal options against the relevant environmental standards during the construction phase of the proposed Project. This will include assessing and optimising plans for minimising water consumption during the construction phase of the project and ensure legal compliance during wastewater discharge events.

The EIA will also consider potential impacts on local drainage and stormwater during construction, with best practice measures identified and included within the CEMP as appropriate.

OPERATIONAL PHASE ASSESSMENT

With dry brush cleaning anticipated to be the cleaning method employed at the site, the use of water is expected to be limited to potable water for operational staff and incidental cleaning of PV panels for difficult to clean dirt.

The EIA will consider the source and amount of water required for panel cleaning and domestic water use as well assessing plans for water use minimisation, water treatment and water reuse and disposal.

Consideration will also be made within the EIA for the stormwater drainage system proposed at the Project site. Potential infiltration and disposal route of drainage water with respect to the local area and potential receptors for this water through identification of natural drainage channels around the Project site and ultimate disposal points.

2.1.7 TERRESTRIAL ECOLOGY

ASSESSMENT OF BASELINE CONDITIONS

With the site having been already cleared by the Ministry of Finance, terrestrial ecology at the Project site is expected to be extremely limited. Nonetheless, a terrestrial ecology survey of the Project site and the immediate surrounding area will be undertaken by specialists within Jordan. Due to the nature of disturbance the survey surrounding the Project boundary is not deemed to extend beyond 10 m.

Fauna, particularly mammals, birds, reptiles and some arthropod groups will be surveyed by direct and indirect observation, with identification to species level wherever possible. Indirect observations will involve identification of tracks, droppings, burrows and carcasses. A rapid flora and fauna survey using transect count will be undertaken over three days. The survey will focus on the following topics:

- Species richness and diversity;
- Plant communities and associated fauna; and
- Ecologically sensitive habitats.

The survey will involve quadrat sampling, transect counts and general observation by undertaking a walkover and drive over assessment of the major habitats, flora and fauna in the Project site.

Data collected during site surveys would then enable the following to be undertaken:

- A qualitative baseline of the habitat classification of the site;
- Assessment of the communities in terms of biodiversity value to provide an indication of national and international importance;
- Indicative species lists for all taxa recorded;
- Digital photographic record of the site and selected taxa on site; and
- Emphasis will be placed on identification of sensitive or threatened/endangered species and communities.

The accompanying Scoping report indicates that no important birdlife areas or areas of high ecology value are within 70 km of the site and migratory routes are also not present in the general area. Notwithstanding this, a desk-based assessment will be made of available information in order to consider within the context of the terrestrial ecology survey findings.

Where appropriate, a standard data sheet will be used during the flora and fauna survey. The International Union for Conservation of Nature (IUCN) Red List of Threatened Species will be used to determine the population status and distribution flora and fauna.

CONSTRUCTION PHASE ASSESSMENT

The EIA will determine whether the scope of impacts may have changed due to landscape and biodiversity changes since the last study for IPP4 was undertaken. The baseline survey will ensure that potential impacts on undisturbed natural habitat or sensitive habitats are identified and key receptors of relevance to each site.

The EIA will assess ecological impacts associated with the footprint of the construction phase as well as those associated with the construction planned activities. Appropriate mitigation and management measures will be established in the CEMP.

OPERATIONAL PHASE ASSESSMENT

Impacts upon terrestrial ecology during the operational phase of the proposed Project are expected to be minimal. The EIA will consider ways to enhance the terrestrial ecology via planned landscaping and irrigation options where feasible (using stormwater) across the proposed footprint area.

2.1.8 SOCIO-ECONOMIC

ASSESSMENT OF BASELINE CONDITIONS

In order to ensure that a comprehensive assessment of the potential socio-economic impacts is undertaken, it will be necessary to conduct a comprehensive baseline data collection exercise that will involve desk-based research and a review of available information relating to the project site. Relevant stakeholders will also need to be consulted with in order to provide a detailed understanding of the issues and requirements of individual stakeholders.

The following data, where available, will be collected as part of the EIA to allow a full assessment of impacts:

- Demographics;
- Economic conditions (e.g. employment, education, livelihood, skills);
- Land ownership and use;
- Social infrastructure, utilities, and services;
- Transportation; and
- Health and safety of communities, construction workers and operational staff.

The baseline data collection will be undertaken in accordance with the following geographical categorisations:

- National – macro social and economic impacts;
- Regional – region-wide social and economic impacts; and
- Local – micro social and economic impacts (within 100-300 m from the Project site boundary).

In addition, the area under assessment shall include any social, civic and commercial facilities that are close to the Project site.

In order to define a communication process in accordance with national regulations and international best practice, several stakeholder groups that may be interested and/or affected by the Project have been categorised as follows:

- People and social groups who will be directly or indirectly affected (positive and negative) by the Project,
- People and social groups who may participate in the implementation of the project;
- People and social groups who may have a possibility to influence and make decisions on the implementation of the project and/or may have an interest in the project; and
- Stakeholders who may be interested in the project: these are stakeholders whom are not affected by the project directly or indirectly but may have an interest in the implementation of the Project.

The overall intention is to disseminate key information to the relevant stakeholders on the project during the Study and determine any concerns or opinions they may have regarding the project. This will be elaborated in the stakeholder engagement plan.

CONSTRUCTION PHASE ASSESSMENT

Once the social and economic baseline has been determined, an assessment of the social impacts, both positive and negative, will be undertaken for the construction phase of the project, and subsequently included within the technical chapter of the EIA.

Based on the findings of the above activities and using the information about the project, the potential impacts of the Project activities on local communities, gender and related social issues will be assessed in accordance with applicable Jordanian laws and regulation, and IFC requirements.

In particular, the EIA will assess the potential impacts of the project activities on socio-economic conditions including:

- Employment
- Supplementary businesses/commercial impacts
- Local infrastructure
- Agricultural and range lands

The EIA will propose mitigation measures to reduce the negative impacts and to enhance the positive ones in addition to necessary follow up and monitoring activities related to socio-economic conditions including gender conditions. Consideration of the construction practices followed by the EPC Contractor during IPP4 construction in addition to feedback received during stakeholder consultations will be made in order to ascertain whether any improvements in the employment business liaising can be made in order to enhance the Project’s benefit to the local community.

Consideration will be made on the potential interactions of the large construction workforce on the local community if they are not sourced from available local workers. Employment strategies and training procedures will also be considered within the context of the experience of the IPP1 and IPP4 projects through liaison with AES personnel for any potential ‘lessons learnt’.

OPERATIONAL PHASE ASSESSMENT

Once the social and economic baseline has been determined, an assessment of the social impacts, both positive and negative, will be undertaken for the operational phase of the project, and subsequently included within the technical chapter of the EIA.

During operation, it is expected that there will be a marginal increase in the demand of local services given the limited staff expected during this phase. Local businesses such as food suppliers, transportation and service providers will benefit directly somewhat from the Project. In response to stakeholder’s feedback during the scoping session, the EIA will aim to identify opportunities for the project to benefit identified and affected communities by schemes such as contributing to vocational training programs, educational programs or similar feasible projects. It is anticipated that any such measures will also consider and complement the IPP4 and IPP1 programmes as appropriate with these existing programmes expected to form the basis for such engagement given their relative proximity to the local community at the Al Manakher village.

2.1.9 CULTURAL, HERITAGE AND ARCHAEOLOGY

ASSESSMENT OF BASELINE CONDITIONS

While the Project site has already been cleared by the Ministry of Finance, consideration of potential antiquities will still be necessary. In order to establish the archaeological baseline, an experienced local specialist will conduct a review of available data through Jordan Antiquities Database and Information System (JADIS) searching library searching of DAJ, American Centre of Oriental Research (ACOR) and British Council for Research in Levant (BCRL).

The specialist will also visit the site and the surrounding area to identify site sensitivities related to the solar development and associated infrastructure including any areas to be avoided, including buffers. Any archaeological finds shall be recorded.

CONSTRUCTION PHASE ASSESSMENT

With the Project site already having been cleared the likelihood of the limited groundworks expected for the solar plant uncovering archaeological finds is considered to be low. Nonetheless, the EIA will identify the main activities during the construction phase that may have the potential to impact upon buried archaeological remains and will establish a guidance document associated with a watching brief to be undertaken during the construction phase of the proposed Project although impacts are expected to be negligible at the present time.

OPERATIONAL PHASE ASSESSMENT

No impacts to cultural heritage/archaeology are expected during construction, but where appropriate, mitigation and management measures may be established in the OEMP.

2.1.10 LANDSCAPE AND VISUAL

ASSESSMENT OF BASELINE CONDITIONS

A desk study will be undertaken initially to establish the physical components of the local landscape (including land uses), using available mapping, aerial photographs and topographical surveys.

The surveys will collect data on the following site and layout design options:

- Module size
- Array configuration
- Module tilt
- Height of module/array above ground
- Spacing between arrays
- Location of inverters and other electrical infrastructure
- Dimensions of inverters and other electrical infrastructure

WSP | Parsons Brinckerhoff will prepare a Zone of Theoretical Visibility (ZTV) up to 10 km from the Project site which will identify where the project can be seen from in relation to the topography surrounding the site. Up to four (4) suitable viewpoints from which photomontages of the development will be produced with consideration of available receptors identified during site walkover, which will include sensitive viewpoints, communities or main highways.

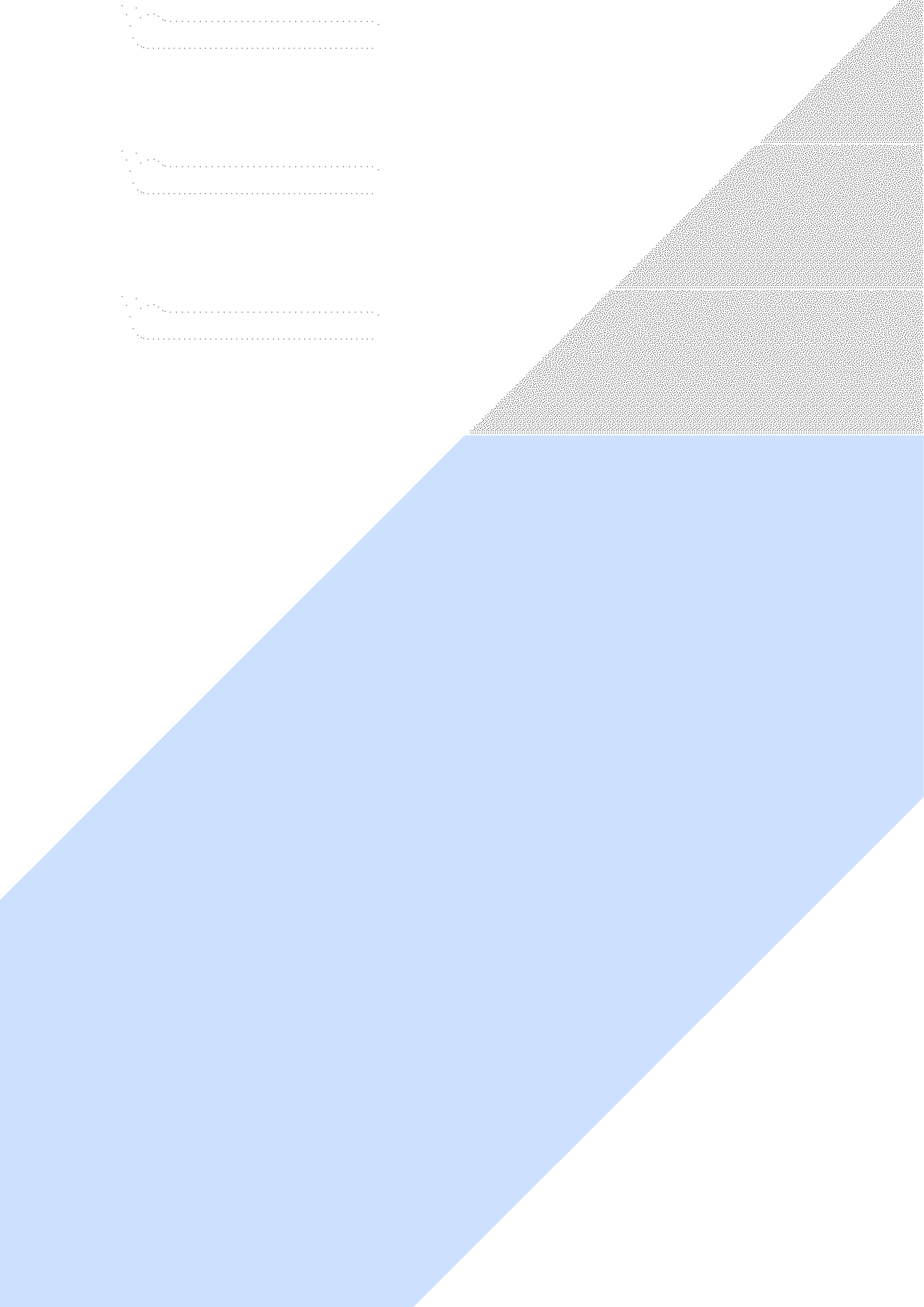
CONSTRUCTION PHASE ASSESSMENT

The ESIA will identify the main activities during the construction phase that have the potential to impact upon the existing landscape character. Mitigation and management measures will be established although impacts are expected to be negligible at the present time.

OPERATIONAL PHASE ASSESSMENT

Subject to the review of the sensitive receptors and design of the facility (with particular respect to height) Images will be produced which show the PV panels and inverters (if site design has been finalised). Figures will be produced to show a 90 degree included angle, the existing panorama and wireframe will be presented with the expected view of the development (or photomontage). The ZTV will also include an assessment of the cumulative impacts of the Project.

The wireframe (subject to plan availability) and panorama photographs will lined up within the MapInfo GIS software programme, by using known topographical features. Mountains and wadis present in the wireframe will be matched up with the topographical features within the panorama and the view direction and included angle adjusted in order to match the wireframe and panorama accurately. Subject to the findings of the assessment, the EIA will identify whether mitigation measures are feasible and/or necessary. Consideration of the visual impacts will also be discussed during stakeholder consultations with respect to local communities' views on the changed landscape character as a result of the proposed Project.



Appendix C

MOE TOR & SOW APPROVAL

APPENDIX C-1

MOE TOR & SOW APPROVAL

بسم الله الرحمن الرحيم

وزارة البيئة

الرقم ٤/١٧/١ ٦٧١

التاريخ ....

الموافق ٢٣/١/٢٠١٧

السادة الجمعية العلمية الملكية

تحية طيبة وبعد ،،

إشـارة لكتـابكم رقـم 227/28/133/29815 (180300) تـاريخ 2016/12/28 ومرفقـه الاسـس المرجعيـة وتقريـر الحلقـة التشـاورية لدراسـة تقييم الأثـر البيئـي لمشـروع محطـة توليـد طاقـة كهربائيـة مـن الطاقـة الشمسـية فـي المنـاخر اراضـي الماضـونة /العاصـمة والعائـد للسـادة شـركة AES Levant Holding B.V Company.

أوافـق علـى الأسـس المرجعيـة المقترحـة للدراسـة أعـلاه وذلـك اسـتناداً إلـى توصـية اللجنـة الفنية لمراجعة دراسات تقييم الأثر البيئي للمشاريع.

وتفضلوا بقبول فائق الإحترام ،،،

وزيـــر البيئـــة

د. ياسيــــن الخيــــاط

المهندس أحمد القطارنه

الأمين العام

الجمعية العلمية الملكية
الديوان المركزي - البريد الوارد
الرقم ....
٢٣ كانون الثاني ٢٠١٧
يحول الى ....

٢٤/١/٢٠١٧

بسم الله الرحمن الرحيم

وزارة البيئة

الرقم ٤/١/١/ ٦٧١

التاريخ ....

الموافق ٢٣/١/٢٠١٧

١٢٢/٢/٢٢٧

السادة الجمعية العلمية الملكية

تحية طيبة وبعد ،،

إشارة لكتابكم رقم 227/28/133/29815 (180300) تاريخ 2016/12/28 ومرفقه الاسس المرجعية وتقرير الحلقة التشاورية لدراسة تقييم الأثر البيئي لمشروع محطة توليد طاقة كهربائية من الطاقة الشمسية في المناخر اراضي الماضونة /العاصمة والعائد للسادة شركة AES Levant Holding B.V Company.

أوافق على الأسس المرجعية المقترحة للدراسة أعلاه وذلك استناداً إلى توصية اللجنة الفنية لمراجعة دراسات تقييم الأثر البيئي للمشاريع.

وتفضلوا بقبول فائق الإحترام ،،،

وزير البيئة

د. ياسين الخياط

المهندس أحمد القطارنه

الأمين العام

الجمعية العلمية الملكية
الديوان المركزي - البريد الوارد
الرقم ٤٦٢
٢٣ / ١ / ٢٠١٧
يحول الى مركز بحوث البيئة والمياه

للعلم واجراء ما يلزم

٢٤/١/٢٠١٧

Ministry of Environment

Date: 23/01/2017
Ref.: 4/7/671

Att./ Royal Scientific Society

Dear Sir;

Referring to your letter Ref. 227/28/133/29815 (180300) dated on 28/12/2016 and the attached baselines and the consultancy report for the environmental impact assessment study for the project ***Generation of Electrical Energy from Solar Energy in Manakher Al Madonah/ The capital*** related to **AES Levant Holding B.V Company**.

We agree on the proposed baselines of the above mentioned study, based on the recommendation of the Technical Committee of reviewing the EIA studies on projects.

Thank you for your cooperation

Best Regards;

Minister of Environment
Dr. Yassin Al Khawat

Ahmed Al Katarna
Secretary General

Appendix D

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

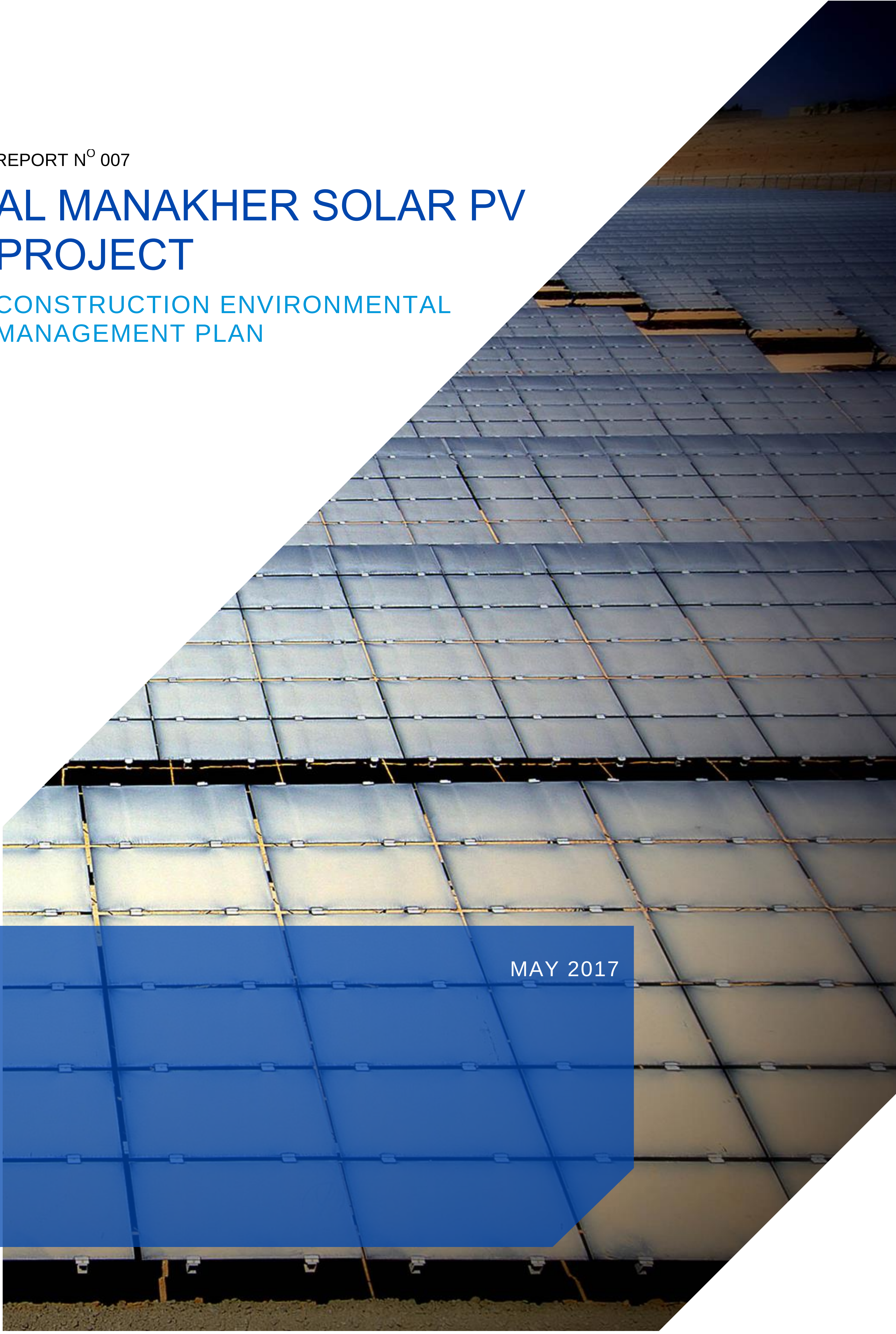
APPENDIX D-1

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

REPORT N^{O} 007

AL MANAKHER SOLAR PV PROJECT

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN



MAY 2017

AL MANAKHER SOLAR PV PROJECT

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

AES

Project no: 52001890
Date: May 2017

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QUALITY MANAGEMENT

ISSUE/REVISION	FIRST ISSUE	REVISION 1	REVISION 2	REVISION 3
Remarks	Draft	Revised draft	Full report – For Onward Submission to MoE	
Date	03rd April 2017	09 May 2017	22 May 2017	
Prepared by	Rachael Ford	Project Team	Project Team	
Signature				
Checked by	Daniel Williams	Mark Silverton	Mark Silverton	
Signature				
Authorised by	Mark Silverton	Mark Silverton	Mark Silverton	
Signature				
Project number	52001890	52001890	52001890	
File reference	52001890-RF-007	52001890-MS-007-R01	52001890-DW-007-R02	

PRODUCTION TEAM

CLIENT

Project Manager	Robin Duncan

WSP | PARSONS BRINCKERHOFF

Environmental Planning and Management	Rachael Ford
Environmental Planning and Management	Daniel Williams
Environmental Planning and Management	Mark Silverton

SUBCONSULTANTS - ROYAL SCIENTIFIC SOCIETY OF JORDAN

Manager of Environmental Studies	Husam Kilani
Senior Environmental Specialist / Biodiversity Specialist	Ahmad Abu-Safa
Senior Environmental Specialist / socio-economic	Rawia Abdullah
Archaeologist	Dr Muhammad Waheeb

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ACRONYMS AND ABBREVIATIONS

µg	Microgram
CAP	Corrective Action Plan
CBD	Convention on Biological Diversity
CEMP	Construction Environmental Management Plant
CITES	Convention on International Trade in Endangered Species
DoA	Jordan Department of Antiquities
EBRD	European Bank for Reconstruction and Development
ECP	Environmental Control Plan
ECP-ARCH	Environmental Control Plan for Cultural Heritage and Archaeology
ECP-AQ	Environmental Control Plan for Air Quality
ECP-C	Environmental Control Plan for Complaints Procedure
ECP-E	Environmental Control Plan for Terrestrial Ecology
ECP-I	Environmental Control Plan for Environmental Inspection Procedure
ECP-IP	Environmental Control Plan for Environmental Incidents Procedure
ECP-N	Environmental Control Plan for Noise
ECP-SE	Environmental Control Plan for Socio-economics
ECP-SGW	Environmental Control Plan for Soil, Hydrology and Water Quality
ECP-T	Environmental Control Plan for Training and Induction
ECP-WM	Environmental Control Plan for Waste Management (inert and hazardous)
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMS	Environmental Management System
EMTN	Excavated Material Transfer Note
HSE	Health, Safety and Environment
ID	Identification
IFC	International Finance Corporation
IPP4	Levant Power Plant
JS	Jordanian Standards
km	Kilometre
m	Metre
m^2	Metres squared
m^3	Metres cubed
MEMR	Ministry of Energy and Mineral Resources
MEP	Mechanical, Electrical, Plumbing
MoE	Ministry of Environment – Environmental Regulator for the Hashemite Kingdom of Jordan
MSDS	Material Safety Data Sheet
NO_2	Nitrogen Dioxide
OE	Owner's Engineer
OHTL	Overhead Power Transmission Lines
PM	Particulate Matter
PPA	Power Purchase Agreement
PV	Photovoltaic
QHSE	Quality, Health, Safety and Environment
RC	Reinforced Concrete
SO_2	Sulphur Dioxide
SMART	Specific, Measurable, Achievable, Realistic and Time-bound
TSP	Total Suspended Particles
UNFCCC	United Nations Framework Convention on Climate Change
WB EHS	World Bank Environmental Health and Safety

WHO	World Health Organisation
WTN	Waste Transfer Notice

1 INTRODUCTION

1.1 OVERVIEW

The Project site is located within the Sahab District in the Greater Amman Governorate, approximately 2.5km north east of the Levant Power Plant (IPP4) which was built, and is operated by, AES Jordan (AES). The Project site is government-owned (Ministry of Finance) and has a proposed footprint of 498,000m^2. The nearest residential properties are in Al-Manakher village, located approximately 2-3km to the south west of the Project boundary.

In its existing state prior to the start of construction, the Project site is clear of structures and has been subject to recent (2010) earthworks by the Ministry of Finance. There is very sparse indigenous vegetation on-site and the Project site and surrounding area are not known to contain any sensitive flora or fauna.

To the south and east of the Project site, there are a limited number of agricultural dwellings belonging to Bedouin families. These groups reportedly use the land primarily for grazing/storing livestock.

1.2 REQUIREMENTS

Projects within the Kingdom of Jordan require an Environmental Permit issued by the Ministry of Environment (MoE), prior to the commencement of construction and operation. This Construction Environmental Management Plan (CEMP) aims to provide a framework to manage environmental and social aspects on site through the implementation of mitigation measures identified within the EIA, and ensure best practice environmental management is implemented.

It is important to note that the CEMP is considered a 'live' document in that it is expected to be reviewed and updated on a regular basis to account for monitoring results and changing conditions on site.

1.3 OBJECTIVES

The aim of the CEMP is to provide guidance to the Contractor so that, during the construction phase, potential adverse environmental impacts are eliminated or at least minimised through the application of best practice measures described in the Environmental Control Procedures (ECP). Therefore, the CEMP aims to:

- Assist the Project Proponent in adhering to the conditions placed by the Ministry of Environment's (MoE) permit requirements;
- Ensure local, national and international legislative compliance;
- Ensure the Project complies with the Lender Bank requirements;
- Provides an implementation and monitoring mechanism to ensure mitigation measures outlined within the EIA are adequately implemented;
- Defines roles and responsibilities for ensuring that all parts of the CEMP are implemented effectively;
- Ensure that control measures can be effectively implemented through the development of ECPs, which determine the Contractors requirements in relation to environmental aspects including, air, noise, groundwater and waste;

- Outlines the training expectations for environmental aspects on site;
- Promote the principles of sustainable development and best working environmental practice in all general and emergency working procedures;
- Maintain high levels of environmental awareness amongst the Project team; and
- Check and monitor the effectiveness of the CEMP.

Fundamentally, the CEMP acts as a guidance manual which all Project parties should become familiar with prior to the commencement of the construction works. In order to ensure effectiveness and ease of application, the CEMP utilises ‘SMART objectives’ which ensures the following:

- Specific objectives are outlined to ensure site and environmentally specific targets are set;
- Measurable objectives are included to ensure that the objectives may be easily assessed;
- Achievable objectives are identified to ensure that the CEMP is a practical tool which will be effective;
- Realistic objectives are included to ensure that the appropriate resources are available to implement the CEMP; and
- Time-bound objectives ensure that all objectives are considered within measurable timeframes.

1.4 AVAILABILITY OF THE CEMP

The CEMP should be provided to all parties involved in the construction works and the overall development including all subcontractors. A complete copy of the most recent version of the CEMP shall be maintained at the site at all times. A copy of the organisation chart of staff operating during the construction period, as well as method statements shall be made available for submittal to MoE upon request.

2 PROJECT DESCRIPTION

2.1 PROJECT OVERVIEW

The Government of Jordan is promoting the generation of renewable energy by adopting a renewable energy strategy. The strategy has set a 10% renewable energy target by 2020. The Renewable Energy and Energy Efficiency Law permits the Ministry of Energy and Mineral Resources (MEMR) to request proposals for the development of renewable energy projects. The Project site is located within the Sahab District in the Amman Governorate, approximately 2.5km northeast of the Levant Power Plant (IPP4), built and operated by AES. The overall site plot is 498,000m^2 of government-owned land. The land will be leased to the Project Proponent by the Ministry of Finance (Department of Land and Survey) under a 20 year tenor i.e. the duration of the power purchase agreement. The nearest residential developments are in Al Manakher village, approximately 3km to the south west of the Project boundary, although two other communities are present within approximately 10km who may also have interests in the Project, particularly with respect to recognition of positive impacts such as employment. As confirmed during a site walkover undertaken by a WSP | Parsons Brinckerhoff environmental consultant on 16-17 January, isolated farm dwellings are also located within several hundred metres of the Project site, with the nearest a sheep farm almost directly opposite the anticipated main site entrance point.

It is understood that the general area is understood to have been designated by the government as a future area for industrial development, with three thermal power plants having been constructed over the past 10 years within a 7km radius and a land port being considered immediately to the west of the proposed site. With the exception of the power plants, there is no heavy industry in the immediate vicinity of the Project site. The site is clear of structures and has been subject to recent (2010) earthworks by the Ministry of Finance. There is very sparse indigenous vegetation on-site and no designated sites or sensitive habitats or species have been identified within the local area as a result of consultations or surveys. To the south and east of the Project site, there are a limited number of agricultural dwellings belonging to Bedouin families. These groups reportedly use the land primarily for grazing livestock. Approximately 3km to the northeast of the site are lands used for arable crops, such as grasses and date palms, these are reportedly owned by members of the local communities.

2.2 CURRENT SITE CONDITIONS AND ENVIRONMENTAL CONSIDERATIONS

2.2.1 EXISTING SITE CONDITIONS

A site visit was undertaken by WSP | Parsons Brinckerhoff environmental consultants on 16-17 January 2017 in order to assess the existing conditions of the site, Figure 2-1 shows an overview of the existing conditions observed onsite. .

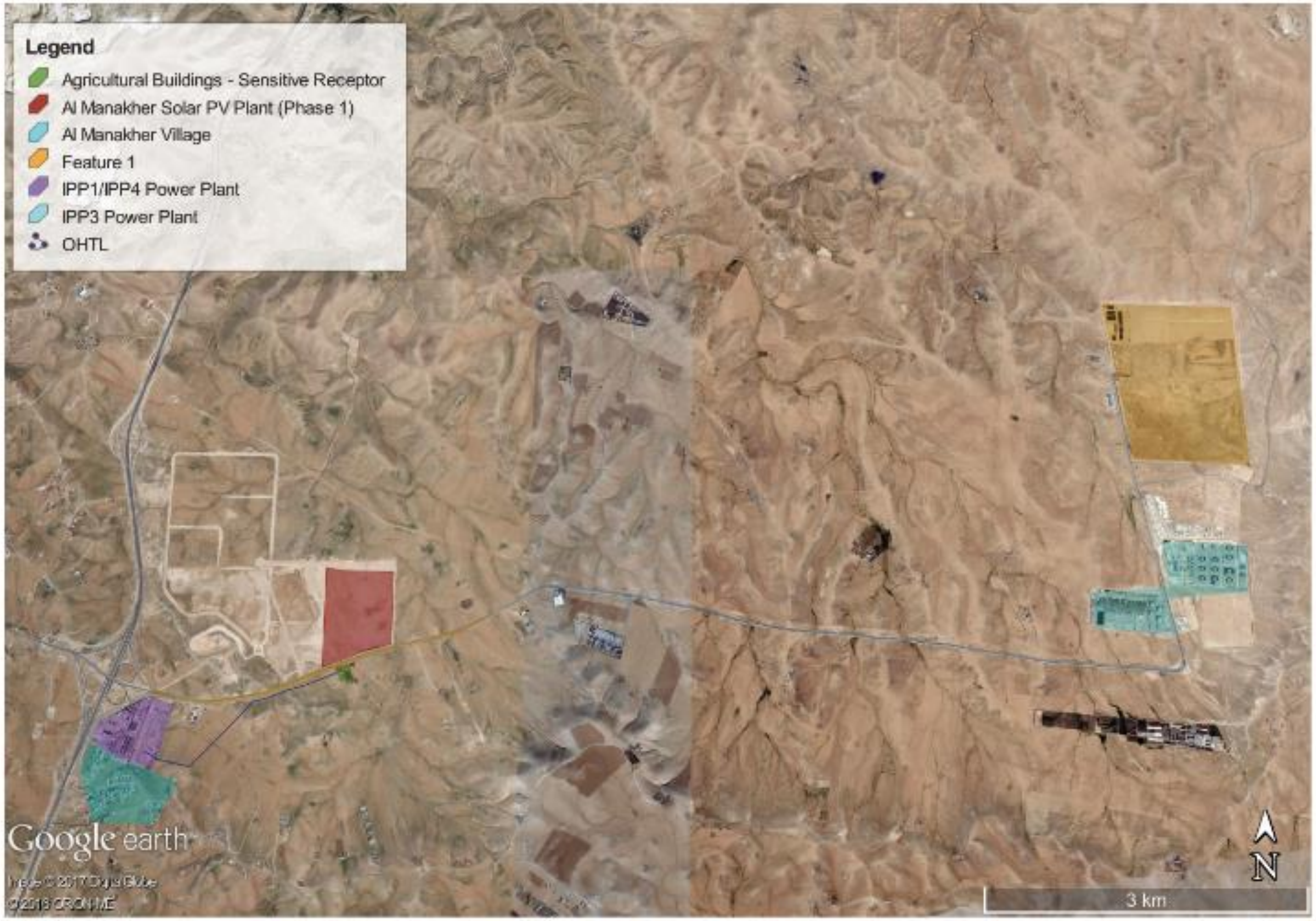


Figure 2-1 Existing Conditions Observed Onsite

The closest residential properties are in Al-Manakher village, located approximately 2-3 km to the south west of the Project boundary. To the south and east of the Project site, Bedouin groups use the land primarily for grazing livestock (Figure 2-2). Approximately 3km to the northeast of the site are lands used for arable crops, such as grasses and date palms, these are reportedly owned by members of the local communities.

An existing paved municipal road, which connects Zarqa to Sahab, is located along the southern Project boundary, this road has existing OHTL running parallel to it (Figure 2-3).

With the exception of the existing IPP1, 3 and 4 (Figure 2-4), there are no industrial facilities in the immediate vicinity of the Project site. The Project site is clear of structures and has been subject to recent earthworks by the Ministry of Land. Figure 2-5 to Figure 2-7 give an overview of the existing conditions observed onsite.

Figure 2-2 Agriculture buildings located to the south of the site

Figure 2-3 Zarqa to Sahab road along the southern Project boundary

Figure 2-4 IPP3 Power Plant, located within the vicinity of the Project site

Figure 2-5 Overview of Site Conditions

Figure 2-6 Grading of the Site

Figure 2-7 Minimal Vegetation Observed On Site

No schools are located within or surrounding the Project site, the closest educational facilities are located within the Al Manakher Village approximately 3km from the site.

The Project site is not considered to be near protected natural reserves; the closest reserves are Azraq Wetland Reserve and As-Samra Wastewater Treatment Plant and are located 30km and 70km away respectively. While no sites of significant cultural heritage and/or archaeological value have been determined within the Project site boundary, four sites of archaeological importance, as designated by the Department of Antiquities (DoA), have been identified as being located to the northwest, west and north of the Project site, with the closest identified site being within 230m. None of the identified archaeological designated sites have been developed for tourism, with the findings largely comprising surface archaeological fragments.

No sources of hazardous contamination, such as petrol stations or visible signs of contamination, were observed within or surrounding the Project site. Access was available to all areas of the Project site. In a number of areas around the Project site there appeared to be waste piles of construction aggregate or waste associated with sheep farms and Bedouins such as fleeces. While detailed analysis of the infrequent waste piles has not been undertaken, such waste is considered likely to be inert and non-hazardous although care should be given to proper handling/disposal with respect to worker health. Notwithstanding this, the wastes should still be removed and disposed of appropriately- whether such disposal comes under the responsibility of the land owner (the Government of Jordan) with respect to providing a ‘clean’ site or the Project Proponent is unclear at present.

Since the initial site visit, a second site visit was undertaken on 13 March 2017 by WSP | Parsons Brinckerhoff staff.

From the site visit, no additional observations were made relating to sensitive receptors or potential environmental aspects, which be a course of concern in relation to the Project. It was noted that seasonal rains had led to the growth of increased ground vegetation in the land surrounding the Project site. No additional vegetation was noted within the Project site.

2.2.2 SENSITIVE RECEPTORS

As described in previous sections, the proposed Project footprint area has already been cleared and prepared by the Ministry of Finance, and is located within a wider area which has been planned for electricity generation.

The nearest existing anthropogenic receptors, other than personnel employed on the adjacent power plant facilities, include the permanent residents of the farm to the south of the site, residents of Al Manakher village and offices for workers currently employed for IPP1 and 4. Following a site reconnaissance, desk based review, and scoping exercise, the following key sensitive receptors and potential impacts associated with the construction and operational phases of the proposed project have been identified (refer to Figure 2-8 and Table 2-1).

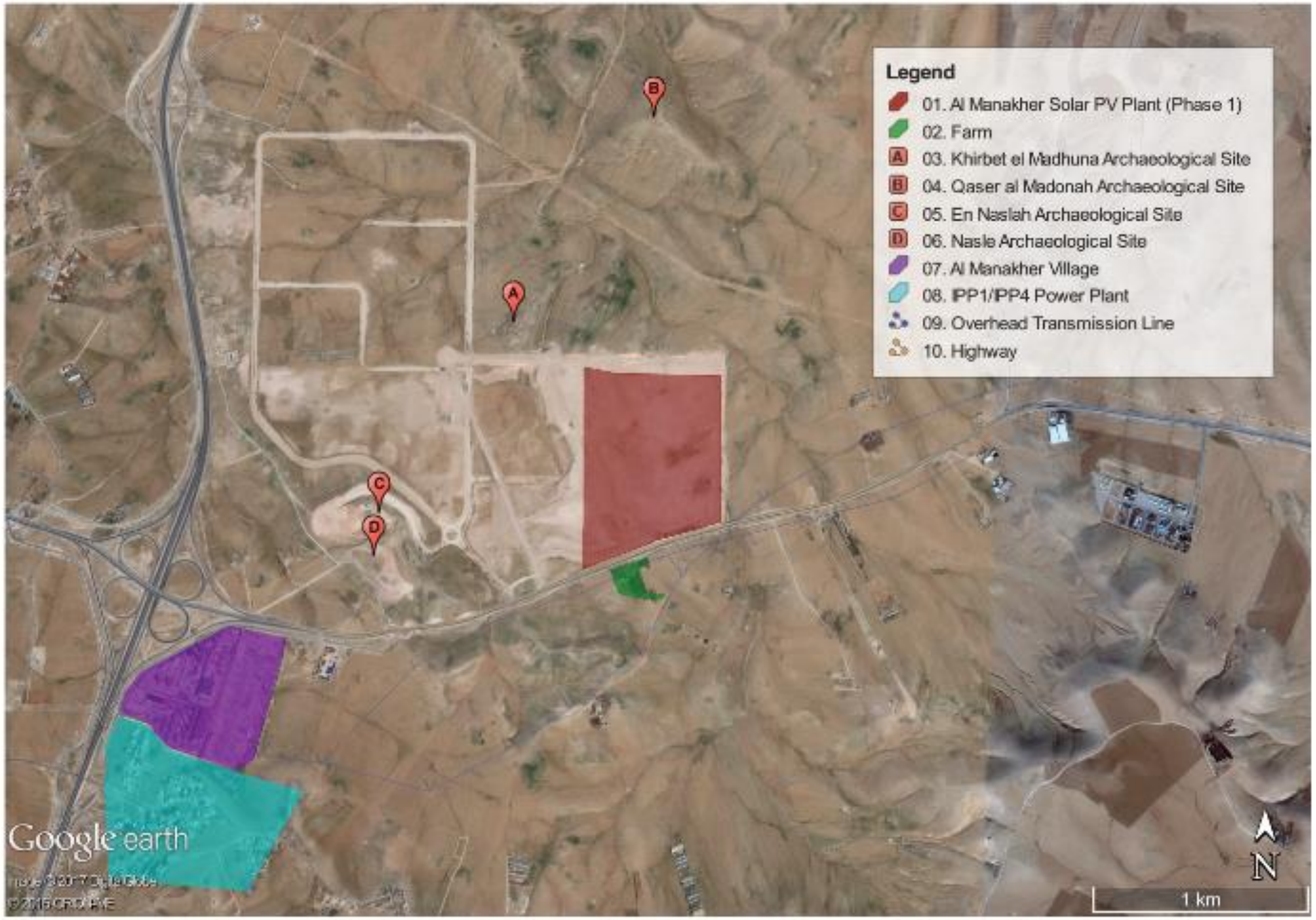


Figure 2-8 Existing Sensitive Receptors

Table 2-1 Key Receptors and associated impacts

Receptor	Potential Construction Impacts	Potential Operation Impacts
Residents at Al Manakher and other communities	→ Disturbance from construction traffic and staff → Noise and air quality impacts associated with construction activities on the residents of Al Manakher → Increased revenue for local businesses due to retail activities → Increased demand for local services → Potential employment opportunities	→ Social impacts associated with the presence of Plant personnel
Residents of the farm to the south of the Project site,	→ Disturbance from construction traffic and staff → Noise and air quality impacts associated with construction activities on the residents of the farm → Increased revenue for local businesses due to retail activities → Increased demand for local services	→ Social impacts associated with the presence of Plant personnel
Construction workers	→ Health and safety risks → Recruitment and employment opportunities → Worker welfare → Exposure to noise and air pollutant emissions	→ None identified
Al Manakher Plant personnel	N/A	→ Health and safety risks → Worker welfare → Exposure to noise or hazardous materials
Terrestrial habitats and associated flora and fauna	→ Contamination events impacting on the terrestrial ecology → Damage to flora located in the adjacent areas → Dewatering activities (if necessary) may reduce groundwater level outside of the project footprint area, impacting on the ability of local species to source water from this resource	→ Potential positive impacts associated with landscaping providing suitable terrestrial habitat
Soil and groundwater	→ Contamination events impacting on ground and groundwater quality → Storm water events eroding adjacent habitats or arable land	→ Contamination events impacting on ground and groundwater quality → Storm water events eroding adjacent habitats or arable land
Socio-economic	→ Positive socio-economic impacts through employment opportunities for local community members and skills transfer	→ Positive socio-economic impacts through employment opportunities for local communities, skills transfer and power supply

RECEPTOR	POTENTIAL CONSTRUCTION IMPACTS	POTENTIAL OPERATION IMPACTS
	→ (Also see impacts to local communities above)	→ (Also see impacts to local communities above)

2.3 CONSTRUCTION ACTIVITIES

The following main construction activities are expected to be undertaken for the Project:

- → Mobilisation to site;
- → Ground clearance;
- → Storage of construction materials and wastes;
- → Movement of machinery, plant and vehicles;
- → Erection of perimeter fencing and lighting;
- → Erection of site welfare facilities and office;
- → Laying of slabs for inverters/transformers;
- → Excavation for sub-station;
- → Construction of substation and associated plant;
- → Erection of photovoltaic (PV) panel frames (including all activities to assemble and fix the frames on site);
- → Placement of PV panels;
- → Connection to overhead power transmission lines (OHTL);
- → Electrification and commissioning; and
- → Demobilisation.

2.4 PROJECT SCHEDULE

It is understood that negotiations with NEPCO are still occurring with respect to when the transmission line from the site substation to the IPP4 substation would be available. As a result a detailed construction schedule is not available at this stage. However, given the size of the plant and land which has already been cleared, it is expected that the Project's construction would be completed within one (1) year. No night work is planned at this time and would only be undertaken if the Project construction schedule has fallen behind. Construction work is expected to start in third quarter of 2018, the timeframe for construction is anticipated to last for 10 months. Based on this the commissioning phase for the Project is expected to start June 1, 2019 and take 4 to 6 weeks to complete. Once the construction schedule has been finalised Wärtsilä are to provide and update this document accordingly.

2.5 ENVIRONMENTAL PERMITS

The full project is being assessed under the accompanying EIA (Ref: 52001890-DW-006-R02). The EIA Terms of Reference was approved on 23 January 2017 (refer letter ref: 4/7/671). A copy of the EIA permit issued by MoE and all associated conditions are included within **Appendix B** [TO BE INCLUDED BY WÄRTSILÄ ONCE OBTAINED by Project Company]. It is recommended that a permits schedule be maintained by the EPC Contractor of the necessary construction permits necessary during the construction period. This should include permits already obtained and permits to be obtained. An outline template for the schedule is included within Table 2-2. Copies and originals of all permits should be maintained and be available on site at all times.

Maintenance of this schedule should continue as appropriate throughout the lifetime of the Project.

Table 2-2 Example template for Permits schedule

Type of Permit	Permit Number	Permit received date	Permit Expiry Date	Permit or renewal to be applied by (date)	Responsible party
Environmental Approval					
Department of Antiquities					
Utilities					
Permit to Construct					
etc.					

2.6 KEY STAKEHOLDERS

The stakeholders relevant to the construction of the Project are summarised in Table 2-3.

Table 2-3 Relevant Stakeholders

STAKEHOLDER	CONTACT DETAILS
AES	Mohammad Al Qudah Env, Health, Safety & Security Manager AES Jordan AES Jordan PSC AES Levant Al Madhonna st P.O.Box 3099 Amman 11181 Jordan Phone - M: +962 797897020 | T: +962 6 4293200 | E: mohammad.alqudah@aes.com |
Wärtsilä/Sgurr	[To Be Updated by Wärtsilä]
Lenders	OPIC Main Address and Phone Number 1100 New York Avenue, NW Washington, D.C. 20527 info@opic.gov (202) 336-8400 Nippon Export and Investment Insurance (NEXI) Chiyoda First Building, East Wing 5th Floor, 3-8-1 Nishikanda, Chiyoda-ku, Tokyo 101-8359, Japan Phone: 81-(0)3-3512-7650 Fax: 81-(0)3-3512-7660
Ministry of Environment	Amman - Um Uthaina - King Faisal bin Abdul Aziz Street - Building No. 83 P. B. : 1408 Postal Code: 11941 City: Amman Phone: 556 0113 6 (962) Fax: 556 0288 6 (962) E-mail address: info@moenv.gov.jo
Department of Antiquities	Department of Antiquities Jebel Amman Street, Sultan al-Atrash PO. B: 88 Director-General Tel: 464 4320 Fax 464 4714 Tel: 464 4336, 464 1275, 464 4482, 464 2669 E-mail: info@doa.gov.jo
Sahab District	Name : DR Mohammad Abu Romman Address: Sahab , Abdalleah cross , Abdel Hadi Al Maharmeh ST Phone: 064021093
Greater Amman Municipality	Greater Amman Municipality Omar Matar St., Rass Alain P.O.box 132, Amman 11118 General Tel 0096 264 636 111 Emergency 535 9970 info@ammancity.gov.jo

3 ENVIRONMENTAL MANAGEMENT

3.1 ENVIRONMENTAL MANAGEMENT SYSTEMS

3.1.1 [TO BE CONFIRMED BY WÄRTSILÄ]

3.2 ROLES AND RESPONSIBILITIES

The Project organisation is provided within **Appendix C**. A summary organogram chart is presented in Figure 3-1.

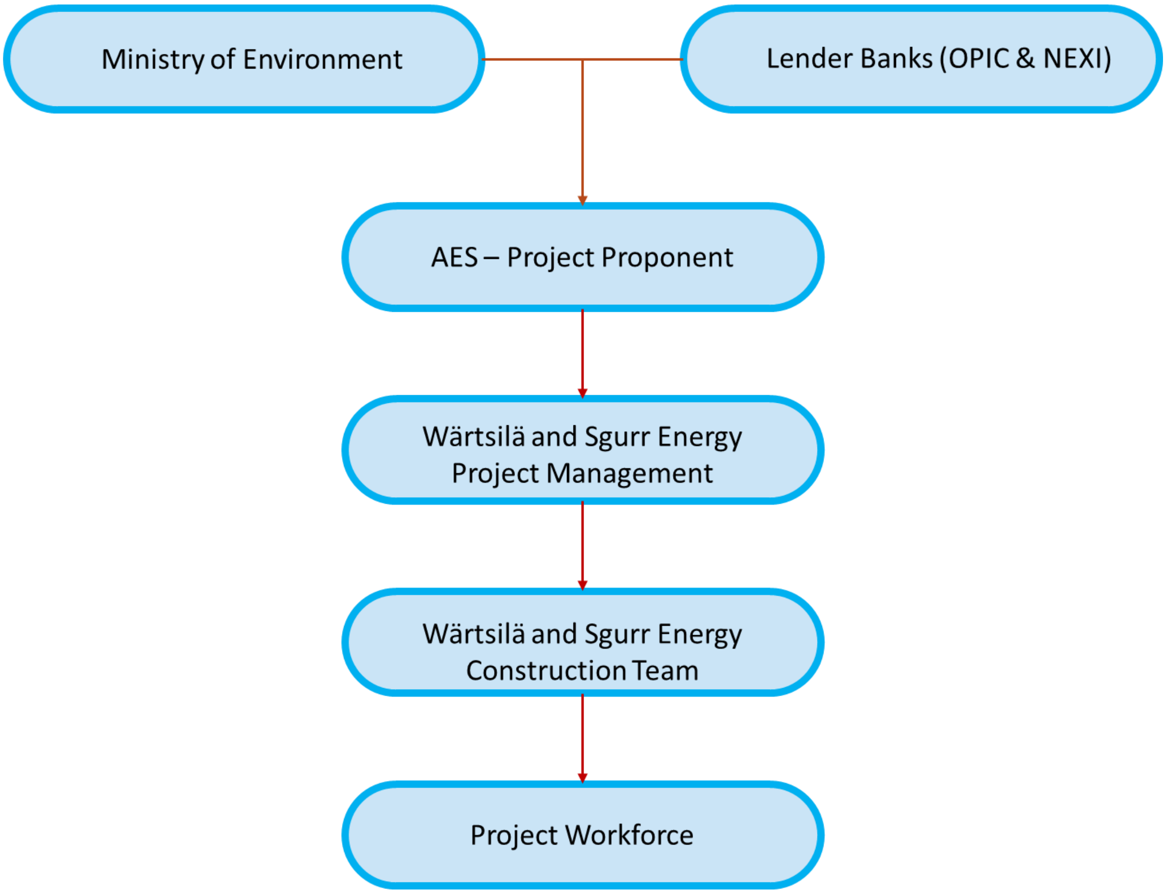


Figure 3-1 Project environmental organogram

The Project signboard to be sited at the entrance of the site will include the Client, Consultant and Contractor details, and an example of the minimum details to be included in sign board provided in **Appendix D** [TO BE PROVIDED BY WÄRTSILÄ]. The sign board must be visible on the Project boundary at all times for the duration of the Project. [

3.2.1 AUTHORITY – JORDAN MINISTRY OF ENVIRONMENT

The MoE as the environmental regulator has the right to undertake site inspections, review documentation relating to environmental management, suspend activities on site and initiate legal action for non-compliance. It is anticipated that the MoE may stipulate regular monitoring reports are submitted by the Project Proponent during the construction phase (and subsequent operational phase). The Project Proponent will be required to demonstrate that the Project is complying with the permit conditions and Jordanian laws to the MoE, either through submitted monitoring reports or through records maintained at the site. Any other MoE permit conditions will need to be adhered to and incorporated within the CEMP or separate site management processes.

3.2.2 LENDERS

As noted previously, a number of international lenders to the Project are envisaged. It is anticipated that, as part of the loan agreements, the Project Proponent will be required to demonstrate their compliance with national and international environmental and social management through provision of suitable record-keeping and reports to the lenders. There are likely to be some requirements (particularly social) which may be stipulated by the lenders for the IPP1 and IPP4 developments but, as a Project within the immediate geographical area and in the same company portfolio, there are likely to be similar requirements on the It is envisaged that the Lenders will:

- → Provide specific requirements for environmental and social management on the Project site.
- → Provide comment on monitoring reports during the lifetime of the loan;
- → Identify additional environmental key performance indicators to be reported by the Project Proponent; and
- → Potentially conduct regular audits (e.g. quarterly during construction) to review environmental and social compliance on the site.

3.2.3 AES

As the Project proponent, AES are ultimately responsible to the Ministry of Environment and international lenders for the Project's environmental and social compliance with national laws and relevant loan conditions and international guidelines. It is unclear at the time of this CEMP whether AES will appoint an Owner's Engineer (OE) company with a scope to also monitor environmental and social compliance on site in addition to the envisaged main task of engineering design review and programme construction monitoring. Should the OE have an environmental and social review role then a subcategory of responsible parties within the organisation chart (and responsibilities) may need to be added and defined in this CEMP. The Project Proponent will:

- → Be responsible for ensuring the Project's compliance with Jordanian laws and international lender requirements;
- → Ensure appropriate design of the Project to account for environmental sensitivities;
- → Review qualifications of environmental personnel provided by EPC Contractor;
- → Be responsible for ensuring EPC Contractors are aware of and provided with the Project's final approved EIA and permit;
- → Regularly visit the site for managerial level health, safety and environmental walk overs to identify issues;
- → Regularly review hiring policies and labour contractors of contractor and subcontractor to ensure they are in adherence to AES policies in addition to
- → Ensure EPC Contractor and subcontractors commit to adherence to EIA, permit and AES policies in addition to IFC Performance Standards, particularly with reference to labour standards;
- → Liaise regularly with EPC Contractor with respect to CEMP adequacy for activities undertaken at site and contractor/subcontractor compliance.

- Provide appropriate monitoring reports and supporting documentation to Lenders (and MoE requirements as necessary).

3.2.4 WÄRTSILÄ AND SGURR ENERGY PROJECT MANAGEMENT

Wärtsilä and Sgurr energy will both be working onsite, undertaking different aspects of the construction. Wärtsilä are the overall EPC whilst Sgurr Energy will be constructing the specific electrical connections in addition to other activities in accordance with their schedule of works. As such, each team will have their own project managers who have the following responsibilities regarding the CEMP to adhere to.

The Project Management will:

- Monitor progress of the construction work against the approved programme;
- Ensure that the Contractors/sub-contractors are working in accordance with approved method statements and the Project Specification;
- Attend progress meetings with the Project Proponent and Contractor;
- Regularly review monitoring data retrieved from site to assess the impact of the works on the surrounds.
- Review Contractor's Environment Management System (EMS) to ensure it corresponds with Project requirements, permits and EIA; including risk assessments, method statements, and mitigation measures;
- Ensure that the CEMP procedures and Contractor's own procedures are implemented and maintained in accordance with the requirements of the CEMP and other legal requirements;
- Accompany the Contractor in undertaking their environmental inspections at least once a week; and
- Hold a monthly progress meeting with all contractors to review environmental performance.

3.2.5 WÄRTSILÄ CONSTRUCTION CONTRACTOR

The Contractor shall appoint a specific Environmental Representative (EHS Manager) who, irrespective of other responsibilities, shall have defined roles and responsibilities and authority including:

- To ensure that the CEMP and their EMS is established, implemented and maintained in accordance with the requirements of the CEMP and other legal requirements;
- The EMS shall identify:
  - Risks associated with their activities;
  - Mitigation measures; and
  - Appropriate monitoring to ascertain compliance with relevant legislation, standards, guidelines and guidelines.
- To ensure that financial and human resources are provided to implement the CEMP and Management System;
- To take action to prevent environmentally/socially unsound and/or unsustainable working practices, infringement of the CEMP and/or Management System or breach of any applicable laws;
- To undertake daily and weekly environmental inspections;
- To act as the main point of contact for all environmental and social issues;

- Responsible for incident investigation and closure of non-conformities;
- To report to the Project Management Company, issues and incidents on a regular basis- with major incidents being reported within an appropriate timeline (also Emergency Preparedness and Response Plan within Section 4.11)
- To record all environmental incidents and social issues, including complaints and grievances from local communities or other interested parties; and
- To attend the weekly environmental performance meeting.

3.2.6 WORKFORCE

- To report any environmental issues to their managers;
- To adhere to and implement the requirements of the CEMP, the Contractor's EMS team and applicable laws prevailing in Jordan;
- To identify HSE issues on site if and when they arise, stop colleagues working unsafely and ensure line managers are kept informed
- To interact with the local community in an appropriate manner;
- To stop colleagues working unsafely or with undue attention to the environment;
- To assist investigation of accidents where appropriate with the main aim of preventing their recurrence; and
- To report any damaged equipment, accidents or dangerous hazard occurrences to their manager.

3.3 REGULATIONS AND REQUIREMENTS

This section describes the applicable Jordanian and International Standards and Guidelines with respect to noise and ambient air quality.

3.3.1 REGULATORY FRAMEWORK FOR THE HASHEMITE KINGDOM OF JORDAN

Development projects in Jordan are subject to various national environmental legislation, regulations as well as international regulations and treaties. The Jordanian regulations for environmental protection, pollution control and management are specified within Environmental Protection Law No. 52 of 2006.

The enactment of Environmental Protection Law No. 52 of 2006 established the MoE as the competent government agency mandated with the responsibility for protection and preservation of the Jordanian environment as well as environmental affairs at the national, regional and international level. Furthermore, the MoE is responsible for the implementation of environmental laws, regulations and standards.

Article 13 of the Environmental Protection Law No. 52 of 2006 is the main regulation related to the protection and preservation of the environment within Jordan.

3.3.2 IFC PERFORMANCE STANDARDS

For non-designated countries, which includes Jordan, the Equator Principles require the implementation of the associated IFC Performance Standards (PS), with the most recent iteration published in 2012[1] in addition to the World Bank Group Environmental, Health and Safety (EHS) Guidelines. The eight PS comprise the following requirements that projects seeking finance from institutions signed onto the Equator Principles should comply with the following:

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

Compliance with the IFC performance standards in the assessment will not only ensure a socially and environmentally sustainable project but it is also envisaged that it will facilitate financing. Of these PS it is considered that PS5 and PS7 would not specifically apply to the Project following the scoping assessment.

3.3.3 AMBIENT AIR QUALITY STANDARDS

The Jordanian Ambient Air Quality Standards (JS: 1140/2006) describe the concentration limits for a range of pollutants in the ambient air. The pollutants of concern from this Project are Particulate Matter 10 (PM_{10}), Particulate Matter 2.5 ($PM_{2.5}$) and Total Suspended Particulates (TSP) during construction and are shown in Table 3-1.

Table 3-1 1140/2006 Ambient Air Quality Standards for Pollutants of Concern

Pollutant	Jordanian Air Quality Standards (JS:1140/2006)			IFC EHS Guidelines (WHO Guidelines) µg /m³
	Averaging Period	Number of Exceedances	Maximum Limit	
Particulate Matter 10 (PM_{10})	24 hours	3 times during any consecutive 30 days in a year	120µg/m³ *	150 (interim target 1) 100 (interim target 2) 75 (interim target 3 50
	Annual	-	70µg/m³	70 (interim target 1) 50 (interim target 2) 30 (interim target 3) 20
Particulate Matter 2.5 ($PM_{2.5}$)	24 hours	3 times during any consecutive 30 days in a year	65µg/m³	-
	Annual	-	15µg/m³	-

[1] http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/performance+standards/environmental+and+social+performance+standards+and+guidance+notes

Pollutant	Jordanian Air Quality Standards (JS:1140/2006)			IFC EHS Guidelines (WHO Guidelines) µg /m³
	Averaging Period	Number of Exceedances	Maximum Limit	
Total Suspended Particulates (TSP)	24 hours	3 times during any consecutive 30 days in a year	260µg/m³	-
	Annual	-	75µg/m³ (geometric average)	-
NO_2	1-hour	3 times within a given month in one year	0.21mg/kg	200
	24-hour	3 times within a given month in one year	0.08mg/kg	-
	Annual	-	0.05mg/kg	40
SO_2	10-min	-	-	500
	1-hour	3 times within a given month in one year	0.30mg/kg	-
	24-hour	Once a year	0.14mg/kg	125 (interim target 1)
				50 (interim target 2)
				20
	Annual	-	0.04mg/kg	-

The IFC and WB EHS General Guidelines (International Finance Corporation and World Bank Environmental Health and Safety) for "Air Emissions and Ambient Air Quality (2007)" has adopted the World Health Organisation (WHO) ambient air quality guidelines. The IFC and WB EHS General Guidelines for "Air Emissions and Ambient Air Quality (2007)" states that WHO guidelines should be implemented in the absence of national standards. Therefore JS: 1140/2006 is the relevant ambient air quality standard for this Project.

3.3.4 NOISE LIMITS

The Jordanian and IFC and WB EHS General Guidelines for the Prevention of Noise are the applicable limits to be observed during the construction. Table 3-2 presents the permissible noise limits.

Table 3-2 Noise Emission Limits – Jordanian and IFC / WB EHS General Guidelines for Prevention of Noise

Receptor	Highest Permissible LAeq (dB(A))			
	Day (06:00 - 21:00)* Day (07:00 – 20:00)**		Night (21:00 - 06:00)* Night (20:00 – 07:00)**	
	Jordanian	IFC / WB EHS	Jordanian	IFC / WB EHS
RESIDENTIAL HAVING SMALL INDUSTRIES, OFFICES AND	65	55	55	45

RECEPTOR	HIGHEST PERMISSIBLE LAEQ (DB(A))			
	DAY (06:00 - 21:00)* DAY (07:00 – 20:00)**		NIGHT (21:00 - 06:00)* NIGHT (20:00 – 07:00)**	
	JORDANIAN	IFC / WB EHS	JORDANIAN	IFC / WB EHS
PUBLIC BUILDINGS				

* Daylight saving time
** Winter time and IFC / WB EHS Guidelines

The Jordanian noise guidelines are general applicable and so the predicted noise levels during both the construction and operational phases will be assessed against these guidelines. The World Bank Group and IFC and World Bank Group General EHS Guidelines Noise Limits (2007) are intended for assessing operational noise only.

3.3.5 SOIL AND GROUNDWATER QUALITY

Soil and groundwater protection and management requirements are provided by the Soil Protection Regulation No. 25, 2005. Due to the absence of soil and groundwater standards, international limits are considered most appropriate, primarily the Dutch Ministry of Housing Soil Quality Standards, summarised in Table 3-3 but which would need to be adjusted according to the soil type.

Table 3-3 Dutch Soil Quality Standards

PARAMETER	SOIL (MG/KG DRY MATTER)	
	REFERENCE VALUE	INTERVENTION VALUE
I. Metals		
Cadmium (Cd)	0.8	12
Chromium (Cr)	100.0	380
Copper (Cu)	36.0	190
Nickel (Ni)	35.0	210
Lead (Pb)	85.0	530
Zinc (Zn)	140	720
Mercury (Hg)	0.3	10.0
Arsenic (As)	29.0	55.0
Barium (Ba)	160	625
Cobalt (Co)	9.0	240
Beryllium (Be)	1.1	30
Silver (Ag)	-	15
Selenium (Se)	0.7	100
Tin (Sn)	-	900
Antimony (Sb)	3.0	15
II.Inorganic Compounds		
Bromide	20	-
Chloride	-	-
Fluoride	500	-
III.(Volatile) Aromatic Compounds		
Benzene	0.01	1
Toluene	0.01	130
Ethyl Benzene	0.03	50
Xylene	0.1	25
Phenol	0.05	40
Styrene (vinyl benzene)	0.3	100
IV.Polycyclic Aromatic Hydrocarbons		
PAH (sum of 10)	1	40
V.Chlorinated Hydrocarbons		

Parameter	Soil (mg/kg dry matter)	
	Reference Value	Intervention Value
Polychlorobiphenyl (sum)	0.02	1

3.3.6 REGIONAL AND INTERNATIONAL STANDARDS

The Government of Jordan is also a signatory to a number of regional and international conventions and protocols concerned with environmental protection with key protocols with relation to the project's potential impacts as follows:

- Convention on International Trade in Endangered Species (CITES) 1975;
- The Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal 1992;
- United Nations Framework Convention on Climate Change (UNFCCC) 1992;
- Convention on Biological Diversity (CBD) 1993;
- Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa 1996;
- United Nations Framework Convention on Climate Change and the Kyoto Protocol 1997; and
- Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol) 1997.Environmental Awareness and Training.

3.4 ENVIRONMENTAL AWARENESS AND TRAINING

Environmental training is essential to effectively implement the CEMP. It will be administered by the Contractor Environmental Representative supported where appropriate by the Director of Human Resources and the HSE Manager. The following sections describe the processes and minimum requirements which are expected with respect to environmental awareness and training on site.

3.4.1 RESPONSIBILITIES

The Wärtsilä Site Construction Manager and EHS Manager will establish the Environmental Training programme schedule, and will be accountable for identifying the generic and specialist training needs. The Human Resources Department will support this function as follows:

- Ensuring all staff receive an environmental induction prior to being allowed to work on site and are given adequate information to undertake their roles competently;
- The preparation and updating of the schedule for environmental training;
- The development of training materials by a competent person, in order to effectively conduct specialist environmental training;
- Undertaking or delegating to relevant individuals the provision of environmental training in accordance with this procedure, which may involve Tool box talks; and,
- The retention of the training records.

3.4.2 ENVIRONMENTAL AWARENESS POSTERS

Environmental instructions and posters will be displayed on site at prominent places such as offices, site main entrance and near areas where high risk operations such as vehicle refuelling and oil and hazardous chemical storage areas.

These instructions and posters aim to increase awareness of construction contractor and sub-contractor workforce and general site staff as well to control environmental impacts associated with construction activities. These instructions will be displayed in key employee languages including at least English and Arabic and ideally too using pictorial references. Where necessary other languages will need to be considered to ensure all workforce are able to understand the relevant procedures and requirements.

The following topics as a minimum will be included within the posters:

- Air pollution;
- Dust minimisation;
- Community interaction;
- Water conservation;
- Water pollution;
- Land contamination;
- Waste minimisation and management;
- Biodiversity; and
- Traffic.

3.4.3 MANDATORY ENVIRONMENTAL AND SOCIAL INDUCTION TRAINING

Awareness and training is critical to the effective implementation of the CEMP. Therefore, all personnel will be required to attend an awareness induction training session prior to being deployed on site. Work passes would be contingent on completing the induction training.

It will be the responsibility of Wärtsilä HSE Manager supported by the relevant subcontractor HSE representatives to ensure that all personnel attend this mandatory awareness induction session.

Induction will include at least an overview of the environmental aspects related to the main activities of the Project, emergency measures, incident reporting, and an overview of the main environmental controls set out within this CEMP, which include but are not limited to:

- Definition of Environment;
- CEMP overview and environmental aspects;
- Waste Management Procedure;
- Air Quality (dust and gaseous emissions);
- Traffic and Transportation;
- Working Rules;
- Archaeological Features and Watching Brief
- Labour and HR policies;
- Emergency Response Plan;
- Hazardous Substances Management;
- Noise;
- Community interaction;
- Incident Reporting Procedure;
- Disciplinary Action;
- Terrestrial Ecology;
- Internal grievance mechanism.

At each of the induction sessions, it will be the responsibility of the training provider to ensure that an attendance list is taken. As part of the training records a statement from the concerned worker that he has understood and will comply with the mitigation measures should also be recorded.

An up-to-date register of those who have completed training will be retained by each contractor.

3.4.4 TOOL BOX TALKS

Tool box talks training are a cost effective way to provide targeted information on an environmental issue, for example, in relation to a change in procedures, the results of an EHS incident investigation, or changes to environmental conditions of the Project site.

Toolbox talks will be provided for all workers by the relevant supervisor on a daily basis in order to reinforce the culture of environmental protection as part of the work ethic and will include any materials referenced within this CEMP including waste segregation and recycling, hazardous substances storage and handling, ambient air quality protection. It will be responsibility of each Construction Contractor's Environmental Representative to identify the topic to be addressed to the workers. Where feasible, consideration of behavioural change should be made within the training approach (reinforcing behaviours rather than outcomes).

3.5 DOCUMENT REVIEW AND UPDATES

This Project CEMP shall be updated on appointment of the Construction Contractor, approval of the EIA, if other relevant studies are required as directed by the MoE, in addition to material changes to construction works, (which will also potentially be subject to approval by the MoE).

The Contractors are responsible for continually reviewing their EMS and for informing the Project Management team of any pertinent changes made.

The CEMP will be reviewed in the event of any of the following occurring:

- Changes to relevant legislation, standards and guidelines;
- Changes to environmental permits and/or statutory assessments;
- Significant changes to organisational structure(s);
- Significant construction methodology changes;
- Following significant changes implemented within the Project Proponent's Management System; and
- As a result of corrective actions, incidents or improvements.

It is the responsibility of the Contractor's Environmental Representative to ensure that any amendments or modifications to the controlled documentation are easily identifiable, recorded and properly communicated to relevant personnel including sub-contractors through standard internal communication methods (e.g. email, meeting, workshops).

3.6 COORDINATION WITH EXTERNAL ENTITIES AND ADDRESSING COMPLAINTS

3.6.1 RESPONSIBILITY

Given the common Project Proponent (AES) between the nearby IPP1 and IPP4 plants, any complaints received at the solar project site will need to be forwarded to the community liaison officer at IPP4 for subsequent follow up and action. Any actions taken will need to subsequently update to the Wärtsilä Project Manager to ensure that they are aware of the situation, particularly if any additional measures are necessary at the Project site. All communication with the MoE should be conducted via the Project Proponent.

The Wärtsilä EHS Manager will be responsible for the provision of signage on Project boundaries such that affected communities are provided with contact details in the event of wishing to raise a complaint.

In addition the following external parties will be contacted in case of emergencies:

- Civil Defence;
- Police;
- Medical Emergency; or
- Jordan Ministry of Environment.

3.6.2 COMPLAINT MANAGEMENT

Members of the public or other interested parties may make complaints or enquiries relating to the aspects of the environment and a particular contractor's work directly to the Contractor Environmental Representative, for whom contact details will be provided on the site notice board.

The complaint mechanism is defined within the Stakeholder Engagement Plan and incorporates the following key principles:

All complaints will be recorded using the Non Conformance Recording Form, and a complaint register will be kept at the site office detailing the name and contact details of the complainant, date and time of the complaint, nature of the complaint, corrective action and preventative action, and date of complaint handover.

3.7 COMMUNICATION AND CONSULTATION

3.7.1 COMMUNICATION AS A ONE-WAY PROCESS

Appropriate communication of environmental information to employees and sub-contractors would ensure that anyone involved in the construction phases of the Project is made aware of the requirements of the CEMP, and they understand the importance of following this specific Environmental Control Plans. Communication is a one-way process, conveying or impacting a message to an intended audience.

AWARENESS AND INDUCTION

Communication is critical to the effective implementation of the CEMP. Therefore, all personnel including site personnel, specialist subcontractors, drivers etc. shall attend an awareness induction within 7 days of starting work. This will ensure the staff gain a better understanding of the environmental issues and associated mitigation measures related to the construction phase of the Project.

ENVIRONMENTAL MEETINGS

Wärtsilä shall hold weekly environment meetings to provide instructions and receive feedback from site personnel on environmental and sustainability matters. The EHS Manager shall chair the environmental meeting. Minutes shall be taken of the meeting and should cover all relevant issues including actions to be taken.

PUBLIC INFORMATION AND INFORMATION

Wärtsilä shall provide advance notice to the public and residents of the impact zone about any activities that are likely to result in disruption or disturbance such as traffic diversion or blocking of access to properties and any other major works.

3.7.2 CONSULTATION AS A TWO-WAY PROCESS

Regular consultations shall be conducted in order to foster and develop partnerships between MoE, employers, staff, subcontractors and other relevant stakeholders involving local communities to ensure protection of the environment.

COMPLAINT MANAGEMENT

Complaints are a principal indicator of nuisance and other community dissatisfaction with site activities. It is important that all complaints are properly and systematically recorded and acted upon. This aspect is also considered within the Stakeholder Engagement Plan. A single record should be used between the SEP and CEMP in order to avoid duplication of effort with the minimum information and procedures to include the following:

- All complaints shall be directed to the Wärtsilä EHS Manager, who will direct it to the Wärtsilä Site Construction Manager and the Project Proponent immediately;
- All complaints shall be acknowledged within 48 hours of receipt by the Project Proponent by contacting the complainant (where not anonymous);
- The Project Proponent community liaison officer will liaise with Wärtsilä EHS Manager and the Wärtsilä EHS Manager to check whether the complaint is valid, and shall assign and dispatch an investigation team;
- The investigation tasks shall be agreed, delegated by the investigation team;
- Remedial action recommended by the investigation team shall be implemented and finalised;
- Complainant shall be contacted either by the community liaison officer or the Wärtsilä EHS Manager if appropriate of the outcome on the investigation within one week, unless additional information or clarifications are needed; and
- All complaints shall be recorded using a Complaint Register that will list the following information:
  - Date that complaint was received;
  - Complainant details (name, contact details, if appropriate);
  - Detailed description of the complaint the person has made;
  - Name of person who is or has responded to the complaint;
  - Action taken to handle the complaint;
  - Outline of what has happened as a result of the complaint; and
  - Any action required because of the complaint. This may include a change to contractor procedures and policies.

4 ENVIRONMENTAL IMPACTS AND CONTROL PLANS

This section of the CEMP identifies the Project's potential environmental impacts and the construction activities that could cause them. Also detailed in this section are guidance and minimum requirements for mitigating the potential environmental impacts. This section should be used as a guide by all Contractors to identify the environmental impacts associated with their works and to develop procedures in line with their own Environment Management Systems.

All Contractor environmental procedures/risk assessments/method statement etc. should be submitted to the Project Company for review and approval prior to being implemented.

The following Environmental Control Plans (ECP) present the management measures required to be implemented for the duration of the construction phase by the contractor. In addition each ECP provides an overview of the expected impacts, activities which may result in the impact, and the required mandatory reporting and compliance measures necessary for auditing purposes.

4.1 ENVIRONMENTAL TRAINING AND INDUCTION – ECP-T

4.1.1 PURPOSE

Environmental training is essential for executing work in an environmentally sound fashion during the Project construction works. This ECP covers all aspects of induction and training for the implementation of the CEMP. This procedure involves those personnel and activities likely to have an effect on the environment.

4.1.2 SCOPE

This ECP provides the framework for the environmental training programme for the Project construction works as follows:

- CEMP Induction Training for new site personnel;
- CEMP training for managers and team leaders;
- Specific CEMP training on environmental limits, standards and targets;
- Specific CEMP training on working with hazardous materials;
- Environmental incident training;
- CEMP training refresher course; and
- CEMP tool box talks.

4.1.3 CEMP TRAINING FOR NEW PERSONNEL

All new Contractor site personnel including management, supervisors and workers will attend CEMP Induction Training on arrival at the site.

The instructors delivering the CEMP Induction Training will be the HSE Manager or the designated competent person(s).

The key environmental elements of the CEMP Induction Training for new site personnel will include:

- Outline of the CEMP
- Emphasis on the importance of the CEMP
- Specific CEMP Training on Environmental Limits, Standards and Targets
- Details of site waste management procedure with emphasis on waste minimisation and the waste hierarchy
- Orientation of the site layout using maps/drawings, etc. with specific emphasis on restricted areas
- Outline of the work scope appropriate to those being inducted
- CEMP organisation and the individual's duties and responsibilities for CEMP
- Working rules (working hours, over-time work, holidays, transportation, housekeeping, etc.)
- HSE and security rules and regulations (gate control, possession of ID card, smoking rules, substance abuse rules, traffic rules, etc.)
- Emergency Action Plan (emergency alarm system, emergency communication system, evacuation route and assembly area, etc.)
- Overview of Environmental Incident Procedure
- Participation in tool box talks (when, where, how)
- Site housekeeping (e.g. after day's work, weekly site cleaning, etc.)
- Reporting incidents, accidents and near-misses
- CEMP incentive scheme to motivate the implementation of the CEMP amongst staff.

The induction will also address the following Health and Safety issues:

- Requirements for proper Personal Protective Equipment (safety harness, helmets, goggles, gloves, dust/gas masks, respirators, etc.)
- Requirements for appropriate working garments and footwear
- Outline of HSE operations procedures
- Permit to work procedures (work items or locations to be subjected, obtaining procedure, etc.)
- Encourage reporting of unsafe acts and unsafe working conditions
- First-Aid facilities (designated first-aiders, location, how to use, etc.), and the risks of infection from cuts, abrasion and ingestion
- Confirmation of personal information submitted prior to the HSE Induction Training (individual's work experience, license/permits, physical condition, etc.)
- Awareness of health risks and hazards of working on an active construction site.

The above list is not exhaustive and should not be used as a substitute for the Contractors Quality, Health, Safety and Environment (QHSE) Plan.

A list of attendees at all CEMP Induction Training sessions will be recorded, and a register of all those who have completed the session will be retained by the Project Manager for inspection and audit purposes.

4.1.4 CEMP TRAINING FOR MANAGERS AND TEAM LEADERS

This training will be given to the Wärtsilä Project Management team prior to dispatch to site or on arrival at the site. All relevant training materials will be prepared by the HSE Manager. The HSE Manager or a designated competent person will deliver this training.

In addition to the contents of the standard CEMP Induction Training, the following environmental items will be specifically highlighted at the CEMP Training for Wärtsilä Project Managers:

- Details of CEMP;
- Specific CEMP Training on Environmental Limits, Standards and Targets, including responding to exceedances;
- Format and availability of CEMP and associated ECPs;
- CEMP organisation and individual's responsibilities regarding CEMP management;
- Emphasis on the necessity for expanding CEMP awareness across the construction site;
- Environmental incident investigation method and reporting system;
- Environmental inspection programme and requirements;
- Non-conformance and corrective action plan (CAP) procedures; and
- CEMP meetings (type, frequency, participants, etc.)

Wärtsilä is obliged to report on concerned matters regarding CEMP management to Sgurr Energy and Wärtsilä Project Manager on a weekly basis.

4.1.5 SPECIFIC CEMP TRAINING ON WORKING WITH HAZARDOUS MATERIALS

Specialised training will be given to all personnel assigned to working with hazardous materials. Such training will be delivered before commencing works and on a monthly basis thereafter.

All training materials will be prepared and delivered by the HSE Manager, or by a designated competent person.

Work requiring special environmental training includes, but is not limited to:

- Refuelling training: to those involved in refuelling operations. Emergency spill response training and mock drills will be conducted on a periodic basis.
- Spills or leaks training.
- Chemical handling.
- Handling of organic solvents or toxic materials.
- Other work designated by the authorities or the HSE Manager.

4.1.6 ENVIRONMENTAL INCIDENT TRAINING

An overview of the Environmental Incident Procedure ECP-IP will be included in the Training for Working with Hazardous Materials to be conducted with all employees.

The Wärtsilä Project Management Team will receive detailed training in the Environmental Incident Procedure and spill response from the HSE Manager.

The HSE Manager will be responsible for providing environmental incident training to relevant site staff and ensuring all site staff are aware of the location of spill kits. The spill response procedures should be clearly listed above the spill kits with the contact number of the HSE Manager displayed. Each spill kit should have a minimum contents list. If any of the material within the spill kit are used the minimum contents list should be updated and the equipment replaced.

Wärtsilä construction staff are required to attend monthly environmental meetings, held by Sgurr Energy and Wärtsilä Project Management to undertake training on environmental issues which feature prominently across the Project.

4.1.7 CEMP TRAINING REFRESHER COURSE

Any employee who has seriously or repeatedly violated any CEMP rules and requirements or who has been otherwise instructed by the HSE Manager or Project Manager will take a CEMP training refresher course to enhance their environmental awareness and reinforce their knowledge.

4.1.8 CEMP TOOL BOX TALKS

CEMP Tool Box Talks will be held as required ensuring that each person on the workforce receives at least one talk each week. The environmental implications of constantly changing work patterns and areas of working can be discussed and reviewed at these sessions.

It is envisaged that the duration of the talks will be approximately 10 minutes. The talks will take place as close to the work place as possible so that any examples of CEMP practices or proposed changes are more easily viewed at the time.

CEMP Tool Box Talks will normally be given by Section Leaders. However, other personnel with site CEMP responsibility (e.g. Wärtsilä Site Construction Manager and HSE Manager) will also provide assistance as required. Topics will include, but will not be limited to:

- ECPs;
- Environmental incidents and reporting;
- Use of spill kits;
- Containment of spills;
- Appropriate disposal of contaminated soil and material;
- Material and chemical storage; and
- Waste management.

4.1.9 ADDITIONAL TRAINING

Additional training will be provided as necessary in accordance with the specific CEMP requirements. The decision to provide additional CEMP training will be made by the HSE Manager or Wärtsilä Site Construction Manager.

4.1.10 RESPONSIBILITY

The HSE Manager for the EPC Contractor will establish the site CEMP training schedule which will incorporate environmental training.

The HSE Manager will be responsible for:

- Development of CEMP training materials or the oversight of the preparation of such material by a competent person, in order to effectively conduct CEMP training;
- The preparation and updating of the CEMP training schedule;
- The communication of the training schedule to the relevant personnel;

- The provision of CEMP training or the designation of competent persons for the provision of CEMP training to the Wärtsilä Site Construction Manager and Wärtsilä Project Management Team;
- The retention of CEMP training records;
- The submission of CEMP training records to the Wärtsilä Site Construction Manager and Wärtsilä Project Manager; and
- The Project Manager will be responsible for reviewing and approving the training and material and schedule.

All site personnel will be responsible for attending and participating in the scheduled training sessions where applicable.

4.1.11 DOCUMENTATION

The following documentation will be required to be prepared:

- CEMP Induction Register; and
- CEMP Training Register.

This documentation will be treated as a record during environmental inspections. This documentation will be and remain legible, identifiable and traceable. This documentation will be kept up to date and maintained at the construction site offices. All documents are to be submitted to Wärtsilä and Sgurr Energy Project Managers and made available for spot-checks by Project Company.

4.2 ENVIRONMENTAL COMPLAINTS PROCEDURE – ECP-C

4.2.1 PURPOSE

This ECP defines how environmental complaints relating to the environmental performance of the construction works will be handled.

4.2.2 SCOPE

This procedure covers any complaints received from interested parties relating to the environmental performance of the Project construction works.

4.2.3 COMPLAINTS CONTROL MEASURE

Complaints are a principal indicator of nuisance and other community dissatisfaction with site activities. It is important that all complaints are properly and systematically recorded, and acted on. A complaint is any communication received either verbally or in writing which identifies a negative aspect of the environmental performance of the construction activities. A complaint may be received from neighbours, authorities, customers or any interested parties.

Complaints received will be directed to the HSE Manager who will direct it to the Wärtsilä Site Construction Manager immediately. Contact details will be sought from the complainant. The complaint will be recorded in the Complaints Register at which point the complaint will be investigated. It is important that communication between all interested parties is maintained.

If a complaint is found to be valid, immediate action will be taken (where appropriate and practical) to address the problem. The necessary preventative action will be taken to ensure conformance (refer to non-conformance and corrective action section of ECP – Environmental Inspection ECP-I).

When a complaint has been investigated and the appropriate action has been initiated, the complainant, where contact details are available, will be informed by letter of the outcome within 48 hours.

In closing out any complaint, all relevant documentation associated with the complaint will be filed in the Complaints Register. A single complaints process should be followed between the CEMP and Stakeholder Engagement Plan to ensure a single record is maintained and avoidance of duplication of effort.

4.2.4 RESPONSIBILITY

The Project Proponent (AES) will be ultimately responsible for handling complaints relating to the environmental performance of the site and for ensuring appropriate communication with interested parties (including the MoE and the complainant) in relation to all complaints.

The HSE Manager will notify the Project Proponent (Community Liaison Officer) by the next working day after receiving an environmental complaint. All relevant site personnel are required to report any environmental complaints received to the HSE Manager who will log it and report it to the Wärtsilä Site Construction Manager, who will report it to the Project Proponent.

4.2.5 DOCUMENTATION

The following documentation will be required to be prepared:

- Complaints Register.

This documentation will be treated as a record during environmental inspections and audits. This documentation will be and remain legible, identifiable and traceable. This documentation will be kept up to date and maintained at the construction site offices. All documents are to be submitted to the Project Proponent via the Wärtsilä Site Construction Manager and Project Manager.

4.3 ENVIRONMENTAL INSPECTION PROCEDURE – ECP-I

4.3.1 PURPOSE

The purpose of this procedure is to formally set-out how the environmental compliance of the Project construction activities with the CEMP will be periodically inspected.

4.3.2 SCOPE

This procedure covers the internal inspection of the CEMP for the Project construction works.

The objectives of this procedure are to:

- Verify that all ECPs are being adhered to in accordance with the CEMP
- Verify the effectiveness of these ECPs
- Identify any non-conformances and corrective actions that the Contractor and/or Sub-contractors will be required to implement in order to comply with the CEMP
- Identify the need to amend the ECPs.

This procedure specifically sets out the requirements for:

- Mobilisation Inspection.

- Daily Internal Inspection.
- Weekly Internal Inspections.
- Monthly Environmental Reports.
- External audits by Project Proponent or designated third party.
- MoE Audits.

4.3.3 INSPECTION CONTROL MEASURES

4.3.3.1 MOBILISATION INSPECTION

Wärtsilä Site Construction Manager will undertake a mobilisation inspection. The inspection will be undertaken to record the existing environmental conditions of the site. A record of the mobilisation inspection will be maintained to aid demobilisation.

4.3.3.2 DAILY INSPECTIONS

A site inspection of the construction site will be conducted and documented on a daily basis by the HSE Manager.

The purpose of this will be to primarily monitor dust levels and excessive vehicle emissions at the construction site. The visual checks will be undertaken by the HSE Manager in accordance with the Environmental Control Measure.

The visual dust check form will be completed on a daily basis by the HSE Manager and issued to the Wärtsilä Site Construction Manager. Vehicle emissions will be considered within context of vehicle maintenance regimes- with vehicles exhibiting excessive smoke taken out of service until serviced.

On identification of significant dust/vehicle emission levels during the visual monitoring, the HSE Manager will be required to inform the Project Manager and respond immediately in accordance with the CEMPP10 Environmental Incident Procedure.

In the event that impacts on receptors are identified, the HSE Manager will follow the Observations and Non-conformances section of this procedure. Where dictated by a specific CAP, further elements of site environmental performance may be added to the visual dust check monitoring form where, for instance, there has been a history of non-compliance.

4.3.3.3 WEEKLY INTERNAL INSPECTIONS

An inspection of the construction site will be conducted and documented on a weekly basis by the HSE Manager and reviewed by the Project Manager.

The purpose of this inspection will be to determine if continued good environmental housekeeping at the site is being maintained and compliance with the ECPs set out in the CEMP is achieved.

An Environmental Inspection Record (provided in **Appendix F**) will be completed during each weekly inspection. These inspection records will be documented, reviewed by the Wärtsilä Site Construction Manager and submitted to Sgurr Energy and the Wärtsilä Project Manager for subsequent submission to the Project Proponent (AES).

This inspection will cover:

- Performance against CEMP limits standards and targets;
- General site housekeeping;

- Dust and air quality;
- Noise;
- Materials management;
- Waste management; and
- Environmental monitoring.

Any observations or non-conformances discovered during the inspection will be addressed in accordance with this procedure. Where dictated by a specific corrective action plans (CAP), further elements of site environmental performance may be added to the weekly Environmental Inspection Record where, for instance, there has been a history of non-compliance.

4.3.3.4 MONTHLY ENVIRONMENTAL REPORTING

The monthly environmental report will be prepared to report environmental performance of the site and to assess compliance with the CEMP.

The objectives of this report are to:

- Assess adherence to the MoE environmental permit requirements.
- Assess compliance of the Project with the requirements of the CEMP and EIA.
- Provide a record of the environmental performance of the Project.
- Verify the closure or otherwise of the identified CAPs.

The HSE Manager who is overseen by the Wärtsilä Site Construction Manager is responsible for:

- Compliance with the CEMP and adherence to the MoE environmental permit requirements.
- Provision of information to facilitate the compilation of the environmental report.
- Conducting daily and weekly site inspections to assess compliance with the CEMP.
- Development of appropriate, Specific, Measurable, Achievable, Realistic and Time-bound (SMART) CAPs where Non-Conformances have been determined.
- Implementation and monitoring of the developed CAPs.
- Issuing the monthly reports to the Wärtsilä Project Manager and Sgurr Energy Project Manager.

The scope of this monthly report is to undertake an environmental review of the Project site. This covers the following aspects:

- Environmental Management
- Labour Welfare
- Environmental Monitoring
- Sustainability Practices
- Compliance with the CEMP.

A template of the Monthly Environmental Report is provided in **Appendix G**.

4.3.3.5 DEMOBILISATION INSPECTION

The HSE Manager will undertake a demobilisation inspection. The inspection will confirm complete demobilisation of construction works at the site. Prior to the demobilisation inspection being undertaken, a Method Statement for the inspection must be prepared and submitted to the Wärtsilä Site Construction Manager and the Wärtsilä Project Manager. Once the inspection has been undertaken, a report must be generated and submitted to the Wärtsilä Project Manager, who will submit it to the Sgurr Energy Project Manager for subsequent submission to the Project Proponent.

4.3.3.6 MINISTRY OF ENVIRONMENT EXTERNAL AUDITS

External audits may be undertaken by the MoE at any time to assess how effectively the CEMP is being implemented, to identify non-conformances and to recommend corrective actions to be taken. To facilitate this, the Wärtsilä will provide the MoE with all reasonable access to the site and to all relevant environmental documentation and records. The Contractor is to inform Sgurr Energy of any proposed visits or inspections of the Project site by the MoE to ensure each party is represented during the visit.

4.3.3.7 OBSERVATIONS AND NON-CONFORMANCES

Observations

Observations are findings relating to poor housekeeping or bad practice which will generate no immediate threat to the environment. Findings will be discussed between the Wärtsilä Site Construction Manager and HSE Manager and a time frame for improvement determined. The observation will be informally noted and increase in significance only if the observation is not closed out to the agreed timescale.

Non-conformances

A non-conformance is a deviation from the agreed process identified within the CEMP, which in the view of the inspector could lead to a significant environmental impact.

Alternatively, poor housekeeping issues repeatedly observed for three consecutive Environmental Inspections, or an observation not closed out within agreed timescales, will also be regarded as a non-conformance.

A non-conformance will be issued when investigation into an environmental incident or complaint highlights the cause being a deviation from the agreed process.

4.3.3.8 INSPECTION REPORTING

Weekly Environmental Inspection Records will be documented by the HSE Manager, approved by the Wärtsilä Site Construction Manager.

All Reports will be agreed and signed off by Wärtsilä.

4.3.3.9 CORRECTIVE ACTION PLANS

Following the determination of the root cause of the non-conformance, it will be the responsibility of the HSE Manager to develop a CAP, which shall be approved by the Project Manager. The CAP will identify the non-conformance, the location of the non-conformance and the action(s) to be implemented to correct that non-conformance.

The actions defined in the CAP will aim to efficiently mitigate the environmental impact and to reduce the likelihood of further environmental non-conformances.

CAPs will be developed in order to prevent recurrence. CAPs will be:

- **S**pecific
- **M**easurable
- **A**chievable
- **R**elevant
- **T**ime-based.

The Wärtsilä Site Construction Manager must review and approve all CAPs. In addition, the HSE Manager will maintain a register of non-conformances and CAPs to facilitate the monitoring and management of overall environmental performance.

The HSE Manager will be responsible for the implementation of the CAPs. However, the Wärtsilä Site Construction Manager will retain ultimate responsibility for ensuring that CAPs are implemented.

Signatures of the Wärtsilä Site Construction Manager and the Contractor will be required when the CAP is developed and when it is closed out.

4.3.3.10 RESPONSIBILITY

The AES HSE Manager will be responsible for facilitating, as far as is practicable, any MoE audits. The Wärtsilä Site Construction Manager will also have the ultimate responsibility for ensuring that the developed CAPs are implemented. The Wärtsilä Site Construction Manager shall submit all required monitoring reports to the AES Construction Project Manager via the Wärtsilä Project Manager. AES will be ultimately responsible to ensure that all ECP's implemented onsite are effective and have closed out the original issue. The Wärtsilä Site Construction Manager will submit copies of all the weekly internal inspection records to the Wärtsilä Project Manager and the Sgurr Energy Project Manager for onward submission to AES for review.

The AES HSE Manager will be responsible for weekly environmental inspections. The HSE Manager will record all non-conformances identified. The HSE Manager will have the responsibility for the development of CAPs and ensuring their implementation. The Wärtsilä Site Construction Manager shall review and approve the CAPs developed by the HSE Manager and follow up on their implementation.

4.3.3.11 DOCUMENTATION

The following documentation will be submitted to the Wärtsilä Project Manager and the Sgurr Energy Project Manager:

- Weekly and monthly environmental reports;
- Monthly monitoring results as defined within the CEMP and relevant permits; and
- Response to third party environmental consultant audits and environmental incident reports.

The Contractor is also required to produce the following documentation:

- Weekly Inspection Records (**Appendix F**); and
- Register of non-conformances and CAPs.

This documentation will be treated as a record during environmental inspections. This documentation will be and remain legible, identifiable and traceable. This documentation will be kept up to date and maintained at the construction site offices. All documents are to be submitted to Sgurr Energy via the Wärtsilä Site Construction Manager and the Wärtsilä Project Manager.

4.4 AIR QUALITY – ECP-AQ

4.4.1 PURPOSE

The purpose of this Air Quality Control Procedure is to guide the Contractor to protect sensitive receptors in the vicinity of the Project construction area by complying with the allowable air emissions during construction works. The sensitive receptors are identified in Chapter 2 of this CEMP.

4.4.2 SCOPE

This ECP covers the local air quality limits, described in Chapter 3, that the Contractor is legally obliged to meet during the construction works.

In order to guide the Contractor to meet the air quality standards, several air quality controls have been provided for the construction activities anticipated on the Project site. Based on a review of the environmental aspects and impacts associated with the construction activities, the following air quality aspects are relevant:

- Dust;
- Gaseous Pollutants; and
- Odour.

This ECP will identify which construction activities are expected to affect each aspect of air quality, and provide mitigation and abatement measures.

4.4.2.1 DUST

Dust Impacts

The key construction activities which will contribute to dust emissions are:

- Earthwork;
  - Site levelling.
  - Stockpiling of soils/spoil.
  - Windblown fugitive dust from stockpiles.
  - Windblown fugitive dust from exposed soil.
  - Stone crushing.
  - Movement of vehicles onsite, particularly unpaved surfaces.
- Building construction;
  - Concreting operations.
  - Movement of vehicles onsite, particularly unpaved surfaces.
  - Stockpiling of materials.
- Dust from Vehicle Track-out / Windblown from material import and export;

- Vehicles leaving site hauling materials.
- Vehicles accessing the site delivering materials.

Impacts from dust emissions and subsequent settlement include hazards to human health, reduced visibility along the adjacent Zarqa to Sahab highway to the south, and deterioration of vegetation and habitats within adjacent open desert areas to the north and east.

Dust Control Measures

In order to minimise the impacts of dust emissions control measures will be implemented as follows:

- Areas of exposed unmade ground should be kept to a minimum and compacted and/or sprayed with water;
- Stockpiles of excavated material should be kept to a minimum, covered or wetted and removed from site as quickly as possible. Stockpiles and material stores shall not exceed 10m in height;
- Stockpiles shall not be located adjacent to the Zarqa to Sahab highway to the south, or open desert areas to the north and east. It is recommended that stockpiles be located at the western side of the site;
- Movements of excavated material are only to be undertaken in low wind and must always be dampened and covered and all haul vehicles must be sheeted prior to accessing public highways;
- Haul trucks shall not be overloaded with sand and materials to prevent shedding of loads;
- Earthworks should not be undertaken during windy conditions. Wind speed and direction must be measured on site at all times, and be visible to all staff (i.e. installation of wind socks at stockpile sites and site access/egress points);
- Haulage routes should be sealed and wheel washes shall be in place at access and egress points where necessary;
- Speed limits shall be imposed and enforced to minimise dust creation within the site and along haul routes;
- Vehicle movements shall be restricted to designated haulage routes, unless required by the work phasing; and
- Wet drilling to be used where necessary where piling and excavations are required.

Responsibility

Ultimately the Project Proponent is responsible for ensuring all ECP's are effectively implemented and enforced in site although on the site itself the task falls to the Wärtsilä Site Construction Manager who would then pass details to the Project Proponent. The Wärtsilä Site Construction Manager shall submit all required monitoring reports to the Sgurr Energy Project Manager via the Wärtsilä Project Manager which would then be passed through to the Project Proponent.

The HSE Manager will be responsible for daily visual assessments of air-born dust as a result of construction activities. Visual assessments shall be conducted each day at the following locations:

- Stockpiles and spoil heaps;
- Access and egress points;
- Construction and excavation site; and
- Perimeter along the Zarqa to Sahab highway.

Each daily visual inspection shall be recorded and saved with the following information:

- Time of inspection;
- Name of inspector;
- Weather conditions during the inspection (to include wind, rain, temperature);
- Notes for each location inspection (to state whether dust levels were visible); and
- Photographs of each location inspected.

Where visual fugitive dust is identified, then mitigation shall be implemented immediately to eliminate the excess the fugitive dust, and including:

- Covering stockpiles and spoil heaps;
- Wetting down exposed ground;
- Wetting excavations; and
- Ceasing excavations/levelling/spoil movements until the fugitive dust is under control.

4.4.2.2 GASEOUS POLLUTANTS

Gaseous Pollutants Emissions Impacts

Gaseous pollutants and particulate matter such as carbon dioxide, nitrous oxides, sulphur oxides, volatile organic carbons, and carbon monoxide are generated and emitted to the atmosphere when plant and machinery is operated. Emissions to atmosphere may also arise from inappropriate storage and containment of volatile chemicals.

Gaseous and particulate matter emissions have potential to degrade the ambient air quality and may lead to adverse effects on human health for the Project work force as well as any workers or users of adjacent sites and facilities.

Gaseous Pollutants Control Measures

The Contractors must identify all sources of emissions to atmosphere including vehicle movements, use of plant and machinery, and chemicals used.

Control measures will include the following:

- Vehicles and machinery must be serviced and maintained to manufacturers guidelines;
- Vehicles and equipment should have appropriate exhaust and filter equipment where practicable;
- ‘Black smoke’ emissions are not acceptable during normal operations i.e. not during the start-up and general use of equipment;
- Plant and equipment will not be used unnecessarily and shall not be left switched idling on when not in use;
- Mains or battery powered equipment will be used in preference to fuel powered equipment;
- All travel and journeys to and from the site will be considered and coordinated to reduce the amount of journeys undertaken;
- Burning of any material is prohibited;
- All fuels and chemicals will be identified, labelled and quantities will be kept to a minimum; and

- Fuels and chemicals will be stored securely in sealed containers, in a temperature controlled environment where appropriate, as per the relevant MSDS.

Responsibility

The Wärtsilä Site Construction Manager is responsible for ensuring all ECP's are effectively implemented and enforced in site. The Wärtsilä Site Construction Manager shall submit all required monitoring reports to the AES Construction Project Manager via the Wärtsilä Project Manager. AES will be ultimately responsible to ensure that all ECP's implemented onsite are effective and have closed out the original issue.

The HSE Manager will be responsible for conducting daily visual assessments of air emissions (black smoke). Any observed black smoke shall be recorded as an environmental incident. Each daily visual inspection shall be recorded and saved with the following information:

- Time of inspection;
- Name of inspector;
- Weather conditions during the inspection (to include wind, rain, temperature);
- Notes for each location inspection (to state whether black smoke was observed).

Where visual black smoke is observed, then mitigation shall be implemented immediately to include:

- Immediately shutting down the emitting equipment; and
- Service and/or replacement of the affected equipment.

Any incidence of black smoke will be recorded including the following information:

- Location of incident;
- Weather conditions;
- Time and date observed;
- Photo of the incident;
- Corrective action completed to reduce the black smoke; and
- Photograph after the implementation of corrective action.

All records of black smoke shall be saved for inspection during site audits.

4.4.2.3 ODOUR

Odour Emissions Impacts

Adverse odours may arise from the storage of waste material, sewage and staff welfare wastes, use of chemicals, and mobilisation of soils and sediments. The generation of odour at the Project site may create a nuisance to adjacent site users, particularly for local residents to the south of the Zarqa to Sahab highway.

Odour Control Measures

In order to minimise the release of odour the following control measures will be implemented:

- Odorous wastes must be stored in sealed containers and removed from site regularly enough not to cause a nuisance;

- Welfare facilities including temporary toilets must be hygienic and regularly cleaned;
- Site welfare facilities and toilets should connect to mains sewerage where possible;
- Welfare wastes should be removed from site regularly enough not to cause a nuisance; and
- Odorous chemicals must be stored in sealed containers and kept in minimum quantities.

Responsibility

Ultimately the Wärtsilä Site Construction Manager is responsible for ensuring all ECP's are effectively implemented and enforced in site. The Wärtsilä Site Construction Manager shall submit all required monitoring reports to the Sgurr Energy Project Manager via the Wärtsilä Project Manager.

The HSE Manager will be responsible for daily site inspections in order to identify any dour emissions. Any noticeable odour will be recorded as an environmental inciden. Each daily inspection shall be recorded and saved with the following information:

- Time of inspection;
- Name of inspector;
- Weather conditions during the inspection (to include wind, rain, temperature);
- Notes for each location inspection (to state whether odour was observed).

Where odour is observed, then mitigation shall be implemented immediately to include:

- Immediately shutting down the emitting equipment; and
- Service and/or replacement of the affected equipment.

Any incidence of odour will be recorded including the following information:

- Location of incident;
- Weather conditions;
- Time and date observed;
- Photo of the incident;
- Corrective action completed to reduce the black smoke; and
- Photograph after the implementation of corrective action.

All records of black smoke shall be saved for inspection during site audits.

4.4.3 DOCUMENTATION

The following documentation will be required to be prepared by the HSE Manager for submission to the Wärtsilä Site Construction Manager:

- Visual Dust Check Monitoring Form;
- Visual Point Source and/or Mobile Source Monitoring Form;
- Odour Check Monitoring Form;
- Environmental Incident Response Form;
- Vehicle Service and Registration Records;

- Maintenance Schedules; and
- Weekly Environmental Inspection Record.

This documentation will be treated as a record during environmental inspections. This documentation will be and remain legible, identifiable and traceable. This documentation will be kept up to date and maintained at the construction site offices.

4.5 NOISE – ECP-N

4.5.1 PURPOSE

The purpose of this Noise and Vibration Control Procedure is to guide the Contractor and Sub-contractors to protect sensitive receptors in the vicinity of the Project construction area by complying with the allowable noise limits during construction works. The sensitive receptors are identified in Chapter 2 of this CEMP.

4.5.2 SCOPE

This ECP covers the local noise limits, described in Chapter 3, that the Contractor is legally obliged to meet during the construction works.

In order to guide the Contractor to meet the air quality standards, several noise emission controls have been provided for the construction activities anticipated on the Project site. This ECP will identify which construction activities are expected to generate noise emissions, and provide mitigation and abatement measures.

4.5.2.1 NOISE IMPACTS

Existing road traffic on the Zarqa to Sahab highway is the only contributor to baseline ambient noise levels, and all measured noise comply with the Jordanian Guidelines for Prevention of Noise (2003).

The following construction works will be completed:

- Site preparation;
- Civil works;
- Supply and installation of plant and equipment; and
- Mechanical, Electrical and Plumbing (MEP) works.

Equipment and associated noise emissions relevant to the construction works are summarised in Table 4-1.

Table 4-1 Typical construction equipment and associated emissions

Noise Generating Equipment	Site Preparation	Civil Works	Plant and Equipment	MEP Works	BS 5228-1 2009+A1: 2014, Table Reference	Equivalent Sound Power Level, dB(A) (Per Item)
Dozer	✓	✓			C2. 10	107
Tracked excavator	✓	✓			C2. 14	106
Wheeled loader	✓	✓			C2. 27	107
Articulated dump truck	✓				C2. 33	108
Lorry	✓	✓	✓	✓	C2. 34	107

Noise Generating Equipment	Site Preparation	Civil Works	Plant and Equipment	MEP Works	BS 5228-1 2009+A1: 2014, Table Reference	Equivalent Sound Power Level, dB(A) (Per Item)
Vibratory roller	✓	✓			C2. 39	101
Large rotary bored piling rig	✓				C3. 14	111
Cement mixer truck		✓			C4. 18	102
Tower crane		✓	✓	✓	C4. 49	104
Tracked mobile crane		✓	✓		C4. 52	102
Lifting platform			✓	✓	C4. 57	94
Diesel generator	✓	✓	✓	✓	C4. 84	101
Water pump (diesel)	✓	✓			C4. 88	95
Angle Grinder		✓	✓		C4. 93	107

As per the EIA, moderate negative impacts are predicted during the night-time construction activities. In order to minimise impacts control procedures shall be implemented as outlined in Section 4.

4.5.2.2 NOISE CONTROL MEASURES

In order to minimise the impacts of noise emissions control measures will be implemented as follows:

- Noise monitoring shall be conducted on the southern site perimeter on a weekly basis as an absolute minimum (refer to for location) for the duration of the construction phase. The noise meter shall be left measuring noise levels for at least 24 continuous hours in order to capture day-time and night-time noise levels. Raw data files from each monitoring survey shall be stored for inspection and audit;
- A survey form shall be completed for each weekly noise survey, for the purpose of record keeping, and shall record the following information as a minimum;
  - Date of monitoring.
  - Time of monitoring (start and end time).
  - Weather conditions, including wind speed.
  - Person conducting the survey.
  - Photograph of noise meter set up.
  - Maximum recorded noise level and minimum recorded noise level.
- If noise exceeds the noise limits the use of acoustic screens or noise attenuation measures shall be implemented;
- Items of plant on site operating intermittently shall be shut down in the intervening periods between use and not left idling;
- Electrically powered plant should be used, where practicable, rather than mechanically powered alternatives.
- All mechanically powered plant shall be fitted with suitable silencers.
- Proper PPE shall be provided to all personnel working in high noise areas.
- Appropriate breaks shall be provided to personnel working in high noise areas
- High noise sign boards shall be placed in high noise areas such as excavation, cutting, grinding.

→ Where noise thresholds are exceeded during construction works it is the responsibility of the Contractor to develop alternative ways of working to reduce noise levels to acceptable levels

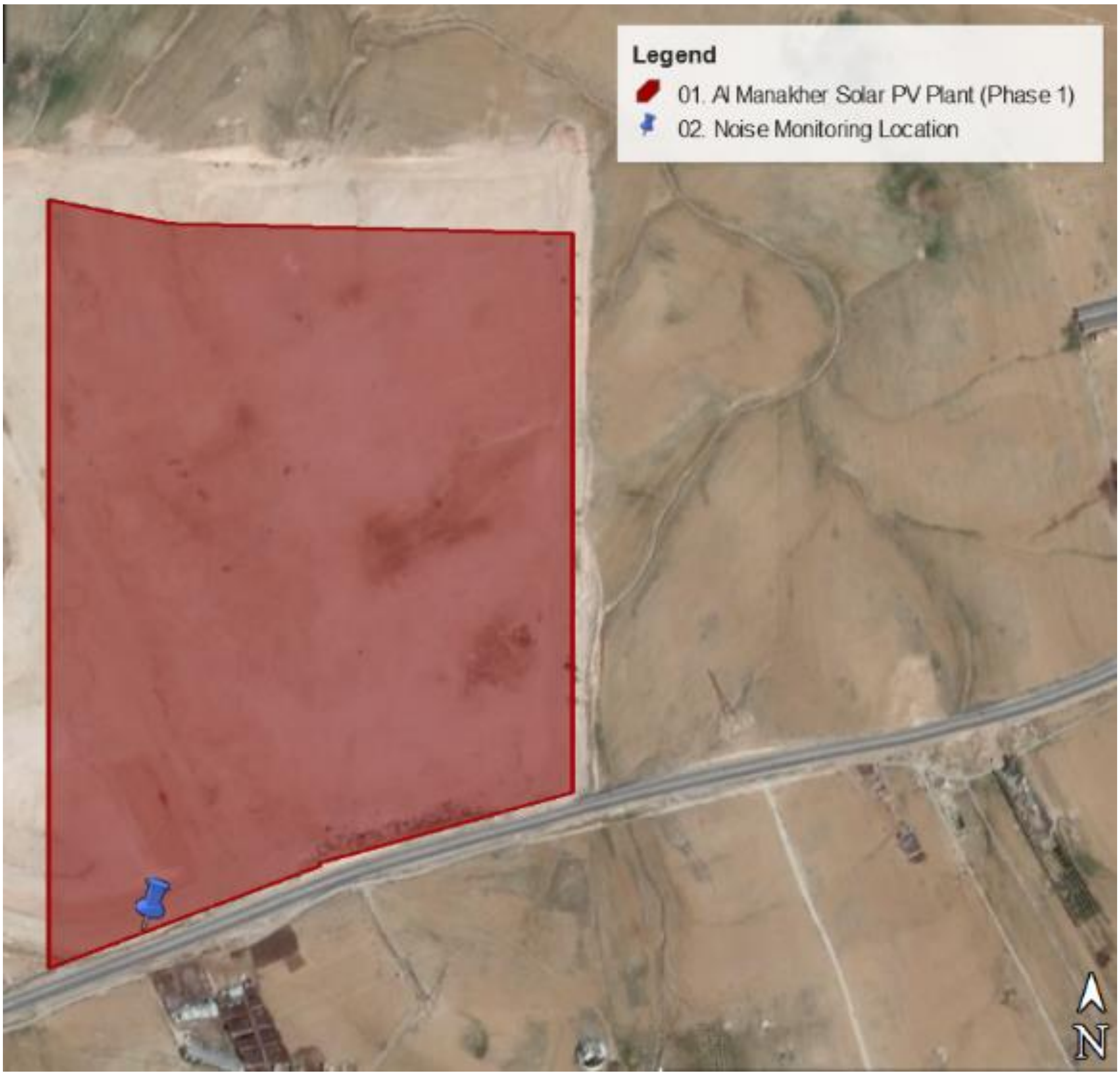


Figure 4-1 Weekly noise monitoring location during construction

4.5.3 RESPONSIBILITY

The Wärtsilä Site Construction Manager is responsible for ensuring all ECP's are effectively implemented and enforced in site. The Wärtsilä Site Construction Manager shall submit all required monitoring reports to the AES Construction Project Manager via the Wärtsilä Project Manager. AES will be ultimately responsible to ensure that all ECP's implemented onsite are effective and have closed out the original issue.

The HSE Manager will be responsible for weekly environmental inspections of the Project site which will include a review of the implementation of the noise and vibration control procedures. The HSE Manager will also undertake noise control checks, as described in the Section 6.

The HSE Manager will be responsible for the CEMP Induction, which will highlight the noise control requirements for the Project construction activities.

The HSE Manager will ensure the following:

- All raw noise monitoring data will be stored according to date for inspections and audits.
- All noise monitoring recording forms will be completed and stored for inspections and audits.
- A noise grievance register should be established to provide written records of any noise complaints as follows:
  - The nature of noise complaints (e.g. shouting, equipment noise, etc.);
  - The contact details of the complainant;
  - An assessment of the validity of the complaint; and;
  - The actions taken, if any.

4.5.4 DOCUMENTATION

The following documentation will be required to be prepared:

- Environmental Incident Response Form
- Monthly Noise Monitoring Results
- Weekly Inspection Records.

This documentation will be treated as a record during environmental inspections. This documentation will be and remain legible, identifiable and traceable. This documentation will be kept up to date and maintained at the construction site offices. All documents are to be submitted to Sgurr Energy Project Manager via the Wärtsilä Project Manager.

4.6 WASTE AND HAZARDOUS WASTE MANAGEMENT – ECP-WM

4.6.1 PURPOSE

The aim of this Waste Management ECP is to develop practical and effective procedures and control measures to allow for the appropriate handling, storage, disposal and treatment of waste (hazardous and inert), and to reduce the environmental footprint of the Project construction activities. This shall be achieved through meeting the following objectives:

- Ensure compliance with the relevant statutory regulations, environmental standards and best practice guidelines; and
- Reduce the potential environmental impacts of the construction works identified through the implementation of best practice mitigation measures.

4.6.2 SCOPE

This ECP details the waste management requirements that the Contractor is required to undertake during construction works. These procedures have been provided for the anticipated construction activities. Based on a review of the environmental aspects and impacts, the following potentially significant impacts have been identified in the CEMP:

- Soil, and groundwater contamination;
- Visual intrusion;

- Odour emissions;
- Landfill exhaustion; and
- Pest infestation and disease propagation.

This ECP, therefore, covers the following key construction activities:

- Site preparation and excavation activities;
- MEP and utility trench construction;
- Concrete Operations;
- Material handling and storage;
- Waste storage and management; and
- Vehicle use, Refuelling and Maintenance.

It is the Contractors' responsibility to demonstrate that its activities are covered by the waste controls stipulated in this procedure. In the event that they are not covered, the Contractor is obliged to take all necessary precautions to ensure no damage to the environment occurs as a result of the handling of hazardous substances. This is to be undertaken through the preparation of waste controls for these works which facilitate compliance with the relevant standards. Compliance will need to be demonstrated to key stakeholders, including the MoE and the Lenders.

In order to determine if wastes generated by the construction activities are effectively managed and disposed of, environmental inspections and tracking will be undertaken. These are covered in the Environmental Inspection Procedure and Environmental Monitoring Procedure referenced below.

4.6.3 WASTE AND HAZARDOUS WASTE IMPACTS

Three main impacts of waste and hazardous waste impacts have been identified due to the improper or inadequate management of any waste streams, which have the potential to result in the following:

- Excessive landfill disposal and pressure on the current waste management infrastructures;
- Soil and groundwater ground contamination;
- Health and safety risks for construction workers.

A summary of waste types and their recommended disposal option is provided in Table 4-2 [waste quantities to be updated once the contractor is appointed and waste quantities are confirmed].

Table 4-2 Construction waste types, quantities and disposal point

Waste Material	Construction	Quantity	Recommended Management Option
Asphalt	Generated from the construction of the future plant roads, access roads, parking etc.		Treatment and Reuse
Concrete and cement	Generated from the construction of the buildings and ancillary structures.		Treatment and Reuse
Soil	Generated by the site clearance and excavation works		Treatment and Reuse

Waste Material	Construction	Quantity	Recommended Management Option
Metals	Generated from construction scrap of structural steel (used for turbine area, frames and other framed structures), reinforced bars for reinforced concrete (RC), security fence, columns, main beams, struts, vertical and horizontal braces, crane girders, ladders, stairs, gates, access platforms and gratings, metallic sandwich insulated roof panel material, aluminium framed windows, wires, cables, pipes, sign board etc.		Reuse and/or Recycling
Brick / block / ceramics	Generated from the construction of the power plant itself and associated structures.		Reuse and/or Recycling
Wood/Timber and plasterboard	Generated from the construction of the plant, buildings and ancillary structures.		Reuse and/or Recycling
Chemicals and hazardous waste	Fuels, hydrocarbons & oils, solvents, waste, contaminated soil, sludge, acid, paints, coating substances including elastomeric polyurethane and epoxy type, coal tar and epoxy resin blends, extruded polystyrene board insulation, used chemical drums, used spill kit materials, batteries / capacitors, fluorescent tubes etc.		Treatment and Disposal
Glass and plastics	Generated from the construction administration office, the canteen area and the labour camp area which include mostly food packaging, office elements, fibreglass (generated from construction scrap of insulation materials and pipes) etc.		Reuse and/or Recycling (and/or treatment and disposal for fibreglass)
PV Solar Panels and E-waste	Generated as a consequence of accidental damage during transportation or mounting stages.		Reuse and/or Recycling (e.g. by panel supplier) E-waste streams would be disposed of in municipal solid waste containers
Electronic	Generated from the operation of the construction administration office, camp which include computers, printers, refrigerators, mobile phones etc.		Reuse and/or Recycling
Cardboard and paper	Generated from the operation of the construction administration office which include office documents, printing, boxes etc.		Recycling
Organic	Landscape waste – generated from site clearance Food waste – generated from daily operations at construction site		Composting

4.6.4 WASTE AND HAZARDOUS WASTE CONTROL MEASURES

Procedures to appropriately segregate, store, handle and dispose of all materials and waste streams anticipated during the construction works will be considered within this Waste Management Procedure. The exact location of the temporary/long-term storage and disposal sites for chemicals, paint cans, or different wastes must be determined by the Contractor and approved by the Wärtsilä Project Manager, and the Sgurr Energy Project Manager prior to commencing any work.

In order to ensure that this is carried out effectively this ECP provides controls for the following:

- Proposes a minimisation; collection, storage, treatment, re-use and disposal route for each waste stream and identifies potential third party re-users
- Enforces the selection of appropriate locations of landfills or long-term storage sites for waste
- States the method to properly manage all wastes i.e. through training, storage, containerisation, labelling, transporting and disposal.

4.6.4.1 BEST PRACTICE

The best way to manage waste is to avoid generating it. In some situations the generation of waste is unavoidable. However, the guiding principles and the philosophy of the Contractor will be to drive towards reduction in waste generation, reclamation of waste (through identification, management and segregation) and either reuse, recovery or recycling of waste.

The Contractor, in accordance with the Waste and Hazardous Waste Management ECP (ECP-WM), will maintain a record of waste materials transferred from the construction site via Waste Transfer Notes (WTN). These WTNs will record the time, date, quantity, type and destination of all wastes. A record of these will be maintained at the construction site.

The following is a brief overview of some of the guiding principles of waste management best practice.

4.6.4.2 WASTE HIERARCHY

The waste hierarchy is a key guiding principle for a more sustainable approach to waste management which details the process for minimising the generation of waste. It represents a chain of priority for waste management from the ideal of prevention and reduction to the last resort of disposal. The waste hierarchy is illustrated in Figure 4-2.

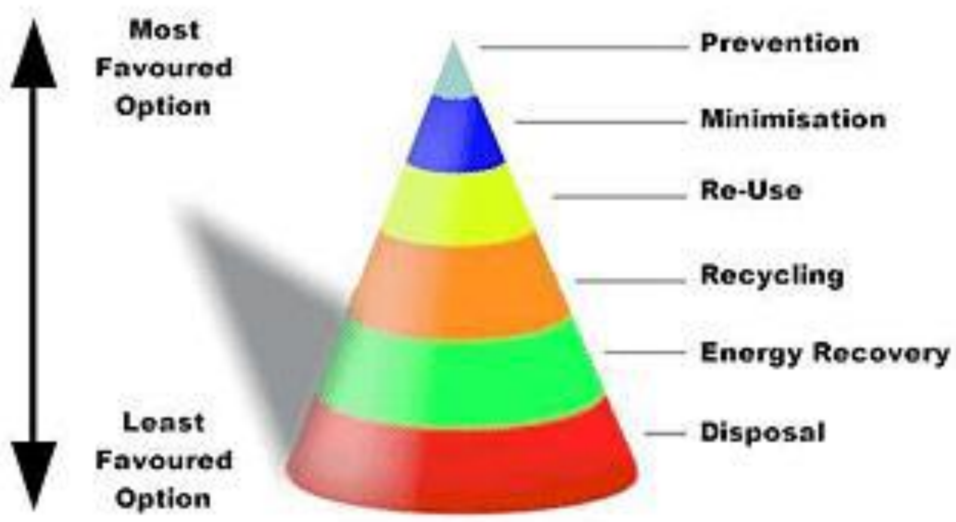


Figure 4-2 Waste Hierarchy Model

Options to prevent or reduce waste should be considered primarily. Where waste cannot be avoided or further reduced at source, materials can be reused either for the same or for a different purpose. Failing that, material should be recovered and recycled into new materials. Finally, waste can be incinerated with energy recovery. Disposal to landfill is the least favoured option in the waste hierarchy and is the last resort after all other options have been considered.

4.6.4.3 WASTE STREAMS

The waste generated during construction activities can be separated into two distinct categories with the accompanying definitions:

- Hazardous waste, which can be defined as *waste which is dangerous or difficult to store, treat, transport or dispose of, and may contain substances which are corrosive, toxic, reactive, carcinogenic, infectious, irritant, or otherwise harmful to human health and which may be toxic to the environment*; and
- Non-hazardous waste, which can be defined as *all waste that cannot be classified as hazardous waste*.

4.6.4.4 PROCEDURES FOR NON-HAZARDOUS WASTE

- All contractors to identify the types and quantities of waste expected to be produced throughout the Project lifecycle.
- All contractors will produce a procurement plan which will include strategies to avoid over ordering of products and minimising the amount of packaging delivered to site.
- Waste will be stored in designated areas, in sealed containers on an impermeable surface.
- Wastes will not be stored within or adjacent to open desert areas.
- Waste storage areas will be clearly signposted.
- Segregation of recyclable waste into designated containers will be in accordance with the waste contractor requirements.
- Waste storage that may cause a nuisance i.e. odour and pests must be removed from site before the nuisance is created.

- Waste storage should be managed to minimise the number of pick up journeys to and from the site.
- All waste streams will be collected by licensed waste collection contractors, including specialist contractors for hazardous waste streams.
- Records will be kept detailing the waste types, quantities, and the waste collection contractor each time waste is removed from site. All records will be available for inspection and audits.
- Records will be kept detailing the types and quantities of wastes recycled. All records will be available for inspection and audits.

Material Re-use

- Materials generated onsite will be re-used where possible, including wooden pallets and packaging that can be reused for internal signs etc.
- Excavated waste will be tested to ascertain the presence of contamination, and where possible will be re-used as fill within the site.
- All reports produced at the site office will be printed double-sided, and all paper will be reused for scrap or drafts, wherever possible.

Recycling

Plastic drums, empty plastic bottles, scrap metal, batteries, and waste paper will be segregated onsite and sent to an appropriate recycling facility.

It is required that the Contractor obtain a list of Sub-contractors from the MoE who specialise in collecting and recycling the following materials

- Paper.
- Plastics.
- Toners.
- Cans (steel and aluminium).
- Batteries.
- Glass.

Options to prevent or reduce waste should be considered primarily. Where waste cannot be avoided or further reduced at source, materials can be reused either for the same or for a different purpose. Failing that, material should be recovered and recycled into new materials. Finally, waste can be incinerated with energy recovery. Disposal to landfill is the least favoured option in the waste hierarchy and is the last resort after all other options have been considered.

4.6.4.5 PROCEDURES FOR HAZARDOUS WASTE

Hazardous waste must be collected and stored onsite in a separate contained skip designated for hazardous waste only. Hazardous waste if stored onsite should be stored away from sources of ignition. The waste will be transported off-site, treated, stored and disposed of by an approved MoE service provider, to an approved disposal site for appropriate disposal.

Hazardous waste produced during the Project has been further divided within this ECP based on the levels of treatment that the hazardous materials will receive onsite:

- Hazardous Construction Wastes, chemicals.
- Sanitary Waste (human waste).

Waste Minimisation

- All recyclable hazardous materials and chemicals, including waste oils, are collected for recycling by an MoE approved service provider.
- Ensure that vehicles used for transporting soil and rocks are not used to transport waste, unless cleaned prior to use.
- When mixing or diluting chemicals ensure that the correct amounts of chemicals are used.
- Appropriate storage of hazardous materials to ensure that they are not spilt or contaminated and thus render unusable.
- Storage areas for hazardous waste are bunded to 110% of the total volume stored or 25% of the total.
- Hazardous chemicals are stored and handled in accordance with the manufacturers Material Safety Data Sheet (MSDS).
- Ensure the correct containers are being used for waste segregation.
- 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.
- The use of disposable materials such as plastic cups, batteries etc. should be avoided where possible.
- Filter systems on all engines will be changed regularly.

Sanitary Waste

Waste Minimisation

Sanitary Waste is composed of sewage and run-off from the welfare facilities produced during the construction works. This category of waste cannot be re-used; however, limited minimisation procedures may be implemented to reduce run-off from the kitchen and wash basins.

- Placing hippo, or brick, in the toilet cistern will reduce the amount of water passed through with each flush.
- Signs/posters in the toilets and kitchens to increase awareness about the amount of water used and to ensure limited use.
- Signs/posters in the toilets and kitchens to increase awareness to ensure that no inappropriate chemicals are disposed of within the toilets.
- Signs/posters in the toilets and kitchens to increase awareness about the amount of detergent required and to ensure limited use.

Sanitary waste shall be collected in septic tanks located within the construction site. Portable toilets will be provided for the employees across the site and in the office accommodation onsite. Sanitary waste would then be tinkered offsite by MoE approved service providers

The septic tanks will allow for the anaerobic decomposition of the sludge and residual sludge can be pumped out and disposed in sludge drying facilities of the sewage treatment plant.

Portable Toilet and Septic Tank Decommissioning Control Measures

- Any known of suspected contamination sites should be identified, monitored if appropriate and remediate prior to decommissioning.
- Removal of storage tanks to take place after systems have been fully decanted and cleaned. Under no circumstances should these systems be removed prior to removal of potentially contaminated substances.
- Water used to clean tanks must be disposed of along with the septic waste.

4.6.4.6 WASTE STORAGE AND DISPOSAL

Inappropriate storage, handling and disposal of Project wastes could potentially impact soils and groundwater quality, thereby violating environmental regulations. Without exception all hazardous material must either be treated, where appropriate, or be moved offsite immediately to avoid contamination. This applies to all hazardous and non-hazardous wastes unless stated otherwise.

Waste materials will be collected, stored and disposed in the site skips. This site shall also temporarily hold recyclable materials. These storage sites will be well organised and segregated into different types of wastes, ensuring that recyclable waste is not disposed of along with the ‘rubbish’ materials. All temporary long-term storage sites for waste and materials will be, at a minimum, stored at a reasonable distance from sensitive sites, such as drainage channels, offices, public and residential areas and the public highways. Construction debris is not allowed to accumulate such that it presents an environmental, health and/or safety hazard.

Vehicles used for the transportation of any type of waste shall not be used to transport materials such as soil and rock, unless cleaned prior to reuse.

The waste storage skips installed at the site must have covers to prevent waste materials, such as plastic and cardboard, from being blown out of the skip and around the site. Food waste skips and bins installed on the site must have lids which are to be kept closed at all times. This is to prevent the release of odours and to reduce potential infestations of pests and vermin. The site staff must make sure that none of the waste skips or bins are located within 50m of the edge of any onsite water body.

Procedures relating to waste disposal should follow, but are not limited to:

- No waste shall be burnt onsite.
- The Contractor shall not dump or bury waste on or surrounding the Project site.
- The Contractor will arrange for the transfer and transportation of waste with a registered authority or licensed waste management contractor.
- Any spillages or waste lost from the disposal vehicle en-route to the waste disposal area shall be cleaned up by the Contractor.
- Vehicles removing waste from the Project site should be appropriately covered.
- Waste concrete slurry should be cleared from site at least every 72 hours.
- Waste concrete slurry should be directed to the washout pit, where it will break down gravel, sand and sludge which can subsequently be collected and reused.
- Dumping of excess concrete onsite is not permitted.
- Excess concrete can be recycled and reused where possible on other jobs.
- Spilled and waste concrete shall be collected and sent to concrete breaking recycling facilities wherever practicable.
- Excess concrete mixture which can’t be used as part of the Project should be used elsewhere onsite, such examples include the creation of concrete base slabs.

- Once concrete wastes are washed into designated area and allowed to hardened, the concrete shall be broken up, removed and disposed of regally by an approved waste disposal contractor.
- Domestic and biodegradable waste from throughout the Project site shall be removed daily to reduce the impact of odours and from pests.

The recommended waste storage area is on the western side boundary, as shown in **Appendix H**. [TO BE UPDATED AS NECESSARY BY WÄRTSILÄ]. Waste storage must not be permitted along the southern boundary in order to prevent nuisance to the residents of the farm. In addition, it is recommended that waste storage is not located adjacent to open desert, to prevent pollution to natural habitats.

4.6.4.7 HOUSEKEEPING

Provisions to address and maintain housekeeping throughout the site should be implemented. Good housekeeping and upkeep of the site ensure that waste problems do no accumulate.

The Contractor shall make available the time and resources needed to undertake routine housekeeping of the works areas and site establishment areas at a minimum of a weekly interval. Housekeeping shall include maintenance of barriers, signage and material stockpiles to ensure that they are safe and of a height to minimise dust. Construction materials shall be stacked in a safe, neat and orderly fashion and shall be appropriately covered. Windblown litter, construction debris and spoil shall be collected and removed for disposal. Bins should also be checked to ensure lids are present and that waste is not over spilling.

4.6.5 RESPONSIBILITY

The Wärtsilä Site Construction Manager is ultimately responsible for ensuring all waste controls are implemented on the construction site. He will submit copies of all reports to Sgurr Energy Project Manager via the Wärtsilä Project Manager.

The HSE Manager will be responsible for the CEMP Induction, which will highlight the waste management requirements during the Project construction activities.

The HSE Manager will be responsible for weekly and daily environmental inspections of the site, which will include waste management procedures. Waste transport documentation will be checked by the HSE Manager at the time of issue. Any adverse issues are recorded as an environmental incident and reported to the Wärtsilä Site Construction Manager.

The Contractor will be responsible for employing an approved Environmental Service Provider, in coordination with the MoE, to collect and dispose of hazardous waste materials from site. The Contractor will be responsible for ensuring that WTNs are completed and the Waste Register is maintained. WTNs and the waste register will be issued to the Wärtsilä Site Construction Manager and Wärtsilä Project Manager.

4.6.6 DOCUMENTATION

The following documentation will be required to be prepared:

- Inventory of Hazardous Materials;
- Waste Transfer Notes;
- Waste Register;
- Environmental Inspection Record; and
- Weekly Inspection Records.

This documentation will be and remain legible, identifiable and traceable. This documentation will be kept up to date and maintained at the construction site offices. All documents are to be submitted to Sgurr Energy Project Manager via the Wärtsilä Site Construction Manager and the Wärtsilä Project Manager.

4.7 TERRESTRIAL ECOLOGY – ECP-E

4.7.1 PURPOSE

The purpose of this ECP is to provide details to the protection of ecological features adjacent to the Project site. The ECP will also describe how to respond to the unexpected presence of wildlife within the Project site.

4.7.2 SCOPE

This ECP relates to the construction activities which have potential to negatively impact terrestrial ecology. It is expected that the relevant construction activities are:

- Excavation and ground preparation works;
- Storage of hazardous materials;
- Spills and leaks of hazardous materials; and
- Movement of plant, machinery and vehicles within, and outside of the site.

This ECP will outline the contractor's responsibility to uphold the procedures within the ECP, and list the necessary reporting requirements.

4.7.3 ECOLOGY IMPACTS

The Project site is highly modified and has been previously graded. Vegetation within the site was identified within the EIA as being of low diversity, limited to nationally common species, and highly localised. No evidence of fauna presence within the site was identified, with the exception of a single avian individual. To the north and east of the Project site is open desert, found to be in natural state.

Construction work will result in increased levels of noise and air quality emissions which have potential to disturb and degrade habitats and fauna within the adjacent open desert habitats. The following impacts to terrestrial may occur during construction activities:

- Disturbance of wildlife as a result of construction personnel and lighting;
- Disturbance to adjacent habitats as a result of fugitive dust and air emissions;
- Disturbance of wildlife as a result of construction noise and vibration; and
- Movement of construction vehicles and machinery.

4.7.4 ECOLOGY CONTROL MEASURES

In order to minimise the impacts to terrestrial ecology within and adjacent to the Project site, the following control measures shall be implemented:

- The overall footprint of the construction area will be minimised to the smallest practicable size;

- Construction works will remain within the immediate boundaries of the Project site. All stockpiles and designated sites for material storage will be within the site boundary, and located away from adjacent open desert;
- Lighting at site is to be minimised and specifically angled into the site to prevent light pollution outside of the construction site and onto open desert;
- Workers will be prohibited from hunting or snaring within the site, and within adjacent open desert;
- Nests of breeding birds or dens of any animal are not to be disturbed;
- Any species of fauna found within the site are to be left undisturbed and allowed to move away from the site freely and without harassment; and
- Noise will be kept to a minimum. Noise levels will be managed in accordance with the Noise Control Plan.

4.7.5 RESPONSIBILITY

The Wärtsilä Site Construction Manager is ultimately responsible for ensuring all ecology control measures are implemented on the construction site. He will submit copies of all reports to Sgurr Energy Project Manager via the Wärtsilä Project Manager.

The HSE Manager will be responsible for the CEMP Induction, which will highlight the ecology mitigation requirements during the Project construction activities.

The HSE Manager will also conduct training and Tool Box Talks regularly to all construction staff to ensure all site staff are aware of the ecological control measures. All training shall be documented and kept as records available for inspection and audits.

Any ecological incidents such as the presence of wildlife within the Project site, or the degradation of habitats adjacent to the site, will be recorded by the HSE Manager during the weekly inspection report. Any incident will be described with the following information:

- Date and Time of incident;
- Inspector/recorder name;
- Nature of the ecological incident;
- Photograph of the ecological incident; and
- Additional measures implemented to correct the incident.

The weekly inspection report and any recorded incident will be maintained and made available for inspection and audit.

4.7.6 DOCUMENTATION

The following documentation will be required to be prepared:

- Environmental Incident report; and
- Weekly Inspection Records.

This documentation will be and remain legible, identifiable and traceable. This documentation will be kept up to date and maintained at the construction site offices. All documents are to be submitted to Sgurr Energy Project Manager via the Wärtsilä Site Construction Manager and the Wärtsilä Project Manager.

4.8 SOIL, HYDROLOGY AND WATER QUALITY – ECP-SGW

4.8.1 PURPOSE

The purpose of this ECP is to guide the Contractor to provide details to ensure the protection of soil and groundwater resources. The ECP also provides best practice measures to manage materials and during construction works to prevent pollution and degradation to soil and water.

4.8.2 SCOPE

This ECP relates to the construction activities which have potential to negatively impact soil and water resources. It is expected that the relevant construction activities are:

- Excavation and ground preparation works;
- Storage of hazardous materials;
- Spills and leaks of hazardous materials; and
- Movement of plant, machinery and vehicles within, and outside of the site.

This ECP will outline the contractor's responsibility to uphold the procedures within the ECP, and list the necessary reporting requirements.

4.8.3 SOIL, HYDROLOGY AND WATER QUALITY IMPACTS

Risks of soil and groundwater contamination are from accidental spillages of fuels and chemicals, leaks from plant and equipment and refuelling areas, welfare effluent, and the water used for washing down and dust suppression. Potential impacts include:

- Contamination through fuel and chemical spills and leaks.
- Erosion and change in soil structure (due to excavation and compaction); and
- Stormwater management.

The key activities associated with soil, hydrology and water quality impacts have been identified as:

- Materials handling, storage and transport;
- Site facilities establishment;
- Increased traffic levels and equipment use onsite;
- External finishing works; and
- Land disturbance.

4.8.4 SOIL, HYDROLOGY AND WATER QUALITY CONTROL MEASURES

In order to minimise the risk of impacts occurring the following control measures will be implemented:

- Materials handling, storage and transport;
  - All fuels and chemicals are to be stored in a designated area with sealed secondary containment which is impermeable and 110% of the largest containers capacity.
  - Pipework and equipment used for refuelling (funnels etc.) are to be stored within the secondary containment.

- Drip trays are to be placed under mobile equipment that contain fuel and oils i.e. generators.
- Refuelling to be undertaken in an area with sealed drainage or over a drip tray with sufficient capacity.
- Delivery of materials including concrete must be undertaken over an impermeable layer capable of containing spills and leaks where possible/practicable.
- Hazard training to be given to all individuals who handle polluting materials.
- Contaminated soil will be regarded as hazardous waste.
- Hazardous materials or equipment containing hazardous materials will be stored on sealed, impermeable surfaces.
- Vehicles and mobile equipment to be regularly inspected and maintained to confirm they are not leaking or dripping. Operators should also be instructed to notify their supervisors if there are any problems with their vehicles.
- Bulk storage vessels to be integrity tested to ensure competency before use.
- Machinery to be washed/degreased prior to arrival at site.
- Hazardous materials only to be handled by operators trained in spill response procedures.
- Any spillage or leakage and resultant contaminated soil (if any) to be removed and disposed of using approved waste management providers as soon as practicable.
- Waste fuel/oil to be removed and transferred to recycling facilities by an approved service provider.
- Vehicles used for transporting materials such as soil and rock shall not be used to transport any type of waste, unless cleaned prior to reuse.
- Written information about all hazardous materials shall be obtained from the manufacturer or supplier and communicated to employees.
- Materials, agents, chemicals and other materials classified as hazardous, shall be used, stored, dispensed, handled and disposed in accordance with the MSDS sheets.
- Prior authorisation and informing the HSE Officer is required before hazardous materials, chemicals, oils, solvents, paints, thinners, compressed gases and protective insulation or coating materials are used or stored on the Project site.
- Each appointed contractor and sub-contractor employee, upon employment or assignment to the Project, shall receive training relative to the use and potential exposure to hazardous materials. This training shall include the use of personnel protective equipment and emergency procedures.
- The appointed contractors shall maintain an inventory of all potentially hazardous materials and chemicals used and stored on the project. A copy of this inventory shall be submitted monthly upon demand.

→ Soil erosion and run-off management;

- Whenever possible, construction works such as rock breaking will not be scheduled when there is a significant potential for rainfall and upon the event of storm events stop works.
- Erosion mitigation techniques such as contouring and mounding to be used to reduce any surface water overflow rates and minimise likelihood of creating preferential pathways of flow.
- Site roads to be graded to a crown and runoff from access roads to be directed to open unlined side ditches and where possible soakaways.
- Where the surface of sites roads has become excessively compacted by heavy vehicle traffic they should be lightly ripped to encourage infiltration rather than runoff.

- Stormwater management;
  - Water must be diverted from areas which are likely to be easily eroded, for example from stockpile areas.
  - Adequate controls shall be placed on all drainage lines to ensure sediment filtration e.g. lined or velocity-reducing structures, such as crushed rock or geotextile, shall be placed in the drainage line. Silt loads should be treated as close to their source as possible using effective sediment traps such as geotextile fences and straw bales.
  - Regular inspections and maintenance, particularly during storms (high wind, rain etc.) to ensure that the drainage controls are operating effectively. Where a device proves inadequate, it should be quickly redesigned to make it effective.

4.8.5 RESPONSIBILITY

The Wärtsilä Site Construction Manager is ultimately responsible for ensuring all soil, hydrology and groundwater control measures are implemented on the construction site. He will submit copies of all reports to Sgurr Energy Project Manager and the Wärtsilä Project Manager.

The HSE Manager will be responsible for the CEMP Induction, which will highlight the ecology mitigation requirements during the Project construction activities.

4.8.6 DOCUMENTATION

The following documentation will be required to be prepared by the HSE Manager:

- Material Safety Data Sheets;
- Integrity Test Certificates for Bulk Storage Vessels;
- Vehicle Maintenance schedules;
- Weekly Environmental Inspection Records;
- Quarterly External Audit Reports.

This documentation will be treated as a record during environmental audits and inspections. This documentation will be and remain legible, identifiable and traceable. This documentation will be kept up to date and maintained at the construction site offices.

4.9 SOCIO-ECONOMIC – ECP-SE

4.9.1 PURPOSE

The purpose of this ECP is to guide the Contractor to prevent impacts to socio-economic receptors.

4.9.2 SCOPE

This ECP relates to the following impacts to socio-economic receptors:

- Members of the public;
- Local communities; and
- Local environment.

4.9.3 SOCIO-ECONOMIC IMPACTS

The following socio-economic impacts may occur at or near the Project site as a result of construction:

- Increased potential employment opportunities;
- Increased demand for local businesses;
- Noise and air quality emissions affecting residents and road users;
- Delays and disruption to residents and local road users.

4.9.4 SOCIO-ECONOMIC CONTROL MEASURES

- Employ local tradesmen and labourers as far as possible through direct liaison with mukhtars of Manakher initially and then through Sahab labour offices. This requirement should be stipulated with the main EPC contractor documentation in addition to all subcontractors terms and conditions.
- All contractors to maintain records of local (Manakher + other 2 towns noted within EIA and Sahab District) employment and training undertaken during the construction period;
- Lead EPC Contractor should regularly review subcontractor labourer contracts (this requirement should be stipulated within terms and conditions agreed upon) to ensure they are in line with Jordanian laws and IFC Performance Standard requirements;
- Project Proponent should regularly review Lead EPC Contractor and subcontractors with respect to wages and ensuring that all employees are paid on a timely basis. This should be through a combination of review of pay slips/bank transfer confirmations (where employees have bank accounts the preference should be to make direct transfers) and spot interviews with employees;
- Ensure that the perimeter fence is kept in good repair to prevent members of public from accessing the site;
- Ensure appropriate security at the site (advice from the local security forces should be taken) to ensure that only authorised personnel enter the site. If security guards are used, ensure background checks are undertaken and appropriate training provided prior to deployment including topics such as the avoidance of force or the use of non-lethal force where absolutely necessary (and where local police forces are not available);
- Ensure main EPC Contractor and subcontractors source materials from local traders and suppliers as much as possible in order to add economic benefit to the community through minimum requirements (KPIs) to report on a monthly basis. KPI/proportion should be considered based on feasibility of procuring the equipment locally rather than regionally/internationally with consideration of cost/quality in addition to preference for local procurement. Records of locally purchased (eg Manakher village, Sahab District and Jordan) should be maintained by all contractors and provided the main EPC Contractor for reporting within monthly reports;
- A clear internal grievance mechanism should be enabled on the site to provide all employees a method to report complaints about other employees or managers without fear of retribution. Ensure all employees are aware of internal grievance mechanism for reporting labour issues.
- Air quality impacts upon socio-economic will be controlled according to ECP-AQ.
- Noise impacts upon socio-economic receptors will be controlled according to ECP-N; and
- Grievance procedure shall be enforced to manage complaints relating to traffic disruption and disturbances in accordance with ECP-C.

4.9.5 RESPONSIBILITY

The Wärtsilä Site Construction Manager is ultimately responsible for ensuring socio-economic impacts are mitigated, and complaints are appropriately handled. He will submit copies of all reports to the Project Management Team in addition to the Project Proponent.

The HSE Manager will be responsible for conducting training to construction workforce during the Induction Training to ensure that the requirements socio-economic control plan are understood by all construction staff. Quarterly Tool Box Talks will be presented by the HSE Manager in order to refresh ECP measures.

The HSE Manager will notify Wärtsilä Site Construction Manager by the next working day after receiving a socio-economic complaint. All relevant site personnel are required to report any environmental complaints received to the HSE Manager who will log it and report it to the Wärtsilä Site Construction Manager, who will report it to Sgurr.

The Wärtsilä Site Construction Manager will copy all reports to Sgurr and which will subsequently be sent to Project Proponent.

4.9.6 DOCUMENTATION

The following documentation will be required to be prepared by the HSE Manager:

- Complaints record as per ECP-I;
- Air Quality inspection records as per ECP-AQ; and
- Noise emission records as per ECP-N.

4.10 CULTURAL HERITAGE AND ARCHAEOLOGY – ECP-ARCH

4.10.1 PURPOSE

The purpose of this ECP is to guide the Contractor to manage materials during construction works to prevent damage, destruction and degradation of existing and undiscovered archaeological and cultural heritage features.

4.10.2 SCOPE

This ECP relates to the construction activities which have potential to negatively impact archaeological and cultural heritage resources. It is expected that the relevant construction activities are:

- Excavation and ground preparation works;
- Increase in number of people in the local area;
- Storage of hazardous materials;
- Spills and leaks of hazardous materials; and
- Movement of plant, machinery and vehicles within, and outside of the site.

This ECP will outline the contractor’s responsibility to uphold the procedures within the ECP, and list the necessary reporting requirements.

4.10.3 CULTURAL HERITAGE AND ARCHAEOLOGY IMPACTS

Four identified sites of archaeological importance are located within 1km of the Project; two sites to the northwest of the Project, and two sites to the west respectively. No features of archaeological interest have been found within the Project boundary due to the grading already conducted.

Although unlikely given the extensive groundworks already undertaken by the Ministry of Finance in 2010, there remains a slight potential for sub-surface archaeological features and sites to be present, which may be uncovered during construction works including excavations and levelling.

The Project may impact archaeological features through the following:

- Ground breaking and excavations damaging and destroying existing buried features within the site;
- Vibration from construction activities damaging archaeological sites outside of the Project boundary; and
- Settlement of fugitive dust and combustion emissions degrading existing archaeological sites outside of the Project boundary.

4.10.4 CULTURAL HERITAGE AND ARCHAEOLOGY CONTOL MEASURES

In order to prevent impacts on the four existing archaeological sites located to the north west and west, dust and combustion emission control measures shall be implemented as per ECP-AQ (Section 4.1). Additional control measures include:

- Haulage vehicles, heavy plant, and construction vehicles shall be restricted to prescribed access and egress routes, and will not be permitted to drive in proximity to the existing archaeological sites in order to minimise vibration;
- Borrow areas: The location of borrow and dumping areas selected by the contractor should be inspected (if not included in the final engineering plans), to prevent antiquities being damaged by quarrying or borrow excavation;
- Site perimeter fencing to be installed as early as possible within the construction process to minimise;
- All employees told within their site induction training not to go across to the identified archaeological sites with HSE managers subsequently charged with ensuring no such movements occur during the construction period.
- All work will be conducted according to an archaeological watching brief to include:
  - Excavation and observation of construction: In areas where the Department of Antiquities suspects the existence of remains, a representative from the department should be present during the opening of any excavation or borrow pit to identify and record any archaeological remains found;
  - Stop work immediately should any suspected feature of archaeological interest be found. This is particularly relevant during excavations and grading.
  - If any suspected features of archaeological interest are uncovered then the Jordan Department of Antiquities (DoA) shall be called. Work must not recommence until the DoA have been informed. The Department of Antiquities will assess the discovered remains and may carry out an emergency salvage excavation. Salvage excavation means archaeological excavation conducted during construction phase it should be conducted only when an archaeological site is found by accident (chance find) during construction. Given the short time available for a salvage excavation, this type of work should be avoided;

- The Project Company shall seek the written approval of the DoA before the removal of any chance find building, foundation, structure, fence and other obstruction over 50 years old, any portion of which is close to the site. All designated salvageable material shall be removed, without causing unnecessary damage, and in sections or pieces which may be readily transported, and shall be started by the contractor at approved locations, for later use or possession of the DoA; and
- All staff must be briefed on the requirement for archaeological watching briefs through regular Tool Box Talks.

4.10.5 RESPONSIBILITY

The Wärtsilä Site Construction Manager is ultimately responsible for ensuring all archaeological and cultural heritage control measures are implemented on the construction site. He will submit copies of all reports to Sgurr Energy Project Manager via the Wärtsilä Project Manager which will subsequently be reported to the Project Proponent.

The HSE Manager will be responsible for conducting training to construction workforce during the Induction Training to ensure that the requirements of the Archaeological Watching Brief are understood by all construction staff. Quarterly Tool Box Talks will be presented by the HSE Manager in order to refresh the Archaeological Watching Brief measures.

Should any suspected archaeological features be identified then this should be recorded by the HSE Manager as an archaeological observation, and included within the relevant monthly report.

Should any archaeological features be damaged or destroyed then this shall be recorded as and environmental non-compliance by the HSE Manager, and corrective actions implemented and enforced.

All recorded archaeological incidents must be traceable and auditable for the duration of construction.

It shall be the responsibility of the Project Company to obtain all information available from the supervisor of the Cultural Resources Management Office of the DoA regarding the location of any known archaeological site near the construction area, and he shall make this information available to the Engineer's representative as soon as he obtains it.

It shall also be the Project Company’s responsibility to notify the supervisor of the Cultural Resources Management Office of the Department of Antiquities of any antiquities is encountered far away from the surrounding zone of the project. If any remains found by chance during construction, the Department of Antiquities in coordination with the contractor will assess the discovered remains and may carry out an emergency salvage excavation. Salvage excavation means archaeological excavation conducted during construction phase. It should be conducted only when an archaeological site / remains is found by accident (chance find) during construction. The available short time for salvage excavations cannot be considered an authorization to destroy the discovered remains or site.

4.10.6 DOCUMENTATION

The following documentation will be required to be prepared by the HSE Manager:

→ Records of archaeological discoveries made on site.

4.11 ENVIRONMENTAL INCIDENT PROCEDURE – ECP-IP

4.11.1 PURPOSE

The purpose of this Environmental Incident Procedure is to provide details of the response to all environmental incidents which may occur during the Project construction activities.

4.11.2 SCOPE

This procedure relates to the Project construction activities. It is applicable to the Contractor and to any Sub-contractors. It details the required responses to different environmental incidents.

It is important to note that the Contractor is responsible for the health and safety of all his workers, and that his approved QHSE Plan should be implemented.

For the purpose of this procedure, incidents have been classified into different tiers, according to their significance:

- **Tier A**: Minor.
- **Tier B**: Medium.
- **Tier C**: Major (also referred to as an emergency).

This procedure deals specifically with how to respond to minor and medium incidents. A major incident must be dealt with as an emergency and thus in accordance with the relevant regulatory authorities' requirements.

For the purpose of this procedure, incidents and emergencies are defined as:

- **Incident** (environmental): Any unplanned event or chain of events, which have or could have caused injury or illness and/or damage (loss) to assets, the environment or third party/parties.
- **Emergency**: Any sudden crisis requiring action: an unexpected and sudden event that must be dealt with urgently.

This Environmental Incident Procedure covers incidents involving the following:

- Oil/Fuel;
- Chemical;
- Explosion/Fire;
- Release of Excessive Dust/Bulk Powders;
- Leakage of Gaseous Substance;
- Generation of Excessive Noise;
- Disturbance to habitat or notable species;
- Archaeological finds; and
- Silt.

In the event of an incident occurring relating to a security issue or breach on site, Wärtsilä staff and subcontractors are to follow the in place AES security procedures. These include the following:

- AES Security & Gate Control Procedure – Document No. OSH/PRO/SAF/017;

- AES Emergency Preparedness and Response Plan – Document No. – EMS/PRO/009; and
- AES Emergency Response Plan - Document No. OSH/PLN/002.

These documents have been included as reference in **Appendix J**, AES are expected to provided Wärtsilä up to date versions during the construction phase and also provide any relevant training.

Social grievances should refer to the grievance mechanism contained within the accompanying stakeholder engagement plan.

4.11.3 CONTROL MEASURES

4.11.3.1 INCIDENT CLASSIFICATION

On identification or notification of an incident, it must be categorised, using the definitions in Table 8-1. All environmental incidents shall be reported to the Wärtsilä Site Construction Manager and the Wärtsilä Project Manager. Categorisation of the environmental incident is listed in Table 4-3 including responsibilities.

Table 4-3 Categorisation of Environmental Incidents

TIER	DEFINITION	EXAMPLE	RESPONSIBILITY
A	**Minor Incident** One that is easily brought under control and prevented from re-occurring by the Contractor	▪ Small, containable spills on land within the site boundary ▪ Minor nuisance but controllable and preventable from re-occurrence ▪ Minimal environmental damage but controllable and preventable from re-occurrence	Following incident response, the HSE Manager will be responsible for notifying the Wärtsilä Site Construction Manager who will follow the correct channels of communication passing the information to Sgurr Energy via the Wärtsilä Project Manager and subsequently reported in the monthly reports to the Project Proponent.
B	**Medium Incident** One that will need to be brought under control and prevented from re-occurrence in consultation with the Wärtsilä Site Construction Manager	▪ Un-containable or uncontrollable spills within the site boundary ▪ Excessive uncontrollable incidents which are likely to re-occur to cause nuisance or when a complaint is received ▪ Un-rectifiable environmental damage and likely to re-occur	Following incident response the Wärtsilä Site Construction Manager will be responsible for notifying Wärtsilä Project Manager and local authorities and detailing actions to prevent re-occurrence. All environmental incidents shall be reported to Sgurr Energy via the Wärtsilä Project Manager and subsequently reported in the monthly reports to the Project Proponent.
C	**Major Incident** (Emergency)	▪ Un-containable or uncontrollable spills outside the site boundary or which affect	Following incident response the Wärtsilä Site

TIER	DEFINITION	EXAMPLE	RESPONSIBILITY
	One which cannot be controlled by the Contractor or that effects local authorities or independent parties	authorities supply networks ▪ Excessive uncontrollable incidents which will re-occur to cause danger, nuisance, numerous complaints or potentially significant impact to the Project Proponent or Wärtsilä and Sgurr Energy reputation and/or principles.	Construction Manager and/or HSE Manager will, in agreement with Sgurr Energy, Wärtsilä Project Manager and subsequently the Project Proponent will be responsible for informing the relevant authorities'. All environmental incidents shall be reported to the Project Proponent as soon as is practical.

4.11.3.2 GENERAL INCIDENT RESPONSE

Figure 4-3 provides an overview of the procedures to be implemented for each incident type identified in Table 4-3.

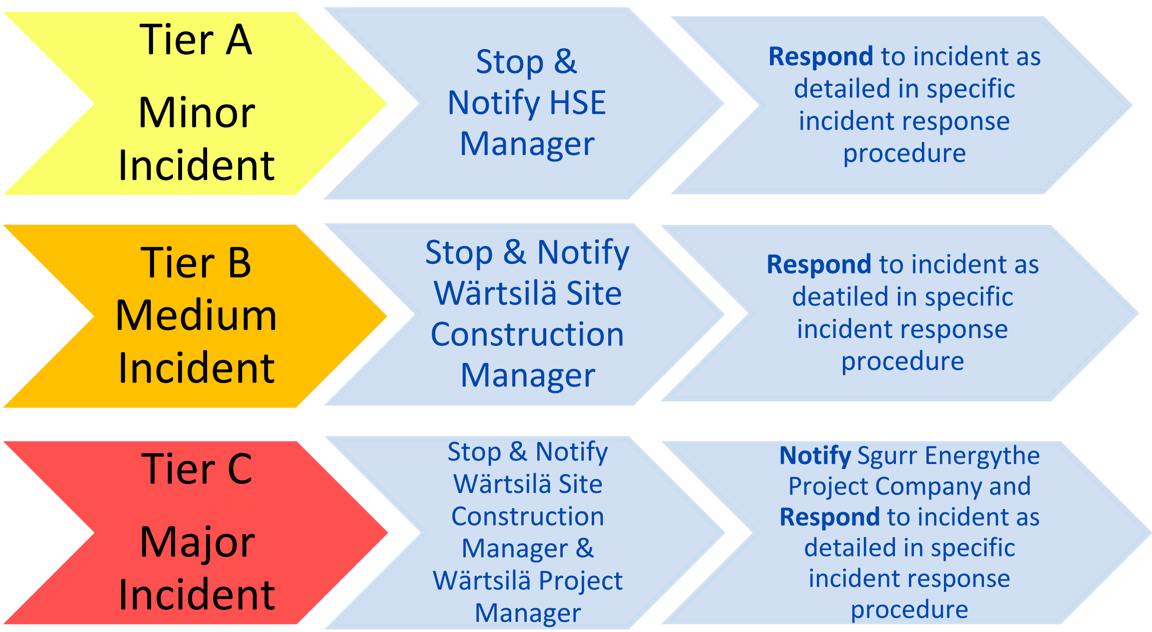


Figure 4-3 Environmental Incident Notification Process

4.11.4 INCIDENT CONTACT DETAILS

In the event that an incident is identified, the contact details provided in Table 4-4 must be used to inform the appropriate parties or authorities.

Table 4-4 Incident Contact Details

Authority	Area of Responsibility	Emergency Contact Number
AES (Project Proponent	Overall Project	TBC
Wärtsilä EHS Manager	Overall construction	TBC
Wärtsilä Project Manager	Project Management	TBC
Sgurr Energy	Project Management	TBC
Jordan Ministry of Environment	Environmental Regulator	Amman - Um Uthaina - King Faisal bin Abdul Aziz Street - Building No. 83 P. B. : 1408 Postal Code: 11941 City: Amman Phone: 556 0113 6 (962) Fax: 556 0288 6 (962) E-mail address: info@moenv.gov.jo
Department of Antiquities	Archaeology and Heritage	Department of Antiquities Jebel Amman Street, Sultan al-Atrash PO. B: 88 Director-General Tel: 464 4320 Fax 464 4714 Chunked Tel: 464 4336, 464 1275, 464 4482, 464 2669 E-mail: info@doa.gov.jo
Greater Amman Municipality Municipality	Municipal Affairs	Greater Amman Municipality Omar Matar St., Rass Alain P.O.box 132, Amman 11118 General Tel 0096 264 636 111 Emergency 535 9970 info@ammancity.gov.jo
Emergency Services	Ambulance/Police	192
Civil Defence	Fire	199

4.11.5 SPECIFIC INCIDENT RESPONSE

Specific incident response procedures for different types of environmental incidents are provided in Table 4-5 to Table 4-11. It is important to note that these response procedures are to be undertaken where safe to do so and as per the QHSE Plan.

These tables do not cover the response to major incidents. Major incidents will be dealt with in accordance with the relevant regulatory authorities' requirements. To determine these requirements the relevant regulatory authority will be notified immediately and their requirements

Table 4-5 Incident Response Procedure – Oil/Fuel Spill

Stop	Wear protective clothing, prevent further release at source e.g. switch off tap/valve, correct leaking drum/tank.
Notify	Categorise Incident and notify responsible party.

	Tier A: Refer to Figure 4-3: Notification Process. **Tier B:** Refer to Figure 4-3: Notification Process. **Tier C:** Refer to Emergency Contacts.
Contain	Use absorbent materials e.g. sand or pads to absorb excessive materials and dispose of in a plastic bucket so as not to transfer spill. Do not rinse away spills. If spill is migrating create temporary bund using soil, sandbags or spill kit materials. If drain located nearby, install drain seals.

Table 4-6 Incident Response Procedure – Chemical

Stop	Wearing protective clothing, prevent further release at source e.g. switch off pump/valve or correct drum. Close off any ignition in the near vicinity.
Notify	Categorise Incident and notify responsible party. **Tier A:** Refer to Figure 4-3: Notification Process **Tier B:** Refer to Figure 4-3: Notification Process. **Tier C:** Refer to Emergency Contacts.
Contain	Wearing protective clothing use absorbent materials e.g. sand or pads to absorb excessive materials and dispose of in a plastic bucket so not to transfer spill. If migrating create temporary bund using soil, sandbags or spill kit materials. Do not rinse away spills. If drain located nearby, install drain seals.

Table 4-7 Incident Response Procedure – Leakage of Gaseous Substance

Stop	Identify the source and prevent further release at source e.g. switch off tap/valve. Remove sources of ignition and prevent access to the site.
Notify	Categorise Incident and notify responsible party. **Tier A:** Refer to Figure 4-3: Notification Process **Tier B:** Refer to Figure 4-3: Notification Process. **Tier C:** Refer to Emergency Contacts.
Contain	It is not practicably possible to contain a gaseous leak, but weather conditions should be checked to assess the most likely direction the pollutant will take if it poses a risk to human health and then the affected area must be evacuated.

Table 4-8 Incident Response Procedures – Release of Excessive Dust/Bulk Powders Powder

Stop	Identify source and prevent further release of dust if possible e.g. if the dumping of earth movements are creating dust emissions as a result of

	windy conditions – identify source and contain as required by implementing abatement measures. Identify construction activities which are causing excessive ambient dust.
Notify	Categorise Incident and notify responsible party. **Tier A:** Refer to Figure 4-3: Notification Process **Tier B:** Refer to Figure 4-3: Notification Process. **Tier C:** Refer to Emergency Contacts.
Contain	Under dry conditions, dampen area using a bowser or similar to prevent wind-blown dust (unless dry dust can be reclaimed immediately for re-use, by use of specialist equipment/plant). When dampening the dust down, ensure the resulting mixture/run-off does not enter any drains or groundwater (see chemical spillage guidance for details of how to prevent this). Deploy dust suppression bowser (or road sweepers in wet conditions) on any hard-surfaces affected by dust. Cover materials which are being transported or large exposed stockpiles or relocate exposed stockpiles where possible. For more permanent areas of site, e.g. site office, promote planting.

Table 4-9 Incident Response Procedures – Noise

Stop	Identify the source of excessive noise. Assess the situation and associated noise level. If an external complaint has been received it may be necessary to go to the location of the complainant to get an idea of the noise at their location. Make a judgement of what can be done, if anything, to minimise the noise propagating from the site, based on factors such as remaining duration of the works
Notify	Categorise Incident and notify responsible party. **Tier A:** Refer to Figure 4-3: Notification Process **Tier B:** Refer to Figure 4-3: Notification Process. **Tier C:** Refer to Emergency Contacts
Contain	Initially ensure all plant is maintained, and with correct appliances, to prevent excessive noise. Conduct work near sensitive receptors during daytime hours only (See Noise and Vibration Control Procedure ECP – AQ and ECP-N). Reach agreement with Project Manager on whether works should be stopped.

Table 4-10 Incident Response Procedures – Damage to habitat or notable species

Stop	Stop works in the affected area immediately. Cordon off affected area/species to prevent further disturbance.
Notify	Categorise Incident and notify responsible party.

	Tier A: Refer to Figure 4-3: Notification Process **Tier B:** Refer to Figure 4-3: Notification Process. **Tier C:** Refer to Emergency Contacts
Contain	Contact Project Manager to ensure no further disturbance. Project Manager to advice of any temporary restoration to, or protection of, any exposed/disturbed habitat or species. Project Manager to advise of notification to appropriate species specialist for rescue/advice.

Table 4-11 Incident Response Procedures – Archaeological

Stop	Stop works in the affected area immediately. Cordon off site to prevent further disturbance.
Notify	Categorise Incident and notify responsible party. **Tier A:** Refer to Figure 4-3: Notification Process **Tier B:** Refer to Figure 4-3: Notification Process. **Tier C:** Refer to Emergency Contacts.
Contain	Cease works in and around the cordoned off site until receive no objection from the Department of Antiquities. Implement response procedures in accordance with the Department of Antiquities instructions.

4.11.6 EXPLOSION / FIRE

An explosion or fire will be dealt with in accordance with the Contractors Health and Safety Procedures. Fire waters will be disposed of in accordance with Civil Defence requirements, as agreed with MoE.

4.11.7 INCIDENT RESPONSE EQUIPMENT

As a minimum, the following spill response equipment will be stored onsite at hazardous materials storage areas, oil/fuel bunds and any vehicle maintenance area:

- Polypropylene adsorbent;
- Shovels;
- Protective gloves;
- Goggles/safety glasses;
- Heavy duty oil resistant storage bags;
- Duct tape;
- Containment drip pans; and
- Absorbent granulate.

The incident response equipment will be inspected and tested monthly by the HSE Manager. If any spill equipment is missing or is damaged, it will be replaced.

MSDS of all chemicals stored onsite will be kept with spill response equipment. The spills will be dealt with in accordance with the instructions of the MSDS.

Storage containers for contaminated materials and earth will be bunded, located in the waste storage area, and labelled and treated as hazardous waste in accordance with the MSDS of the contaminant. Contaminated materials will be disposed of in accordance with the disposal requirements detailed in the following section.

4.11.8 DISPOSAL

Contaminated soils and used adsorbent and incident response equipment will be treated as hazardous waste and be disposed of through an approved environmental service provider, in coordination with the Greater Amman Municipality and the MoE.

The Contractor will ensure that a WTN is signed by the environmental service provider prior to the waste leaving the site. A template WTN is provided in the Environmental Monitoring Procedure: as outlined in Chapter 6.

4.11.9 TRAINING

The Environmental Training and Induction Procedure ECP-T provides details of environmental training.

4.11.10 RESPONSIBILITY

The AES HSE Manager will ensure all workers and operators onsite are familiar with this procedure. They will also approve any CAPs required to mitigate an environmental incident. The AES HSE Manager is responsible for ensuring the local authorities instructions' are implemented in the event of a Tier C major incident.

It is the responsibility of the AES HSE Manager to ensure that all employees are aware of this environmental incident procedure for each specific incident.

On notification of an incident the Wärtsilä Site Construction Manager is responsible for ensuring all response procedures are implemented in accordance with this procedure. In the event of a Tier B medium incident, the Wärtsilä Site Construction Manager is responsible for ensuring the incident response detailed in Section 4.12.5 is implemented and the incident response form is completed and CAP prepared, signed off and implemented. In the event of a Tier C major incident the Wärtsilä Site Construction Manager is responsible for notifying Sgurr Energy via the Wärtsilä Project Manager. The Project Proponent will communicate with all external agencies unless permission is granted for the Contractor to contact external agencies directly.

The Wärtsilä Site Construction Manager will submit copies of all reports to Sgurr Energy via the Wärtsilä Project Manager.

It is the responsibility of the HSE Manager to train site personnel in incident response procedures, with support from the Project Manager. It is the responsibility of the HSE Manager to visit the incident site, when safe to do so, classify the incident and notify the Project Manager of all Tier B and C Incidents. The HSE Manager is responsible for ensuring the incident response for Tier A incidents is implemented and that the Incident Response Form is completed and CAP prepared, signed off and implemented.

It is the responsibility of the HSE Manager to organise the disposal of any hazardous waste generated during an environmental incident by a Greater Amman Municipality approved environmental service provider.

It is the responsibility of staff to inform the appropriate personnel, as detailed in Figure 4-3, of all incidents.

4.11.11 DOCUMENTATION

In the event of Tier A, B or C environmental incidents, the Environmental Incident Form will be completed.

Both the Project Manager and HSE Manager will be responsible for ensuring that an Environmental Incident Report Form is completed correctly for Tier A and B. The Wärtsilä Site Construction Manager will be responsible for ensuring that an Environmental Incident Form is completed for Tier C incidents.

The Environmental Incident Form will include details on the following:

- Details of the Contractor employee and/or witness responsible for reporting the Incident.
- Date of Incident.
- Conditions onsite during incident.
- Description of location of Incident.
- Description of the incident.
- Cause of the incident.
- Scale of incident.
- Potential Impacts of the incident.
- Confirmation that environmental control measures had been implemented.
- Description of the non-compliance with reference to the CEMP.
- Proposed corrective actions to correct the incident and prevent re-occurrence.
- Person responsible for corrective action.
- Date the corrective action is to be completed.
- Signature on completion.

Preparation and implementation of CAPs is provided in the Environmental Inspection Procedure (ECP-I). The CAP must be signed by the responsible person for overseeing its implementation (refer to Table 4-10).

The completed Environmental Incident Response Forms will be submitted to the appropriate responsible parties or if in the event of a Tier C incident, to the relevant regulatory authority.

An example of the HSE incident form is provided in **Appendix I**.

Incident reporting and circulation list is provided in Table 4-10.

Table 4-12 Environmental Incident Reporting and Circulation Lists

TIER	RESPONSIBLE PERSON FOR COMPLETING FORM	CIRCULATION LIST
A	HSE Manager	Project Manager
B	Project Manager/HSE Manager	Wärtsilä
C	Project Manager	Wärtsilä, Sgurr Energy\

This documentation will be treated as a record during environmental inspections. This documentation will be and remain legible, identifiable and traceable. This documentation will be kept up to date and maintained at the construction site offices. A copy of this documentation is to be submitted to Sgurr Energy and Wärtsilä Project Management for subsequent submittal to the Project Proponent.

5 ENVIRONMENTAL ASPECTS AND IMPACTS REGISTER

As presented in the EIA, the construction of the Project will have impact on the surrounding environment. The general construction activities include the following:

- Construction Activity 1: Site Facilities Establishment (including mobilisation);
- Construction Activity 2: Enabling and Substructure Construction Activities;
- Construction Activity 3: Structure Works (including substation, PV frame and transformers slabs);
- Construction Activity 4: Material Storage and Handling;
- Construction Activity 5: Waste Storage and Handling;
- Construction Activity 6: Vehicle Use, Refuelling and Maintenance; and
- Construction Activity 7: Finishing Works (including demobilisation).

Table 5-3, referred as the ‘environmental aspects and impacts register’, details the list of the key Project construction activities which lead to environmental aspects and adverse impacts. Should additional construction methodologies or activities be identified or implemented the CEMP should be updated to account for these additions. Each activity impact(s) significance is then assessed taken into account the likelihood, degree of control and severity of the impact as detailed in **Table 5-1**.

Table 5-1 Environmental impact risk ranking methodology

Ranking Number	Risk Ranking Criteria		
	Likelihood (1 – 5)	Degree of Control (1 – 3)	Severity (1 – 5)
1	Improbable	Normal	Negligible
2	Unlikely	Abnormal	Slight
3	Infrequent	Emergency	Moderate
4	Likely		High
5	Almost certain		Severe / Profound

The impact significance is determined by the risk ranking results of the following formula:

Risk Ranking = Likelihood **x** Degree of control **x** Severity

Table 5-2 Environmental impact risk ranking methodology

Risk Ranking Number	Impact Significance
$x \leq 14$	Impact is regarded as non-significant, **negligible**
$x \geq 15$	Impact is regarded as significant, **minor to moderate impact**
$x \geq 20$	Impact regarded as a significant, **major to critical impact**

Finally, the environmental aspects and impacts register indicates the mitigation and control measures that should be applied in order to minimise the adverse environmental impacts.

Table 5-3 Project's environmental aspects and impacts register

Aspect	Impact	Impact Significance				Mitigation and Control Procedures
		Likelihood	Degree of Control	Severity	Risk Ranking	
Construction Activity 1: Site Facilities Establishment (including mobilisation);						
Generation of non-hazardous waste from the site offices operation	Pressure on waste infrastructure	4	1	2	8	Waste and Hazardous Waste Management (ECP-WM) including: → Waste Management Hierarchy Principle and Procurement Strategy → Life Cycle Analyses and Procurement Strategy → Construction Waste Management Plan → Waste Acceptance Criteria → Waste Regulatory Control and Compliance → Waste Handling and Storage
Generation of hazardous waste from the site offices operation	Pressure on waste infrastructure	3	2	2	12	
Generation of E-waste from the site offices operation	Pressure on waste infrastructure	3	2	2	12	
Generation of wastewater from the site offices operation	Pressure on waste water treatment facilities	4	1	2	8	
Use of modular wastewater storage tanks	Odour from sewage collection	4	2	2	16	Air Quality (ECP – AQ) and Waste Management (ECP-WM) including the following measure(s): → Ensuring there are no leaks of the tanks and collection system (gauged tanks should be used with regular checking)
Leak from the modular wastewater storage tank	Contamination of the soil and groundwater	2	3	4	24	
Use of lighting, particularly during night-time	Disturbance to wildlife or road users	4	2	1	8	Terrestrial Ecology (ECP-E) including the following measure(s): → Baffles to be fitted to all site lighting to prevent light spill on to adjacent open desert/road

Aspect	Impact	Impact Significance				Mitigation and Control Procedures
Use of portable generators (most likely diesel generators) for the site office during daytime and night-time	Noise pollution	4	1	4	16	Noise (ECP-N)
	Soil and groundwater pollution from diesel leaks and spills	3	2	3	18	Soil, Hydrology and Water (ECP-SGW)
	Reduction in air quality from emissions	4	1	4	16	Air Quality (ECP – AQ)
Construction Activity 2: Enabling and Substructure Construction Activities						
In-situ concreting works	Contamination of soil	4	1	4	16	Environmental Training and Induction (ECP-T), Environmental Inspection (ECP-I), Soil, Hydrology and Water (SGW), Waste and Hazardous Waste Management (ECP-WM) and Environmental Incident (ECP-IP).
	Contamination of groundwater	4	1	4	16	
Use of hazardous chemicals in waterproofing and pest-control materials (including run-off in stormwater)	Adverse impacts on human health	5	2	4	20	Environmental Training and Induction (ECP-T), Environmental Inspection (ECP-I), Soil, Hydrology and Water (SGW), Waste and Hazardous Waste Management (ECP-WM) and Environmental Incident (ECP-IP).
	Contamination of soil	4	1	4	16	
	Contamination of groundwater	4	1	4	16	
Use of substructure construction machinery, vehicles and plant, including concrete pumps and generators	Noise nuisance to sensitive receptors due to use of superstructure machinery	4	1	4	16	Noise (ECP-N)
	Dust and particulate pollution	5	1	4	20	Air Quality (ECP-AQ)
	Air quality pollution from SO_2, NO_x and CO emitted from construction vehicles and plant	5	1	3	15	Air Quality (ECP-AQ)
Excavations and construction vehicles movement	Disturbing, damaging or destroying identified	2	3	4	24	Cultural Heritage and Archaeology (ECP-ARCH)

ASPECT	IMPACT	IMPACT SIGNIFICANCE				MITIGATION AND CONTROL PROCEDURES
	archaeological remains					
Generation of waste	Contamination of soil	2	2	5	20	Waste and Hazardous Waste Management (ECP-WM), Soil, hydrology and Water Quality (ECP-SGW), Environmental Training and Induction (ECP-T) and Environmental Inspection (ECP-I)
	Contamination of groundwater	2	2	4	16	
	Odour from sanitary waste	3	1	3	9	
Concrete pouring and truck washing	Contamination of groundwater from alkaline washings	3	1	5	15	Waste and Hazardous Waste Management (ECP-WM), Soil, hydrology and Water Quality (ECP-SGW), Environmental Training and Induction (ECP-T) and Environmental Inspection (ECP-I)
	Generation of waste concrete	4	1	4	16	Waste and Hazardous Waste Management (ECP-WM)
	Noise pollution	5	1	3	15	Noise (ECP-N)
	Refer to Construction Activity 5: Vehicle use, refuelling and maintenance	-	-	-	-	-
	Refer to Construction Activity 3: Material Storage and Handling	-	-	-	-	-
Transport of Concrete	Dust and particulate pollution	5	1	3	15	Air Quality (ECP-AQ)
	Reduction in air quality from vehicle emissions outside site	5	1	4	20	

ASPECT	IMPACT	IMPACT SIGNIFICANCE				MITIGATION AND CONTROL PROCEDURES
	Traffic congestion and nuisance on public roads	2	2	3	12	Socio-Economic (ECP-SE) including: → Specific delivery hours and Specified access road agreed with Traffic Police
	Increase in noise pollution outside site	4	1	4	16	Noise (ECP-N)
Construction Activity 3: Structure Works (including substation, PV frame and transformer slabs)						
Use of construction machinery	Noise nuisance to sensitive receptors due to use of machinery	5	1	4	16	Noise (ECP-N)
	Dust and particulate pollution	5	1	3	15	Air Quality (ECP-AQ)
	Air quality pollution from SO_x, NO_x and CO emitted from construction vehicles and plant	5	1	3	15	Air Quality (ECP-AQ)
Pre-casting works	Noise pollution from pre-cast concrete erection works	4	1	4	16	Noise (ECP-N)
Concrete pouring and truck washing	Contamination of groundwater from alkaline washings	3	1	5	15	Soil, hydrology and Water Quality (ECP-SGW) and Terrestrial Ecology (ECP-E)
	Generation of waste concrete	4	1	3	12	Waste and Hazardous Waste Management (ECP-WM)
	Noise pollution	5	1	3	15	Noise (ECP-N)
	Refer to Construction Activity 6: Vehicle use, refuelling and maintenance	-	-	-	-	-

Aspect	Impact	Impact Significance				Mitigation and Control Procedures
	Refer to Construction Activity 4: Material Storage and Handling	-	-	-	-	-
In-situ concreting	Contamination of soil during in-situ casting	4	1	4	16	Environmental Training and Induction (ECP-T), Environmental Inspection (ECP-I), Soil, Hydrology and Water (SGW), Waste and Hazardous Waste Management (ECP-WM) and Environmental Incident (ECP-IP).
	Contamination of groundwater during in-situ casting	4	1	4	16	
Steel Works	Noise pollution from steel works erection	5	1	4	16	Noise (ECP-N)
	Contamination of groundwater during welding and using adhesives	3	1	5	15	Environmental Training and Induction (ECP-T), Environmental Inspection (ECP-I), Soil, Hydrology and Water (SGW), Waste and Hazardous Waste Management (ECP-WM) and Environmental Incident (ECP-IP).
	Contamination of soil during welding and using adhesives	4	1	4	16	
MEP Works and Utility Installation	**Refer to Construction Activity 4, due to main activity is management of handling materials and chemicals**	-	-	-	-	-
Generation of waste (including hazardous, non-hazardous and E-waste)	Pressure on waste infrastructure if not reuse or recycled, especially regarding PV solar modules	3	2	3	18	Waste and Hazardous Waste Management (ECP-WM)
	Contamination of soil	2	2	5	20	Waste and Hazardous Waste Management (ECP-WM), Soil, hydrology and Water Quality (ECP-SGW), Environmental Training and Induction (ECP-T) and Environmental Inspection (ECP-I)
	Contamination of groundwater	2	2	4	16	
	Odour from sanitary waste	3	1	3	9	

Aspect	Impact	Impact Significance				Mitigation and Control Procedures
Use of hazardous chemicals in waterproofing materials	Adverse impacts on human health	4	1	5	20	Waste and Hazardous Waste Management (ECP-WM), Soil, hydrology and Water Quality (ECP-SGW), Environmental Training and Induction (ECP-T) and Environmental Inspection (ECP-I)
	Contamination of soil	4	1	4	16	Waste and Hazardous Waste Management (ECP-WM), Soil, hydrology and Water Quality (ECP-SGW), Environmental Training and Induction (ECP-T) and Environmental Inspection (ECP-I)
	Contamination of groundwater	4	1	4	16	
Construction Activity 4: Material Storage and Handling						
Material stockpiles	Dust and particulate matter PM_{10} and $PM_{2.5}$ pollution	5	1	4	20	Air Quality (ECP-AQ)
	Impact on visual amenity	4	1	4	16	Landscape and Visual (ECP-LV)
Storage and segregation of materials	Cross contamination of materials – loss of reusable and/or recyclable materials	4	1	4	16	Waste and Hazardous Waste Management (ECP-WM), Environmental Training and Induction (ECP-T) and Environmental Inspection (ECP-I)
	Dust and particulate matter PM_{10} and $PM_{2.5}$ pollution	5	1	4	20	Air Quality (ECP-AQ)
Removal and movement of material	Dust and particulate matter PM_{10} and $PM_{2.5}$ pollution	5	1	4	20	Air Quality (ECP-AQ)
	Noise pollution	5	1	4	20	Noise (ECP-N)
Storage and use of hazardous of materials	Adverse impacts on human health	2	3	5	30	Waste and Hazardous Waste Management (ECP-WM), Soil, hydrology and Water Quality (ECP-SGW), Environmental Training and Induction (ECP-T) and Environmental Inspection

Aspect	Impact	Impact Significance				Mitigation and Control Procedures
						(ECP-I)
	H&S impacts	3	2	4	24	Environmental Training and Induction (ECP-T) and Environmental Inspection (ECP-I) Construction is to be undertaken in accordance with the appointed contractors HSE Plan
	Explosion or Fire	2	3	4	24	Environmental Incident (ECP-IP)
	Contamination of soil from spillage	3	2	4	24	Waste and Hazardous Waste Management (ECP-WM), Soil, hydrology and Water Quality (ECP-SGW), Environmental Training and Induction (ECP-T) and Environmental Inspection (ECP-I)
	Contamination of groundwater from spillage	3	2	4	24	
Vehicle use and movements	**Refer to Construction Activity 6: Vehicle use, refuelling and maintenance**	-	-	-	-	-
Construction Activity 5: Waste Storage and Handling						
Movement of waste material	Dust and particulate matter PM_{10} and $PM_{2.5}$ pollution	5	1	4	20	Air Quality (ECP-AQ)
	Reduction in air quality from machinery emissions	5	1	4	20	
	Noise pollution	5	1	3	15	Noise (ECP-N)
Storage and segregation of materials	Cross contamination of materials – loss of reusable and/or recyclable materials	4	1	4	16	Waste and Hazardous Waste Management (ECP-WM), Environmental Training and Induction (ECP-T) and Environmental Inspection (ECP-I)
	Energy and resource use associated with future treatment of materials	4	1	3	12	

Aspect	Impact	Impact Significance				Mitigation and Control Procedures
	Dust and particulate matter PM_{10} and $PM_{2.5}$ pollution	5	1	4	20	Air Quality (ECP-AQ)
Storage of hazardous wastes	Contamination of soil from spillage	3	2	4	24	Waste and Hazardous Waste Management (ECP-WM), Soil, hydrology and Water Quality (ECP-SGW), Environmental Training and Induction (ECP-T) and Environmental Inspection (ECP-I)
	Contamination of groundwater from spillage	3	2	4	24	
	Pollution of soil and groundwater	2	3	4	24	Waste and Hazardous Waste Management (ECP-WM), Soil, hydrology and Water Quality (ECP-SGW), Terrestrial Ecology (ECP-E), Environmental Training and Induction (ECP-T) and Environmental Inspection (ECP-I)
	H&S impacts	3	2	4	24	Environmental Training and Induction (ECP-T) and Environmental Inspection (ECP-I)
	Explosion or fire	2	3	4	24	Environmental Incident (ECP-IP)
Generation and disposal of waste materials	Inadequate disposal of hazardous materials causing pollution off site	2	2	5	20	Waste and Hazardous Waste Management (ECP-WM), Soil, hydrology and Water Quality (ECP-SGW), Environmental Training and Induction (ECP-T) and Environmental Inspection (ECP-I)
	Inadequate storage of waste materials	3	1	5	15	
Storage of organic waste	Odour and pests	3	1	3	9	Waste and Hazardous Waste Management (ECP-WM) including: → Containing organic matter in covered suitable containers and regularly disposing
Construction Activity 6: Vehicle Use, Refuelling and Maintenance						
Construction vehicle and plant use	Degradation of air quality from	5	1	4	20	Air Quality (ECP-AQ)

ASPECT	IMPACT	IMPACT SIGNIFICANCE				MITIGATION AND CONTROL PROCEDURES
	pollutant emissions					
	Noise pollution	5	1	4	16	Noise (ECP-N)
	Disturbance of species especially due to collision risk	3	2	3	18	Terrestrial Ecology (ECP-E) and Noise (ECP-N)
Construction machinery	Degradation of air quality from pollutant emissions	5	1	3	15	Air Quality (ECP-AQ)
	Dust and particulate matter PM_{10} and $PM_{2.5}$ pollution	5	1	3	15	
	Noise during daytime and night-time in typical condition	5	1	3	15	Noise (ECP-N)
	Noise during daytime and night-time in “worst case” condition	5	1	4	20	
Handling and storage of fuels	Contamination of soil from spillage	3	2	4	24	Environmental Training and Induction (ECP-T), Environmental Inspection (ECP-I), Soil, Hydrology and Water (SGW), Waste and Hazardous Waste Management (ECP-WM) and Environmental Incident (ECP-IP).
	Contamination of groundwater from spillage	3	2	4	24	
	Adverse impacts on human health	2	3	4	24	
	Explosion or Fire	2	3	4	24	Environmental Incident (ECP-IP).
Vehicle maintenance	Contamination of soil from spillage	3	2	4	24	Environmental Training and Induction (ECP-T), Environmental Inspection (ECP-I), Soil, Hydrology and Water (SGW), Waste and Hazardous Waste Management (ECP-WM) and Environmental Incident (ECP-IP).
	Contamination of groundwater from spillage	3	2	4	24	

ASPECT	IMPACT	IMPACT SIGNIFICANCE				MITIGATION AND CONTROL PROCEDURES
Generation and disposal of waste oils	Inadequate storage of waste materials resulting in loss of containment	4	1	5	20	Waste and Hazardous Waste (ECP-WM)
	Inadequate disposal of hazardous materials causing pollution off site	3	2	4	24	Waste and Hazardous Waste Management (ECP-WM), Environmental Training and Induction (ECP-T), Environmental Inspection Procedure (ECP-I).
Construction Activity 7: Finishing Works (including demobilisation)						
Generation and disposal of waste materials	**Refer to Construction Activity 5: Waste Storage and Handling**	-	-	-	-	-
Movement of waste material		-	-	-	-	-
Material stockpiles	**Refer to Construction Activity 4: Material Storage and Handling**	-	-	-	-	-
Storage and segregation of materials		-	-	-	-	-
Removal and movement of material		-	-	-	-	-
Storage and use of hazardous of materials		-	-	-	-	-
Vehicle use and movements	**Refer to Construction Activity 6: Vehicle use, refuelling and maintenance**	-	-	-	-	-

6 ENVIRONMENTAL MONITORING AND REPORTING

6.1 ENVIRONMENTAL REPORTING

Environmental monitoring will be undertaken for the following:

- Dust;
- Air Quality;
- Air emissions from point sources and/or mobile sources;
- Noise;
- Soil and Groundwater;
- Excavated Material;
- Archaeology and Cultural Heritage;
- Waste; and
- Backfill.

Monitoring results will be continually reviewed to assess that the procedures are working effectively and, where applicable, that the environmental limits and standards are being met. The results will be submitted to the Wärtsilä Project Manager by HSE Manager. The Wärtsilä Project Manager will then report the information to the Project Proponent.

6.1.1 REGULAR MONITORING, INSPECTION, SAMPLING AND TESTING

Environmental monitoring is required in relation to the ECPs summarised within Table 6-1.

Table 6-1 Environmental Control Plans Requiring Monitoring

ENVIRONMENTAL CONTROL PLAN	REFERENCE
Environmental Training and Induction	ECP-T
Environmental Complaints Procedure	ECP-C
Environmental Inspection Plan	ECP-I
Air Quality Control Plan	ECP-AQ
Noise Control Plan	ECP-N
Waste and Hazardous Waste Management Plan	ECP-WM
Cultural Heritage and Archaeology Plan	ECP-ARCH
Terrestrial Ecology Control Plan	ECP-E
Soil, Hydrology and Water Quality Control Plan	ECP-SGW
Environmental Incident Procedure	ECP-IP

6.1.2 MONITORING PROCEDURES

6.1.2.1 DUST AND GASEOUS EMISSIONS MONITORING

The HSE Manager will be responsible for undertaking visual checks for dust levels. These will be undertaken across the site on a daily basis.

The visual dust check form, provided in Table 6-2, will be completed on a daily basis by the HSE Manager and issued to the Wärtsilä Site Construction Manager and Sgurr Energy via Wärtsilä Project Manager on a weekly basis. The HSE Manager will be required to use best judgement in order to classify dust emissions. Examples of weather conditions which are likely to cause various scales of dust emissions are provided:

- Slight: Calm winds and/or rainfall events
- Moderate: Gusty winds and/or hot and dry conditions
- Heavy: Strong winds and hot and dry conditions.

On identification of moderate or heavy dust emissions during monitoring (or general site observations), the HSE Manager will be required to inform the Wärtsilä Site Construction Manager and respond immediately in accordance with the Environmental Incident Procedure (ECP-IP).

In the event that levels are considered Moderate/Heavy, the HSE Manager will complete an Environmental Incident Response Form. In response, a corrective action will be designed with the objective of preventing further exceedances.

Table 6-2 Visual Fugitive Dust Check Monitoring Form

VISUAL DUST AND EMISSIONS (BLACK SMOKE) CHECK MONITORING FORM

WEEK ENDING:		
LOCATION:		
NAME OF AUDITOR:		
DAY	Dust/Smoke presence (Dust/Smoke))	**INTENSITY (SLIGHT/MODERATE/HEAVY)**
DESCRIPTION OF ACTION TAKEN TO REDUCE DUST / SMOKE WHEN INTENSITY IS OBSERVED AS MODERATE OR HIGH		
SIGNATURE OF INSPECTOR:		

6.1.2.2 NOISE MONITORING

During the construction works, the Contractor will be required to undertake noise monitoring at one location as shown in ECP-N, Figure 4-1, as follows:

- Noise measurements will be taken one time per week, for a 30 minute period, divided into 10 minute intervals.
- Noise will be measured in terms of L_{Aeq}, L_{A90}, L_{A10}, L_{Amax} and L_{Amin} during construction activities
- Noise levels should generally be undertaken during dry conditions with wind speeds of less than 5 m/s.

Noise Monitoring Locations

The noise monitoring location is shown on Figure 4-1.

Noise Meter Specifications

- All sound level meters will conform to the specifications in International Electrotechnical Commission Publications 651:1979 (Type 1) and 804:1985 (Type 1) or a comparable professional quality.
- All equipment will be operated, maintained and calibrated in accordance with the manufacturer's instructions.
- All equipment will be operated by competent users.

Calibrations

- The equipment will have been calibrated to traceable standards (e.g. UKAS) in the last 12 months and will be fully operational in advance of construction works. The documentation for calibration will be filed
- The sound level meters will be calibrated before and after each measurement period and any drift recorded.

Additional Noise Monitoring

On identification of noise levels which exceed the local standards, the HSE Manager will be required to inform the Wärtsilä Site Construction Manager and respond immediately. An environmental incident response form will be completed. In response, a corrective action will be developed, with the objective of preventing further exceedance of the standards. If the initial results indicate any particular problems, then long-term continuous noise monitoring may be required. The need for long term continuous noise monitoring will be agreed between the Wärtsilä Project Manager, the Project Proponent and regulators as appropriate.

6.1.2.3 WASTE TRACKING AND MONITORING

The Contractor will maintain a record of all wastes removed from the construction site. This will be achieved through the completion of the WTN provided in Table 6-3. This information will be collated on a Waste Register.

The WTN will be a carbon copy form produced in triplicate:

- **Copy 1** will be retained at the Construction Site;
- **Copy 2** to the Project Manager; and

- **Copy 3** will accompany the waste shipment to the disposal facility.

The HSE Manager will require the service provider to sign the WTN before waste is removed from site. The WTN will accompany the waste during transport.

The waste transporters will obtain a signature at the disposal facility. This will indicate the waste, location and time of delivery made to the designated site. The transporter will return Copy 3 to the HSE Manager, countersigned, at a minimum by the transporters, verifying where the waste has been disposed. The HSE Manager will then complete the entry in the Waste Register.

The Contractor will not allow the release of the waste if there is concern about the standard of transport or destination of the waste. If waste is to be disposed of at a new disposal facility, the HSE Manager will be notified.

Only approved service providers will be used to transfer hazardous waste from site.

Table 6-3 Waste Transfer Notice

Date Transferred		Time	
Site		Main Contractor	
Waste Category	**Recyclable**	**Non-Hazardous Construction Waste**	**Hazardous Waste**
Description of Waste مواصفات المخلفات			
Composition of Waste نوعية أو تركيبة المخلفات			
Process from which waste Originated مصدر المخلفات			
Containment details مواصفات المستوعب أو حاوية القمامة			
Total Quantity to be transferred الكمـية المنقـولة			
Disposal Site موقع التفــريغ			
Material Safety Data Sheet Provided? هل تقرير الأمن والسلامة مرفق؟			
Were there any spills noted before transfer? هل كان يوجد أي اندلاق زيوت قبل النقل؟			
Were there any spills noted during transfer? هل لوحظ أي اندلاق زيوت عند النقل؟			
In the event of a spill ensure the Incident Response Procedures are undertaken immediately and Incident Response Forms are filled and submitted to HSE Manager. A copy of the procedures and forms are to be kept with these Waste Transfer Notes at all times.			

Remarks

Signatures:

*Authorised Personnel Handling Waste	Authorised Personnel Handling Transfer	Project Managers
Name: Date:	Name: Date:	Name: Date:

6.1.2.4 TRACKING EXCAVATED MATERIAL

Tracking of the excavated materials will be undertaken to determine if re-use and recycling is being achieved.

The EHS Manager will maintain a record of the quantities and final destination of all of the excavated materials. This will be achieved by the completion of the Excavated Material Transfer Note (EMTN) provided in Table 6-4.

This information will be collated in an Excavated Materials Register which will show the total volumes, percentages of materials removed from site and disposal locations.

Table 6-4 Excavated Material Transfer Note

Date Transferred			Time	
Site of Origin			Main Contractor	
Weight Removed			Destination of Excavated Material	
		Resale/Reuse/Stockpiling for future use etc.		**Landfill**
End Use of Excavated Material				

Remarks

Signatures:

Authorised Personnel Handling Excavated Material	Authorised Personnel Handling Transfer	Project Manager
Name: Date:	Name: Date:	Name: Date:

6.1.2.5 ARCHEOLOGY CONSTRUCTION MONITORING PROGRAMME

Regular and frequent site inspections will be required to ensure effective monitoring of the performance of the contractor with regard to compliance with applicable guidelines, regulations and statutes, and contract specifications. For the proposed program monitoring and during the construction phase, it will be necessary for authorized agents from the DoA to have guaranteed access to all sites related to any project component.

Two forms of inspection will be required:

- Event specific: These will be pre-programmed events such as the opening and demarcation of a borrow area.
- Random inspections: Additional site inspections should be carried out on a regular basis but not necessarily to a structured pattern.

→

6.1.3 NON-CONFORMANCE AND CORRECTIVE ACTION PLANS

If, during monitoring, exceedances of the relevant environmental limits are discovered, then an environmental incident response form (section 4.12.11) will be completed.

In response, a CAP will be developed with the objective of preventing further exceedances of the standards or other CEMP requirements. The same response will apply whenever excessive dust emissions are observed or visual observations of contamination are identified.

6.1.4 ENVIRONMENTAL MONITORING OVERVIEW

The required environmental monitoring procedures are summarised in Table 8-14. This presents the environmental monitoring required to be undertaken during the construction activities, as well as identifying the frequency and responsible bodies for organising and undertaking the environmental monitoring.

Table 6-5 Monitoring Requirements for the Project Construction Activities

Item	Type of Monitoring	Body responsible for scheduling monitoring	Body/person responsible for undertaking monitoring	Frequency of monitoring
1	Weekly Environmental Inspections	Contractor	HSE Manager	Weekly
2	Visual Dust Monitoring	Contractor	HSE Manager	Daily
3	Air emissions from point sources and/or mobile sources;	Contractor	HSE Manager	Daily
4	Noise Monitoring	Contractor	HSE Manager	Weekly (Section 6.1.3.2)
5	Excavated Material Monitoring	Contractor	HSE Manager	Daily (Section 6.1.3.4)
6	Archaeology	Contractor	HSE Manager	Ad-hoc and random by DoA
7	Waste Monitoring	Contractor	HSE Manager	Each occasion that waste is transferred from site

6.1.5 RESPONSIBILITY

It is the responsibility of the Wärtsilä Site Construction Manager to ensure the environmental monitoring is undertaken. The Wärtsilä Site Construction Manager will be responsible for reviewing all environmental incident reports to determine any exceedances. He will also collate all monitoring data for Wärtsilä Project Manager, Sgurr Energy Project Manager and pass this through to the Project Proponent.

The Wärtsilä Site Construction Manager will review monitoring results on a weekly basis and highlight any issues to the HSE Manager.

The HSE Manager will ensure that all inspections and monitoring is undertaken in accordance with this CEMP. In the event of environmental non-conformance, the HSE Manager will be responsible for immediately informing the Wärtsilä Site Construction Manager.

All site personnel will be required to facilitate the environmental monitoring programme.

7 Worker Welfare

To ensure that the welfare of the work force is maintained, the International Finance Corporation (IFC) standards shall be implemented. The following standards are relevant:

- Worker accommodation shall be provided in accordance to IFC/EBRD Guidance of Workers Accommodation (2009); and
- IFC General Health and Safety Guidelines (2007).

Implementing the standards will include, but not be limited to:

- Designated transport will be provided;
- Sufficient potable water will be available at the site and accommodation;
- Adequate sanitation will provided at the site and accommodation;
- Fire precautions will be designed and implemented at the site and accommodation;
- Clean eating areas are provided at the site and accommodation;
- Safe access, egress and working areas will be maintained to prevent injury;
- First aid will be provided at all times at the site and accommodation and in accordance with Jordanian minimum standards;
- Natural lighting, fresh air and appropriate work environment temperature will be monitored and maintained at the work site and accommodation;
- Appropriate personal protective equipment (PPE) will be provided without charge to all staff, and its use will be enforced on site at all times;
- Hazard warning signs will be erected at all appropriate locations including electrical hazards, working at height, moving vehicles and plant etc.;
- Diseases and fatalities amongst the work force (both at the work site and during leisure time) shall be monitored and recorded, and where necessary CAPs will be put in place to prevent future occurrence;
- If worker accommodation is provided by EPC Contractor or subcontractors then the IFC/EBRD Guidance for worker accommodation should be used. This includes consideration of:
  - Minimum space per person.
  - Separate beds for each worker.
  - Common dining rooms, canteens, rest and recreation rooms.
  - Adequate sewage and garbage disposal systems and facilities.
  - Protection from heat, cold, damp, noise, fire, pests, vermin and disease-carrying animals, including insects.
  - Adequate sanitation facilities including ventilation, cooking, storage, washing, natural and artificial lighting.
  - Minimum degree of privacy between individual workers within the household, and protection from undue disturbance from external factors.
  - Suitable separation of rooms devoted to living purposes from quarters for animals.

Workers will be transported to the site from designated accommodation by dedicated transport to ensure that staff have travel means each day and do not enter villages.

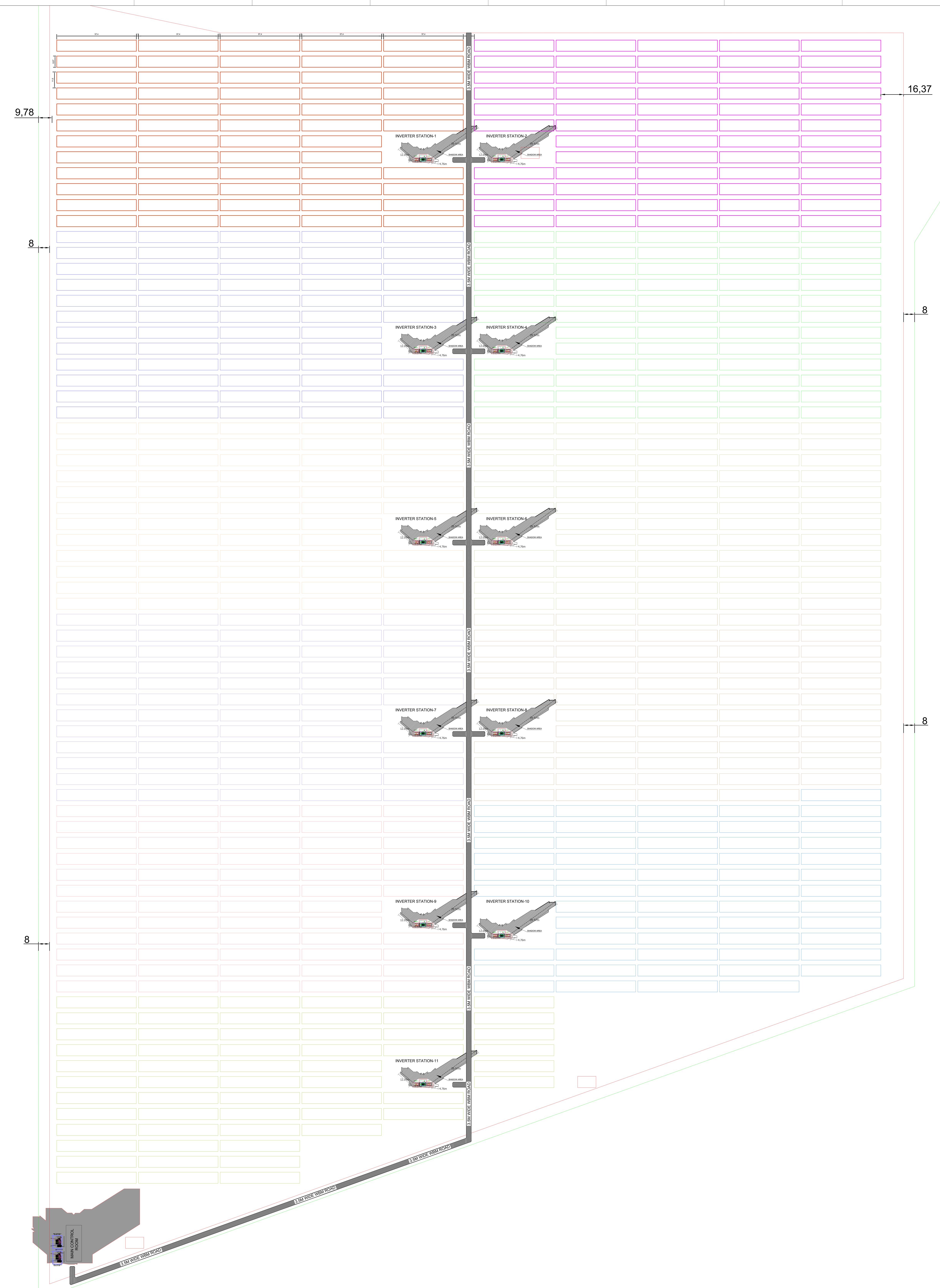
Workers shall be discouraged from visiting Al Manakher village in large numbers, and as far as possible all necessary facilities will be provided at the accommodation site, to prevent the need for the work force to visit neighbouring towns and villages.

Social grievance procedures are noted within the accompany Stakeholder Engagement Plan.

Additional worker welfare requirements are noted within ECP-SE (Section 4.9) with respect to contracts, payments and internal grievances.

Appendix A

PROJECT LAYOUT



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Rev	Date	Description	Sign
C0	05/12/16	Conceptual	VK

EPC Contractor:

WÄRTSILÄ

Wartsila Finland Oy

Name of Poject developer:

AES Netherlands Holding B.V. and Mitsui & Co. Ltd.

Site Detail :

AL MANAKHER, JORDAN

Job Title :

44MWac SOLAR PV PLANT

Drg Title :

CONCEPTUAL PLANT LAYOUT

Scale	Not to scale
Date	05/12/16
Authorised By	Arif Aga
Reviewed By	Rhushikesh Kathe
Checked By	Nayeem Tamboli
Drawn By	Vinod Kumar
Job Number	6.16.10752.PUN001
Drawing Number	XXX-XXX-XXX

Name of project consultant

sgurr energy
A Wood Group Business

SgurrEnergy India Pvt. Ltd.
506 Clover Metropole, 25 NIBM Road,
Next to Clover Highlands,
Pune-411048, Maharashtra INDIA
Tel: +91 20 65279957/ +91 20 41230967
www.sgurrenergy.com

SR.NO.	SYMBOL	INVERTER STATION	NO. OF TABLE	NO OF MODULE	MODULE Wp	TOTAL CAPACITY (kWp)	Pnom Ratio
1)		INVERTER STATION-1	58	13,456	350	4709.60	1.177
2)		INVERTER STATION-2	58	13,456	350	4709.60	1.177
3)		INVERTER STATION-3	58	13,456	350	4709.60	1.177
4)		INVERTER STATION-4	58	13,456	350	4709.60	1.177
5)		INVERTER STATION-5	58	13,456	350	4709.60	1.177
6)		INVERTER STATION-6	57	13,224	355/350	4660.88	1.165
7)		INVERTER STATION-7	58	13,456	355	4776.88	1.194
8)		INVERTER STATION-8	58	13,456	355	4776.88	1.194
9)		INVERTER STATION-9	58	13,456	355	4776.88	1.194
10)		INVERTER STATION-10	57	13,456	355	4694.52	1.174
11)		INVERTER STATION-11	57	13,456	355	4694.52	1.174
				TOTAL DC CAPACITY MWp		51.93	

NOTES:-

1. PITCH: 11.5m
2. MODULE MAKE: JA SOLAR-350 and 355Wp.
3. TOTAL NUMBER OF INVERTERS: 22(2MW ABB MAKE).
4. EACH INVERTER STATION IS HAVING 2NOS. OF INVERTERS.
5. ALL DIMENSIONS ARE IN METER.

LEGENDS

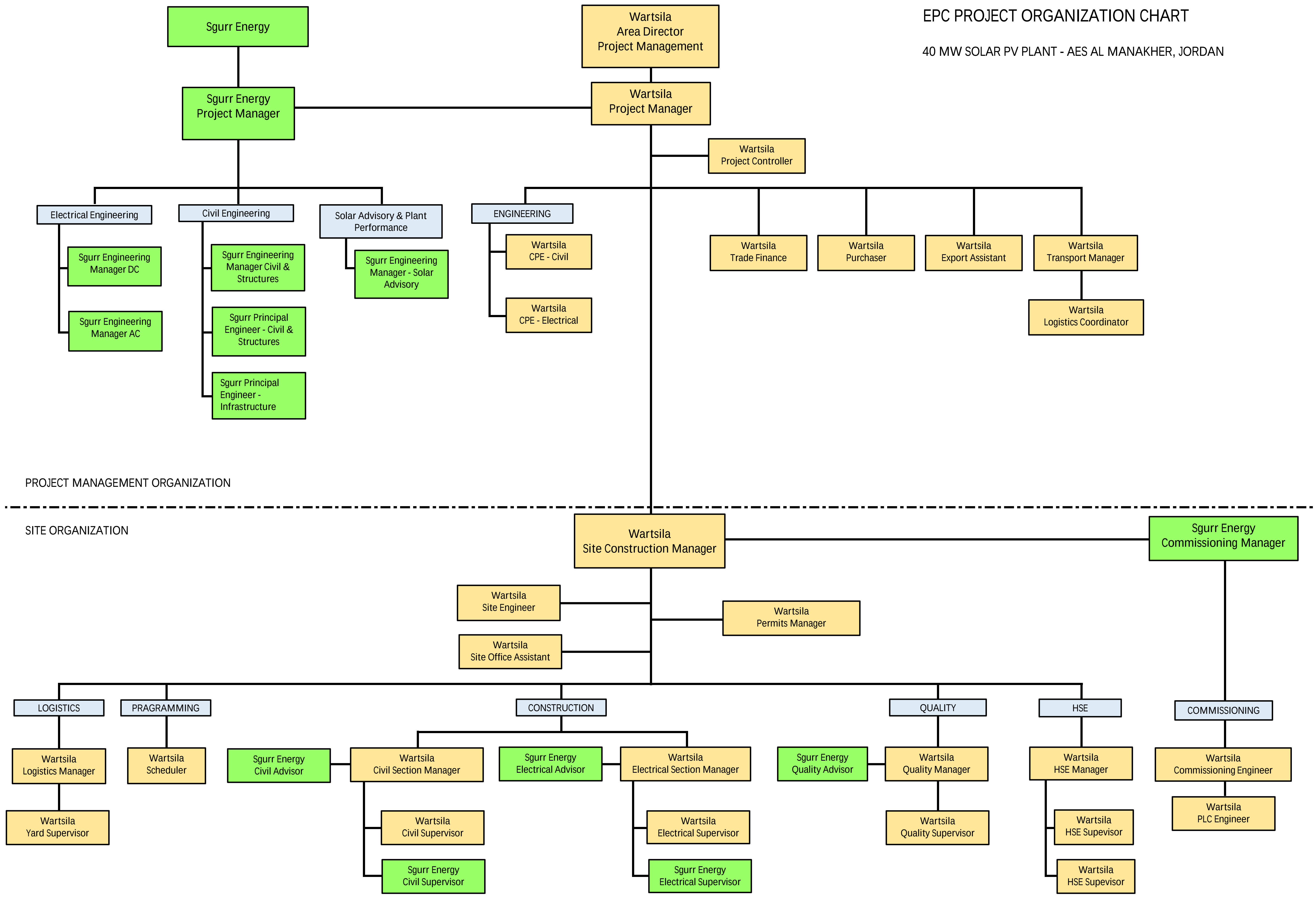
	INVERTER ROOM
	PVCS STATION
	29X8 LANDSCAPE STRUCTURE
	BOUNDARY LINE
	ROAD

Appendix B

ENVIRONMENTAL PERMIT AND CONDITIONS

Appendix C

PROJECT ORGANISATION CHART


EPC PROJECT ORGANIZATION CHART
40 MW SOLAR PV PLANT - AES AL MANAKHER, JORDAN
Sgurr Energy
Wartsila Area Director Project Management
Sgurr Energy Project Manager
Wartsila Project Manager
Wartsila Project Controller
Electrical Engineering
Civil Engineering
Solar Advisory & Plant Performance
ENGINEERING
Sgurr Engineering Manager DC
Sgurr Engineering Manager AC
Sgurr Engineering Manager Civil & Structures
Sgurr Principal Engineer - Civil & Structures
Sgurr Principal Engineer - Infrastructure
Sgurr Engineering Manager - Solar Advisory
Wartsila CPE - Civil
Wartsila CPE - Electrical
Wartsila Trade Finance
Wartsila Purchaser
Wartsila Export Assistant
Wartsila Transport Manager
Wartsila Logistics Coordinator
PROJECT MANAGEMENT ORGANIZATION
SITE ORGANIZATION
Wartsila Site Construction Manager
Sgurr Energy Commissioning Manager
Wartsila Site Engineer
Wartsila Permits Manager
Wartsila Site Office Assistant
LOGISTICS
PRAGRAMMING
CONSTRUCTION
QUALITY
HSE
COMMISSIONING
Wartsila Logistics Manager
Wartsila Yard Supervisor
Wartsila Scheduler
Sgurr Energy Civil Advisor
Wartsila Civil Section Manager
Wartsila Civil Supervisor
Sgurr Energy Civil Supervisor
Sgurr Energy Electrical Advisor
Wartsila Electrical Section Manager
Wartsila Electrical Supervisor
Sgurr Energy Electrical Supervisor
Sgurr Energy Quality Advisor
Wartsila Quality Manager
Wartsila Quality Supervisor
Wartsila HSE Manager
Wartsila HSE Supervisor
Wartsila HSE Supevisor
Wartsila Commissioning Engineer
Wartsila PLC Engineer

Appendix D

PROJECT SIGN BOARD

Appendix E

NON-COMPLIANCE REPORT

Site Environmental Non-conformance Report

Project	
Issue Date	
Reference	
Subject	
Inspection Date	
Inspection Time	
Location	
Inspector	
Resident Engineer / Site Construction Manager	
HSE Manager	

Ref	Description of non-conformance	Photograph of Non-conformance	Level of non-conformance*	Date Issued to Resident Engineer	Date Issued to Contractor	Summary of Corrective Action	Date of Corrective Action	Photographic Evidence and Date of Closure

Summary of construction site visit:

*Definitions:

Note; a minor issue identified on site which does not represent an immediate, significant risk of environmental damage. The issues represent poor environmental management procedures and have potential to escalate should they remain over the duration of construction.

Environmental issue; the issue does not pose a significant threat to the environment and can be easily remediated. However the issue has potential to quickly escalate to become a significant non-conformance and result in environmental damage. Corrective action is required to remediate the issue.

Non-conformance; a significant issue which demonstrates ineffective implementation of the CEMP. The issue is deemed to be significant and has the potential to / is causing major environmental damage. Should corrective action not be implemented and the non-conformance continues, the Contractors KPIs will be affected.

Appendix F

WEEKLY ENVIRONMENTAL INSPECTION RECORD

WEEKLY INSPECTION CHECKLIST

Tick Satisfactory **or** Not Satisfactory **or** add NI (not Inspected) **or** NA (not Applicable). All Not satisfactory should be numbered for corrective action.

Date:		**Company:**	
Name / Role:		**Work area:**	

Weather Conditions										
Condition	Sunny		Fine		Overcast		Light rain		Heavy rain	
T°	°C		Humidity		High		Moderate		Low	
Wind	Calm		Light		Breeze		Strong		Direction	

	ITEM	Satisfactory	Not Satisfactory	Comments
General				
G.1	Confirm all works are confined to permitted site limits.			
G.2	Confirm that damage is not occurring to existing facilities, including public roads.			
G.3	Confirm work is undertaken within approved time.			
G.4	Is the general appearance of the work area acceptable?			
G.5	Confirm that Tool Box talks have been undertaken			
G.6	Confirm complaints have been forwarded to EHS Manager			
Comments				

	ITEM	Satisfactory	Not Satisfactory	Comments
	Air Quality			
AQ.1	Confirm equipment and vehicles are regularly serviced and maintained			
AQ.2	Confirm equipment and vehicles that are emitting excessive smoke or emissions are inspected and serviced immediately.			
AQ.3	Confirm equipment and vehicles used on an intermittent basis is shut down or throttled down when not in use.			
AQ.4	Confirm that excavated materials, where appropriate, being watered or sheeted before being transported.			
AQ.5	Confirm dust from batching plant is being controlled.			
AQ.6	Is watering of work areas being effective in reducing dust generation and impact?			
AQ.7	Inspect stockpile and confirm if wet suppression needed and is being applied.			
AQ.8	Confirm that sub-contractor reuse unsuitable / non potable water when possible for dust suppression.			
AQ.9	Confirm that trucks carrying soil have got their load covered, and are not overfilled.			
AQ.10	Visually confirm that vehicle speeds are restricted to 20kmph on un-surfaced areas of the site.			
AQ.11	Confirm no open burning waste takes place.			
AQ.12	Confirm that dusty items are stored appropriately?			
AQ.13	Confirm that all complaints relating to dust / air quality have been forwarded to the EHS Manager.			

ITEM	Satisfactory	Not Satisfactory	Comments
Air Quality			
Comments			

	ITEM	Satisfactory	Not Satisfactory	Comments
Noise Management				
N.1	Confirm that acoustic covers on all machinery that generates excessive noise levels remain closed at all times.			
N.2	Confirm that plant and equipment are switched off when not in use.			
N.3	Confirm that all vehicles waiting to enter the site are not generating excessive noise likely to cause a nuisance.			
N.4	Confirm that noisy plant / equipment is being located away from identified sensitive areas.			
N.5	Confirm that noisy activities are only carried out between 07:00 and 20:00. If operation is out this timeframe, confirm that it is documented.			
N.6	Confirm that all complaints relating to noise have been forwarded to the EHS Manager.			
N.7	Confirm that potentially affected sensitive receptors been informed in advance of proposed work.			
Comments				

ITEM		Satisfactory	Not Satisfactory	Comments
Contamination Management				
CM.1	Confirm that fuel, paint and other chemicals with a combined volume of more than 200 litres are stored in a properly constructed bund (correct size, bund walls are structurally sounds, walls sealed)			
CM.2	Confirm that all bunds areas have at least a capacity of 110% of the volume of stored materials (if above 200litres)			
CM.3	Confirm that bunds are well maintained and no water has been accumulated within.			
CM.4	Confirm that no other items are stored into the bund, other than tank, drums and dispensing hoses			
CM.5	Confirm that all bulk storage tanks have adequate signage indicating contents and quantity stored.			
CM.6	Confirm that all minor fuel / chemical storage (combined total less than 200l) is stored in sealed containers and on sealed surface (such as drip tray or a concrete pad).			
CM.7	Confirm that Emergency spillage kits and MSDS are available.			
CM.8	Confirm that all valves on bunds are closed.			
CM.9	Confirm that vehicles and mobile equipment is regularly inspected and maintained (to confirm that they are not leaking).			
CM.10	Confirm that concrete trucks / equipment are washed into a purpose-built wash bay, or off site at a proper facility.			
CM.11	Confirm that generators and pumps are located on a concrete pad or within a metal drip tray.			

ITEM		Satisfactory	Not Satisfactory	Comments
Contamination Management				
CM.12	Confirm that oil/fuel filters are drained over a container, prior to recycling or disposal.			
CM.13	Confirm that there is no visible contamination.			
CM.14	Confirm that dewatering effluent, if not reused on site, is diverted to a two-stage interceptor prior to being discharged into the water network.			
CM.15	Confirm that sewage holding tanks are not full and are regularly pumped out.			

Comments

	ITEM	Satisfactory	Not Satisfactory	Comments
	Waste Management			
WM.1	Confirm that waste is being segregated in an orderly and clean manner (e.g.: no overfull bins or skips, or waste stockpiling).			
WM.2	Confirm that the work areas are free of litter.			
WM.3	Confirm that all containers are clearly labelled.			
WM.4	Confirm that correct containers are being used for segregation.			
WM.5	Confirm that different types of solid waste are kept separate.			
WM.6	Confirm that waste areas, both hazardous and non-hazardous are clearly signposted in English and Arabic.			
WM.7	Confirm that suppliers have been requested to use minimal packaging.			
WM.8	Confirm that chemicals have been ordered in returnable drums.			
WM.9	Confirm that refillable containers are being used, where possible, for collection of waste fluids such as waste oil, hydraulic oils and used grease.			
WM.10	Confirm that the use of disposable materials such as plastic cups, batteries are being avoided.			
WM.11	Confirm that there is re-use and recycling of wood, steel, cardboard, paper and concrete on site.			
WM.12	Confirm that hazardous waste is being removed from site as soon as practicable by an MoE approved disposal contractor.			
WM.13	Confirm that vehicles used for transporting soil/rocks are not used to transport waste, unless cleaned prior to use.			

	ITEM	Satisfactory	Not Satisfactory	Comments
Waste Management				
WM.14	Confirm that storage areas for liquid waste are bunded (if above 200l) to 110% of the total volume stored.			
WM.15	Confirm that an adequate number of waste containers are maintained strategically throughout the project area. Confirm that they are regularly collected.			
WM.16	Confirm that all organic waste container are properly sealed.			
WM.17	Confirm that hazardous waste are stored away from sources of ignition.			
WM.19	Confirm that hazardous waste are stored separately in order to avoid adverse chemical reactions and facilitate treatment.			
WM.20	Confirm that hazardous waste are stored in tightly closed, leak proof containers made of or lined with materials that are compatible with the hazardous waste to be stored.			
Comments				

Appendix G

MONTHLY REPORT TEMPLATE

Wartsila

Al Manakher Solar Project

Monthly Environmental Audit Report

Author
[Date]

QA/QC

Version					
Date					
Author					
Checker					
Approver					
Report Ref					
Revision					

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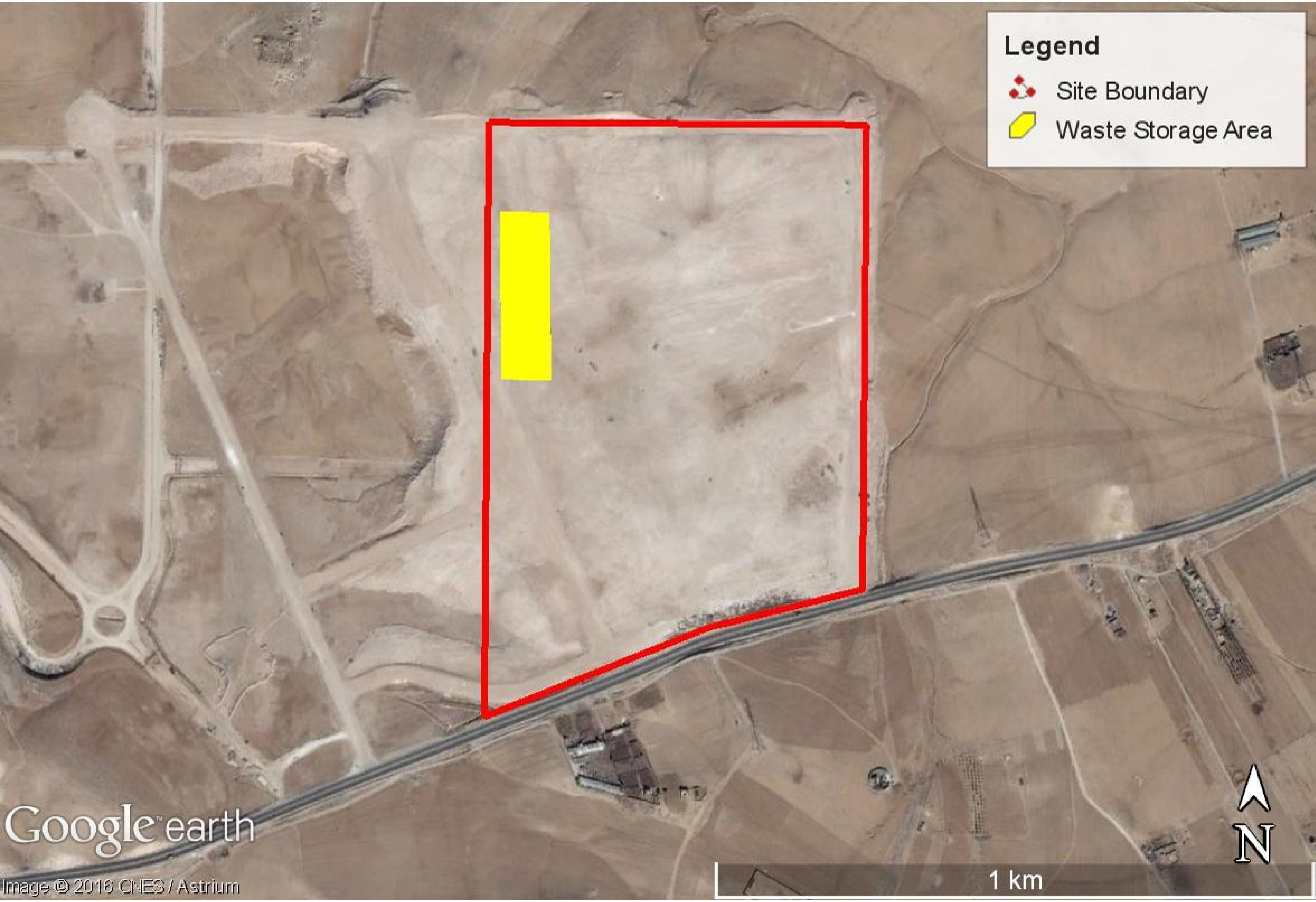
APPENDICES

Appendix H

RECOMMENDED WASTE STORAGE LOCATION


Legend
Site Boundary
Waste Storage Area
Google earth
Image © 2016 CNES / Astrium
1 km
N

Appendix I

EXAMPLE HSE INCIDENT FORM TITLE

HSE Incident Report

The incident		
Reported by	Department	
Email	Phone	Ext
Date of occurrence	Time	
Exact location		
Accident ☐ Incident ☐ Near miss ☐	Violence ☐ Ill health ☐ Safety ☐	
What happened? Report any details that may have contributed to the incident (i.e., poor lighting). Use additional paper as necessary and attach to form.		
Describe the outcome: harm/health effects/damage.		
Describe corrective measures taken to address immediate hazards related to incident.		

<table>
<tr><td colspan="3">The affected person</td></tr>
<tr><td colspan="2">Worker ☐ other: (i.e., visitor, contractor) ☐</td><td>Name</td></tr>
<tr><td colspan="2">Address</td><td>Date of birth</td></tr>
<tr><td colspan="2">Email—work:</td><td>Email—home</td></tr>
<tr><td>Employer's name if other than worker</td><td>Address</td><td>Phone</td></tr>
<tr><td colspan="3">Witness details</td></tr>
<tr><td colspan="2">Names(s) and contact information</td><td>Names(s) and contact information</td></tr>
<tr><td colspan="3">First aid</td></tr>
<tr><td colspan="3">First aid provided: Yes ☐ No ☐ N/A ☐ Time of attendance:
By whom: Contact information:
Details of provision:</td></tr>
</table>

Post incident			
Where did the person involved in the incident go next?			
To the hospital ☐	home ☐	returned to work ☐	other ☐
Was a member of the joint health and safety committee notified of the incident? Yes ☐ No ☐			
Name:			

cope 343

Additional notes:

Appendix J

AES EMERGENCY PROCEDURES - SECURITY

AES Levant Jordan

Security & Gate Control Procedure

Name	Date	Signature
Prepared by: Aamer Shamim HSE Manager	15-May-2014	
Reviewed by: Khaled Salameh Deputy Plant Manager	20-Jun-2014	
Approved by: Meftaur Rahman Executive Manager	25-Jun-2014	
Reviewed by: Tarek Quronfuleh	1-July-2015	
Reviewed by: Tarek Quronfuleh	20.Aug.2016	
Next Review: August.2017		

1.0 PURPOSE

This document specifies the security and gate control procedures and rules applicable to AES Jordan people, visitors, vendors, material suppliers, contractors, contract labours and for movement of material in and out of the premises of AES Jordan, ("**Facility**").

2.0 Scope

This procedure will be applicable to all AES Jordan people, contractors and visitors entering in to the premises of AES Levant Jordan.

3.0 AES Levant Jordan

3.1 All AES LEVANT JORDAN employees are provided with valid plant access card.

3.2 All AES LEVANT JORDAN employees shall make sure that they have logged in and logged out through access control system available near the main gate near South exit door each time while they are going in and out respectively.

3.3 Security guards will randomly inspect the vehicle of AES LEVANT JORDAN employee's while going in and out

3.4 If an AES LEVANT JORDAN Employee wishes to enter the plant without Access Card, he/she must report to the Security guard and must make sure that he/she is logged in the log book provided in the Guard House.

3.5 If the Plant access card is lost or misplaced, employee should immediately report to the IT Engineer and their team leader to make sure that the access card is disabled until it traced out.

4.0. Contractors

4.1 Only people with AES LEVANT JORDAN approved plant ID (from authorized AES Jordan personnel) shall be allowed inside the plant. AES Levant Jordan approved two types of contractor ID cards.

- Contractor ID – Long Term. These ID cards shall be issued to the contractors have work for longer time – AES Levant Jordan management will decide for the issuing of long term ID cards.
- Contractor ID – Short Term

4.2 Passes will be issued only with an official request from the direct Contractor, Supplier or Vendor of AES Levant Jordan

4.3 Prior to commencement of any contracted service inside the Facility premises, Department Manager/Team Leader shall submit a list of

Contractors' workers who are required to be visiting the Facility to carry out jobs. The list should contain at least the following details:

- Name of the Contractor
- Name of the contract labours.
- Identification number (eg. Passport/ National identification).
- Intended period of the visit
- The vehicle details and the details of driver

4.4 Security will maintain a Contractor Log based on the above details provided by the Department Managers/TLs. Any person who is not included in the Contractor Log will not be permitted entry into the Facility.

4.5 Each ID card is marked with number and this number shall be logged against each individual's name. Use of other person's card is strictly prohibited and in case of such violation person shall go under AES Jordan disciplinary action

4.6 All the people must show the plant ID to the security guard and make sure that his/ her name is logged in and logged out each time; they enter and exit the plant respectively.

4.7 It is mandatory to carry the plant ID at all times.

4.8 This plant ID must be produced if demanded by AES Levant Jordan Employee or AES Levant Jordan appointed Security guard.

4.9 Contractors are not permitted to take their vehicles in to the plant until and unless it is allowed by AES Levant Jordan personnel.

5.0. Visitor

5.1 Visitor(s) will be allowed entry in to the plant strictly with a prior approved (**from Authorized personnel of AES LEVANT JORDAN**) .The visitors entry purpose must be verified by necessary enquiry by the concerned person

5.2 Visitor Pass request must be approved by the person, whom he want to meet inside the plant

5.3 List of visitors that are required to visit the Facility must be provided to the Security by AES Person through EHS Manager, who intends to take visitors into the plant area. The list should contain at least the following details:

- Name of the Company

- Names of the people.
- Identification number (eg. Passport/ National identification).
- Intended period of the visit & purpose of the visit
- The vehicle details and the details of driver

5.4 Visitor's gate pass could be availed only for one day. Each time visitor (s) has to get new card and shall be retuned at gate before leaving the premises of AES Levant Jordan

5.5 Visitor / AES personal or Security guard shall enter the details and sign in the Register available in the guard room

5.6 Security will issue a visitor's pass on submitting the approved gate pass to all visitors

5.7 The visitor pass must be returned to the security when the visitor exits the plant.

5.8 Visitor's vehicles are not allowed to enter into the plant unless it approved by AES LEVANT JORDAN with a genuine reason

5.9 All the visitors must obtain a Visitor's Gate Pass from the security on submission of Identification card.

5.10 Security shall issue a recept to the visitor (in addition to the Visitor's Gate Pass) and when he returns after meeting the AES person, visitor needs to come with the signature of the AES person who he met.

5.11 When the visitor is leaving the Facility Security shall issue the visitor's identification card back to the visitor after verifying the recept is signed by the AES person and taking back the Visitor's Gate Pass.

5.12 Each of the visitors must carry the Visitors Gate Pass at all times, while in the Facility.

5.13 If visitor is going beyond the Admin Building he/she/they need to go through the Safety induction conducted by the EHS Department.

6.0. Safety and Security:

7.1 Before commencement of the work/service, a confirmation that each of the Contractor and its contract labours has undergone the AES safety induction programme which is given by the EHS department.

7.2 A body check will be performed by the Security for all Contractors and contract labours coming in and going out of the Facility.

7.3 No alcohol, betel chews or drugs are permitted inside the Facility. No person under the influence of alcohol or drugs will be permitted entry into the Facility. In case the Security suspects that someone is under the influence of alcohol and/or drugs, the Security shall communicate with the Control Room for getting such person tested.

7.4 All the Contractors and contract labours visitors are required to follow the Safety Guidelines for Visitors and Contractors, issued at the Security Office.

7.5 No weapons are allowed in the facility

7.0. List of Materials, Tools & Equipment:

7.1. A list of all Materials, Tools & Equipment (the "**Material List**"), that the Contractor intends to bring into the Facility for carrying out his service, must be submitted to the respective AES person

7.2. The respective AES person shall submit the Material List to the Department Manager/TL for approval. The approved Material List then to be provided to the main gate security

7.3. The Material List should include the following at minimum:

- The details of each material, tool or equipment with identification number (if possible);
- The designated area of use inside the Facility; and
- The intended period of use in the Facility.

8.0. Entry and Exit of Materials, Tools & Equipment:

Entry:

8.1. Security shall verify all materials, tools and equipment of a Contractor against the approved Material List;

8.2. Security shall not allow entry of any material, tool or equipment into the Facility which is not included in the Material List; and

8.3. The vehicle carrying the materials shall be accompanied by a Security Guard to the designated area for offloading.

8.4. Cranes, forklifts, trailers, and any heavy vehicle shall not be allowed to enter from the gate without accompanied by the respective Engineer who requested for the service of such vehicle. The Security shall inform all the operators of such vehicles to obtain all the gate passes and time sheets to be cleared as the work is completed.

Exit:

8.5. A Gate Pass must be issued for return of all materials, tools and equipment after completion of services;

8.6. The Gate Pass must be accompanied by a copy of the approved Material List; and all returning items will be verified by Security against the approved Material List.

8.7. At the exit of cranes, forklifts, trailers or any other heavy vehicle shall have signed clearances from the respective Engineer.

9.0. DELIVERY OF MATERIALS PURCHASED

9.1. Delivery of materials to the Facility, by any mean (by hand, by a delivery van, by a truck or trailer), must be supported by a Delivery Note or Invoice issued by the Supplier and a copy of the Purchase Order issued by AES Levant Jordan, , which should be produced to the Security.

9.2. Security shall consult the Store Officer or Procurement Officer before allowing the delivery to enter into the Facility in weekdays. If it is weekend or after normal working hours security shall consult the Control Room Engineer (CRE) at central control room (CCR)

9.3. If any delivery is there in weekends or after normal working hours Store Officer / Purchasing Officer shall inform shift CRE on prior basis. And the shift CRE shall convey the message to the next shift CRE if shift change happen before material arrived.

9.4. The delivery person or delivery vehicle shall not be allowed beyond the area marked "**Stores Parking Area**".

9.5. AES Levant Jordan Store Officer / Procurement Officer shall sign the delivery note acknowledging receipt of materials. Security shall keep a copy of the signed delivery note before the delivery person/vehicle leaves the Facility.

9.6. In case of unavailability of Warehouse Officer and procurement Manager during off hours, the CRE may sign the delivery note and Security may receive the goods/materials on behalf of the Company.

9.7. All materials are required to be disclosed to the Security Office

10.0. RELEASE OF MATERIAL FROM THE FACILITY

10.1. Gate Pass shall be initiated by the respective Plant Engineer, any Maintenance Engineer or Stores Officer, who has the knowledge of the release of the material from the Facility. Gate Passes would have to be duly signed by Maintenance Manager/Mechanical Maintenance TL/E&I TL.

10.2. No item or materials including any waste material shall be released from the Facility without a valid Gate Pass.

10.3. Only Maintenance Manager/Mechanical Maintenance TL/E&I TL are authorized to sign gate passes. However, during the night shifts and during weekends the CRE can sign the Gate Pass provided such gate passes are counter signed by one of above people on the next working day.

10.4. At a given time only one gate pass book should be in use and this needs to be in the custody of the Chief Security Officer at the Gate Security Office.

10.5. All unused gate pass books should be kept under lock at the Stores.

10.6. Security shall maintain copies of all the Gate passes and an Information Book, where all the movements would be logged.

11.0. GENERAL

11.1. Registration numbers of the Vehicles that are required to enter into the Facility to be provided to the Security. All the vehicles are subject to inspection on entering & leaving the Plant.

11.2. All the instructions to the Security will be issued only by the EHS Manager or nominated person by the EHS Manager and has to be in writing.

11.3. All the personnel belonging of AES People, shall preferably be voluntarily declared to the Security before entering the Facility

11.4. Security shall maintain two log books for vehicle entry & exit and people (Contractors, material delivers & Visitors) entry & exit.

12.0. Security Guards Responsibilities

Visitors and contractors:	الزوار والمقاولين:
• Body search all visitors including subcontractor people.	• تفتيش جميع الزوار بما فيهم عمال المقاولين.

• All accompanies baggage, i.e. briefcase, toolbox, laptop computers should be checked after asking the person politely and look for any suspicious items.	• جميع المتعة المصاحبة كالحقائب، صندوق المعدات وأجهزة الكمبيوتر المحمولة يجب أن تفحص بعد الإستئذان من الشخص والتأكد من أي شيء مشبوه.
• All visitors and sub-contractor people must sign-in in the log book their name, company name, time of entry, visitor or contractor card number and time of exit.	• يجب على جميع الزوار وعمال المقاولين تدوين أسمائهم وإسم الشركة التابعه لهم ورقم بطاقة الزائر أو العامل ووقت الدخول والخروج.
• All visitors and contractors will be given visitor or contractor cards respectively before entering into plant and card should be displayed all the time and number of card will be logged on the book.	• جميع الزوار وعمال المقاولين سيعطى بطاقة زائر أو عامل على التوالي قبل دخول المحطة ويجب أن تكون البطاقة معروضه كل الوقت وسوف تسجل رقم البطاقه في السجل الموجود في غرفة الحراسه.
• **<u>Card issued to specific person shall not be used by other person and such violation shall be reported to AES personal immediately.</u>**	• **<u>عند اصدار بطاقة لشخص معين لا يجوز استخدامها من قبل شخص آخر و عند حدوث هذا الانتهاك يتم تبليغ أيه إى أس مباشرة.</u>**
• For any plant visitors, contact the required person.	• عند وجود زوار في المحطة، يتم تبليغ الشخص المطلوب بذلك.
• Friends and family visiting guards while guards are on duty are not allowed, security house will not be used as a social gathering place.	• الزيارات العائلية والأصدقاء ممنوعة خلال فترة العمل للحراس، غرفة الحراسة ليست مكان لتجمع العائلات والأصدقاء.
• All vendors and delivery people will stop at security room and sign in before deliveries can be made.	• على كل البائعين والموصلين للبضائع التوقيع في غرفة الحراسة قبل الدخول الى المحطة لتسليم البضاعة.
• After dropping off deliveries they are to sign out at the security room.	• وبعد الخروج عليهم التوقيع بالخروج في نفس السجل الموجود في غرفة الحراسة.
<u>Vehicle entry:</u>	**<u>دخول الآلات:</u>**
• Vehicles weight and height should be known by asking the driver, especially big and heavy vehicles.	• يجب معرفة طول ووزن المركبات بسؤال السائق عن ذلك، وخصوصا المركبات الكبيرة والثقيلة.
• All passengers must disembark the vehicle and come to the security desk for body search and log register entry.	• يجب على جميع الركاب النزول من المركبة والتوجه الى غرفة الحراسة من أجل التفتيش وتدوين بياناتهم.
• All vehicles must be checked & inspected from underneath, inside the passenger cabin, trunk and boot.	• يجب تفتيش جميع السيارات من كل الإتجاهات ومن تحت وداخل كابينة الركاب.
• In case of delivery trucks, carry out a	• في حالة الشاحنات المحمولة والقادمة الى المحطة،

thorough inspection of the carriage also ask questions about the delivery items from the driver. Look out for suspicious people. • Contact stores people to meet the delivery truck at the gate. Only then open the gate. • All vehicles must be searched when exiting the plant. • For delivery trucks and equipment exiting the plant, inspect thoroughly, inside, carriage, hold and underneath, before opening the gate. • AES responsible person must be contacted before entering any delivery inside the plant. • Ask for a signed copy of .Delivery Note.. This must be signed by an AES stores person. DO NOT LET ANY TRUCK OUT WITHOUT IT. • Ask for material in / out permit • Maximum effort will be undertaken to avoid entry of delivery trucks into the plant site. Forklifts and hydraulic trolleys will be used by AES team members where possible for delivering material within the site, unless not practical.	يجب تفتيش الشاحنة والمادة المحمولة والتحقق من أي شيء أو شخص مشبوه. • يجب الإتصال بموظفي المخازن عند وصول أي من البضاعة من أجل التاكد من حمولة الشاحنة قبل السماح لها بالدخول. • يجب تفتيش كل السيارات عند مغادرتها للمحطة. • يجب تفتيش كل المعدات والشاحنات من الداخل والخارج ومن الأسفل قبل فتح البوابه والسماح لها بالخروج. • يجب الإتصال بالشخص المسؤول قبل دخول أي تسليمات أو بضاعة الى المحطة. • يجب الإستفسار عن نسخة من توصيل الحمولة والموقعة من احد موظفي المخازن وعدم السماح لأي شاحنة بالمغادرة من دونها. • يجب الإستفسار عن تصريح الدخول والخروج. • سوف تبذل جهود قصوى لتفادي دخول الشاحنات الى المحطة، وسيستخدم فريق عمل أيه إي أس رافعات شوكية ورافعات هيدروليكية لإيصال البضائع الى داخل الموقع، الا اذا كان غير عملي.
Plant Rounds and Cameras:	**التفقدات والكاميرات:**
• At least 2 rounds to be taken around the perimeter fence during each shift except morning shift. • These 2 rounds should be taken across full plant including lay-down area at the begging and middle of the shift. • Each round to be taken by different guard. • Security cameras shall be used efficiently to help doing duty. • If any camera found not working or unclean during taking rounds or observation, inform AES control room.	• يجب أخذ دورتان على الأقل حول سياج المحطة أثناء كل تغيير في الدورية، ما عدا تغيير وردية الصباح. • يجب أن تؤخذ الدورتين عبر المحطة كاملة في البداية وفي منتصف تغيير الدورية. • كل دورة حول المحطة يجب أن تؤخذ من قبل حارس مختلف. • يجب ان تستخدم كاميرات الأمن والمراقبة بفاعليه أكبر للمساعده على أداء الواجب على أكمل وجه. • إذا وجدت أي آلة تصوير معطلة أو لا تعمل أو غير نظيفة أثناء أخذ الدورات يجب إبلاغ غرفة التحكم بذلك. • نقطة الإتصال عند الحاجة (الضرورة) تكون غرفة

• Point of contact will be control room and the AES security responsible person, if guards should need to contact • Watching TV is not allowed inside the security room. • Primary contact for security services management team will be AES Security person.	التحكم أو مسؤول الأمن في ايه اي أس. • لا يسمح بمشاهدة التلفاز في غرفة الحراسة. • المسؤول الأساسي للإتصال بإدارة أجهزة الأمن هو الشخص المسؤول عن أمن ايه اي اس.

Revision / Changes record

Sr. No.	Revision No.	Reference No.	Details Of Change	Date	Approved By
1					
2					

AES Levant Jordan

Emergency Preparedness and Response

Name	Date	Signature
Prepared by: Aamer Shamim HSE Manager	15-May-2014	
Reviewed by: Khaled Salameh Deputy Plant Manager	20-Jun-2014	
Approved by: Meftaur Rahman Executive Manager	25-Jun-2014	
Reviewed By: HSE Committee	1-July-2015	
Reviewed By: Ops. Team	20.Aug.2016	
Next Review: August.2017		

EMS /PRO/009: Emergency Preparedness and Response

1.0 Purpose/Scope:

- The purpose of emergency preparedness and response is to recognize and plan for appropriate responses to an emergency so that safety and environmental risks associated with emergency may be prevented.
- Prepare individuals working inside the plant so that they can respond effectively in the following:
  - Potential Risk Assessment
  - Fire detection and Alarm System
  - System for Intervention and Actions to control any incident
  - Emergency Evacuation Procedure/Drills in order to meet the emergency situations like Bomb Threatening Message or Terror Act/Threat etc…

2.0 Activities Affected:

All areas and departments

3.0 Forms Used:

None

4.0 References:

- EMS/PRO/001 Environmental Aspects
- EMS/PRO/003 Objectives, Targets and Programs
- EMS/PRO/006 Communication
- EMS/PRO/012 Non-conformity and Corrective and Preventive Action
- AES Levant Jordan Safety Manual Ref: OSH/PLN/002 - Emergency Response Plan

5.0 Definitions:

5.1 Environmental Incident or Emergency Situation: environmental releases that require an emergency response

5.2 Emergency Response: actions taken by personnel outside of the immediate work area to address an environmental incident.

6.0 Procedure:

6.1 Potential environmental incidents and emergencies likely to occur at the facility shall be identified by the HSE committee and documented according to EMS/PRO/001: (Environmental Aspects) and Emergency Response and Planning requirements.

6.2 Where applicable, regulatory agencies shall be notified by the Business (EHS Manager/EHS Engineer) of environmental incidents.

6.3 See AES Levant Jordan Safety Manual's Emergency Procedure for complete Emergency Preparedness and Response plan [**OSH/PLN/002**].

7.0 Description :

Plant Description:

Facility Name	AES Levant Jordan
Site Address	Al Madhona St.- Al Manakher Village, Amman 11181, Jordan
Responsible Site Official	Meftaur Rahman
Title	Executive Manager
Phone Number	+96264293201
Facility Description	Electric Power Generation
Date Operation Started	11 July, 2014

EMERGENCY TELEPHONE NUMBERS:

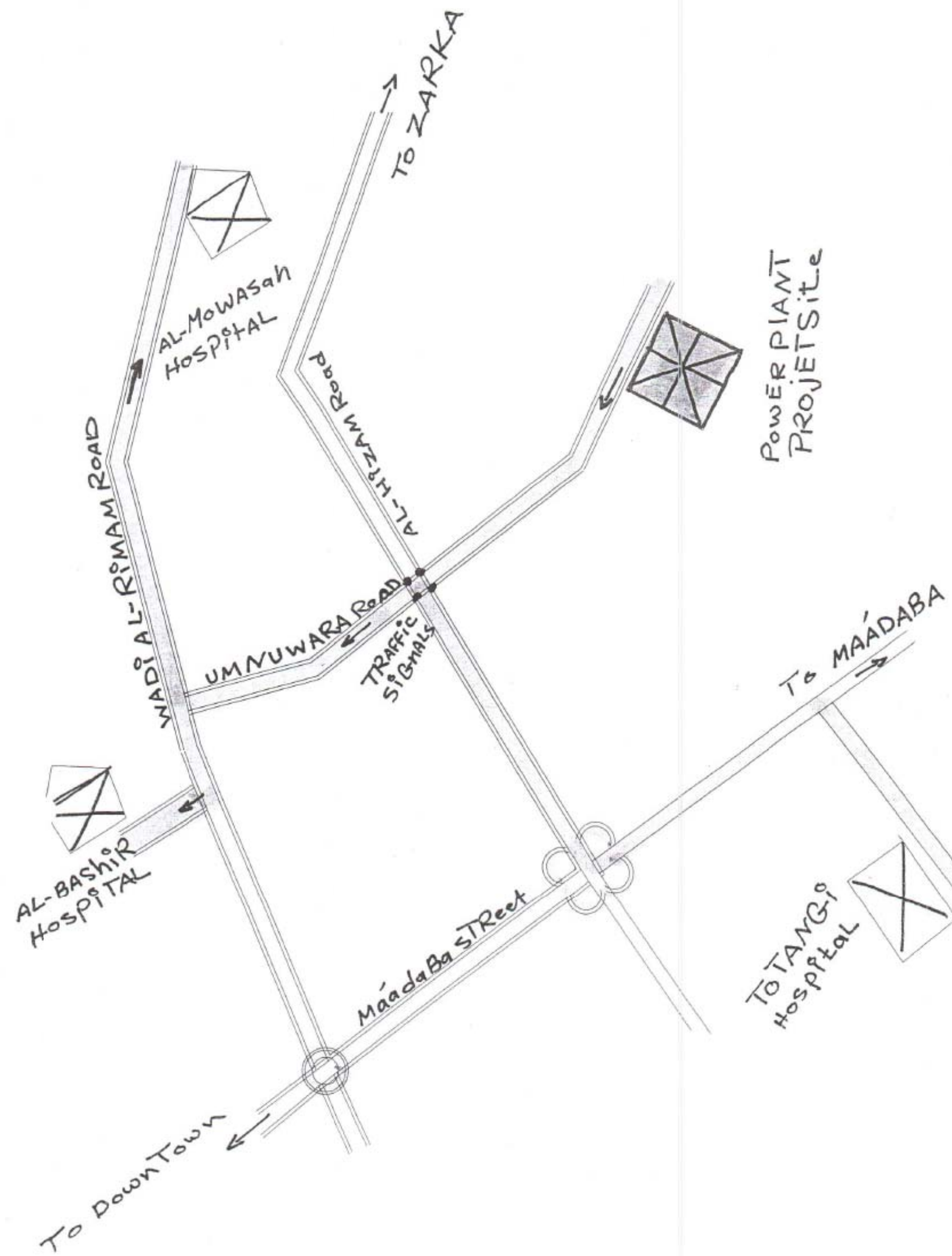
Notification Contacts:

Meftaur Rahman Executive Manager	+96264293201 +962796099511 (cell)
Oil Spill Contact: Mohammad Al qudah HSE Manager	+962 797897020
Fire/Police/Ambulance:	911
Jamil Totanji Hospital Sahab	+96264020090
Ahmad Hamaida Hospital	+96264785555
Al Bashir Hospital	+96264753101
Ministry of Environment:	+96265560113

Clean-up Contacts:

Saif Station	+962795426436
Ghazi Alkaraki	+962788855327
Rizeq Lutfi	+962779998881
Mihad Mohammad Deep	+962785537163
Ahmed Abdel Rahman	+962799355349

Plant Location:



Main chemical stored in large quantity at site is Ammonia

Below is the location of the chemicals & oils being used in the plant with their capacities:

Area	Tank Name	Nominal Capacity	Unit
Tank Yard	LFO-1	7,500	m3
	LFO-2	7,500	m3
	HFO-1	10,000	m3
	HFO-2	10,000	m3
	HFO-3	10,000	m3
	HFO-4	10,000	m3
Day Tank Area	HFO Day Tank-1	500	m3
	HFO Day Tank-2	500	m3
	HFO Buffer Tank-1	200	m3
	HFO Buffer Tank-2	200	m3
	Oily Water Buffer Tank	55	m3
	Sludge Tank	80	m3
	Used Lube Oil Tank	55	m3
	Clean Lube Oil Tank	80	m3
	Lube Oil Service Tank-1	20	m3
	Lube Oil Service Tank-2	20	m3
NH3	Ammonia Tank	900	m3
Raw Water	Fire Fighting Water Tank	5,000	m3
Demin Water	Demin Water Tank	80	m3
	Main Transformer	80,000 KG for main transformer (4 *20,000KG/each)	
	AUX Transformer	(4*2,127KG/each)	
	FF Diesel Tank	4	m3
	LFO Day tank for Boiler 1	4	m3
	LFO Day tank for Boiler 2	2	m3
	Electrical Fire Fighting pump (NaOCL)	0.1	m3
	Aux Boiler 901 (Elminox)	0.1	m3
	Aux Boiler 901 (Tri-act 1820)	0.1	m3

Countermeasures:

Engineering Control:

1) Oil storage Tank has secondary containment of 110%. The outlet from the dyke is controlled by a discharge valve. In case of rain water, the discharge is directed to storm water drain.
2) All the leakages from the oil filled transformers are collected underground of the transformers. They can be directed to oily waste water treatment plant.
3) All chemical tanks & containers are equipped with secondary containment & connected to chemical waste water treatment plant.
4) All the drain & vent points of oily systems are collected in sumps & sent to oily wastewater plant for further treatment.
5) The unloading area of diesel oil are designed to collect oil spill during unloading & sent to oily waste water treatment plant.
6) All the tanks are equipped with high & low level alarms & displayed at control room with buzzer.
7) Oil storage at unloading area was designed there to direct any potential spill to the blind oily trench located at the end of the unloading area slop. Physical barriers were built for this purpose.

Administrative Control:

1) MSDS's have been placed in all the places where tanks & drums are located.
2) Spill kits have been provided at strategic locations of plant where possibilities of spillages are high.
3) Monthly inspection of the spill kit is in place.
4) Daily plant round up by plant engineers is in place.
5) HMIS labels for all the drums & tanks are in place.
6) Transportation of chemical & oil drums are carried out by listed authorized persons only.
7) Key plant personnel are trained on emergency preparedness should a spill occurs.
8) In plant Mock drill for chemical spillage.
9) Joint drill arrangement is in plant with CDD for various emergency scenario including chemical & oil spill

PPE:

1) All unloading activities are carried out wearing proper PPE.

2) In case of ammonia solution preparation, ammonia vapor cartridge is used for personal protection.

Potential Spill Scenario:

Aboveground Storage of Drums:
Seventy 55-Gallons Capacity

Potential Event	Spill Direction	Volume Released	Spill Rate
Oil Storage Area Complete failure of a full drum	Oil drums are stored at the fuel unloading area; any spill will be directed to the blind oily trench as physical barriers were built for this purpose.	Up to 55 Gallons	Slow to Instantaneous
Hazardous Waste Storage Area Complete failure of a full drum	Into area drains on the west leading to waste water treatment area.	Minor	Slow

Lube Oil System:
280 m3 Capacity

Potential Event	Spill Direction	Volume Released	Spill Rate
Engine Hall-A&B	A spill would be directed away from the power block into area drains. The drains convey material to a below grade oil water separator and then the water is pumped to a retention basin.	104 m3	Slow leak to Instantaneous

Electrical Transformers:
Mineral Oil
85,000 litre Capacity

Potential Event	Spill Direction	Volume Released	Spill Rate
Step-up Transformer	Flow to area drains of transformers. Then to an oil water separator and then on to a retention basin.	21,400 ltr	Slow leak to Instantaneous
Station Transformer	Flow to area drains of transformers. Then to an oil water separator and then on to a retention basin.	5,000 liters	Slow leak to Instantaneous

Battery Rooms:

- 96 batteries
-

Engineering Control:

- All batteries are sealed with gel
- All batteries rooms are closed and only authorized persons are entering
- Preventive maintenance job is done on all batteries in a regular manner
- All batteries rooms are ventilated

PPE:

- The use of PPE is as per the MSDS of the batteries
- MSDS is available at each battery location
- Warning and PPE signs are in place on each battery room door

SECURITY

Facility Fencing

Levant Jordan is surrounded by a six-foot chain link fence topped with triple strand barbed wire. A single entrance is manned by a security guard 24 hours per day, 365 days per year. In addition to the control over the entrance, operations personnel conduct rounds during each shift that include checking security measures.

Drain and Flow Valves

Flow and drain valves that allow direct flow from any tank or vessel are labeled and maintained in the closed position when not operating or not in a standby mode.

Oil Pump Controls
Oil transfer pumps are de-energized and cannot be turned on except by an authorized operator. Site security assures that no unauthorized persons are allowed onto the plant and operational personnel conduct rounds to check for security related events.

Out-of-Service Pipelines
Petroleum deliveries are performed by contractors who deliver product from the supplier. Deliveries consist of 55-gallon drums and infrequent tank truck deliveries. The loading and unloading connections for tank truck deliveries are securely capped or blind flanged to minimize the possibility of a release.

Facility Lighting
Overall facility illumination is designed to eliminate darkened areas within the facility so that night spills could be readily observed and vandalism is discouraged. Area lighting is appropriate for the type of work conducted in the area and was designed with consideration of prompt discovery of releases occurring during the evening.

Accumulated Rainwater Drainage
Rainwater from the open drain is discharged into an open wadi. Rainwater from secondary containment is not discharged outside unless it has been inspected for potential oil contamination

Effluent Treatment Facilities
All the spilled oil at site is being treated at oily wastewater treatment plant. Oily waste water is treated at oil separator. Skimmed oil from the separator is sent outside by authorized contractors of ministry of environment .Spill from other chemicals are treated at chemical waste water plant.

TRANSFER OPERATIONS, PUMPING, AND IN-PLANT PROCESSES

Pipe Supports
Pipe supports have been designed to minimize corrosion (painted surfaces) and are protected from motorized equipment.

Piping and Valve Inspections
All aboveground piping and valves are examined daily by facility personnel to assess their condition and written records are kept on a weekly basis.

The facility does not contain aboveground piping that may be endangered by vehicle traffic. It is protected with signage.

Vehicle Warning

The facility has no aboveground piping or oil transfer operations that may be endangered by vehicle traffic. Accordingly, warnings are not necessary.

TRANSFER OPERATIONS, PUMPING, AND IN-PLANT PROCESSES

Out-of-Service Piping

This facility has no out of service buried piping .

Pipe Supports

Pipe supports have been designed to minimize corrosion (painted surfaces) and are protected from motorized equipment.

Piping and Valve Inspections

All aboveground piping and valves are examined daily by facility personnel to assess their condition and written records are kept on a weekly basis.

The facility does not contain aboveground piping that may be endangered by vehicle traffic. It is protected with signage, bollards, and

Vehicle Warning

The facility has no aboveground piping or oil transfer operations that may be endangered by vehicle traffic. Accordingly, warnings are not necessary.

In case of a spill:

Chemical Spills on the AES Levant Jordan are not considered to be a major threat due to good segregation of all chemicals, all stored to the guidelines of the information depicted on the Material Safety Data Sheets (MSDS).

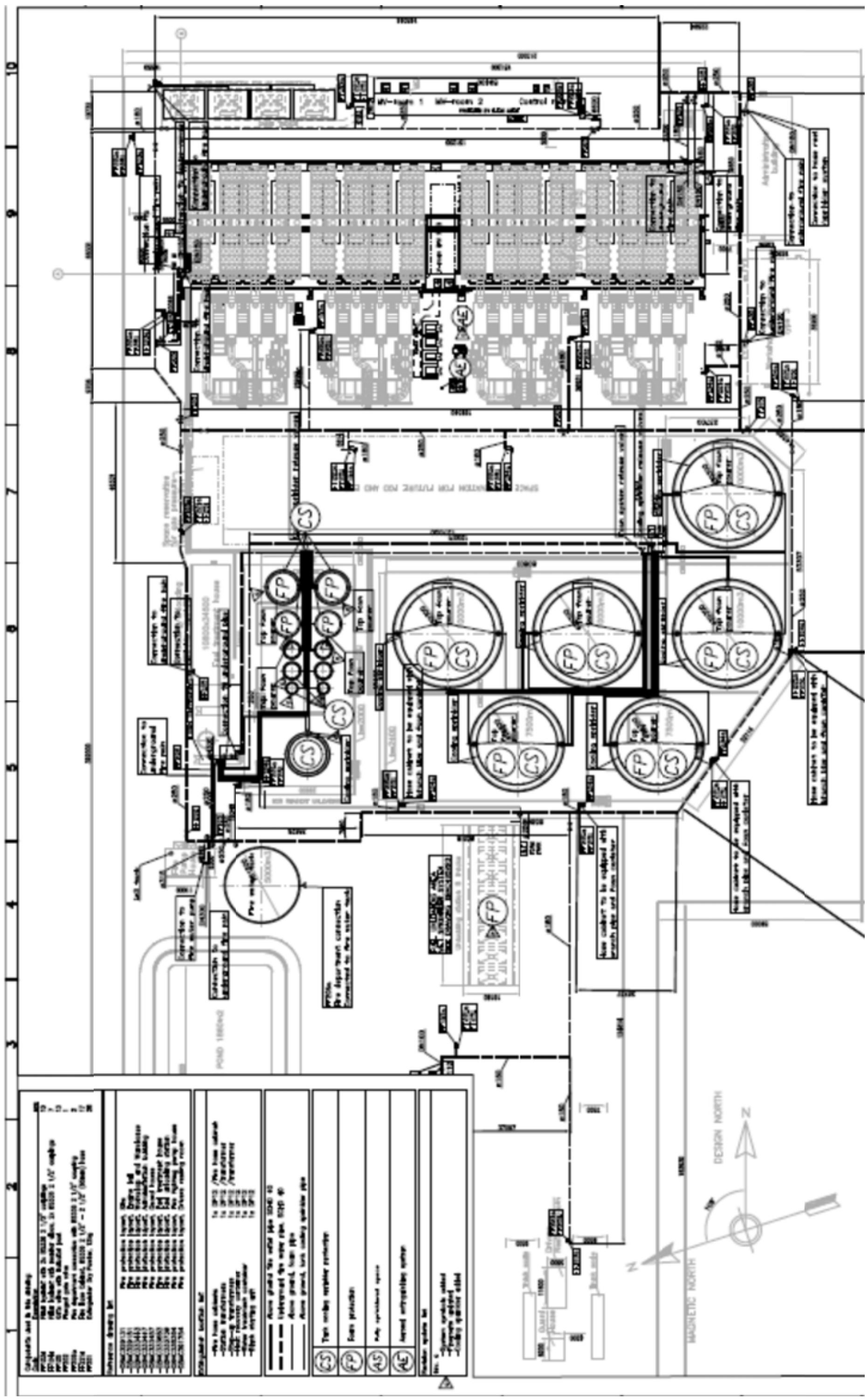
A further very prominent aspect of control of the Chemical hazards is the state of art engineering during design. The mechanical process recovery has enabled accidental spills of chemicals to be reduced to As Low As is Reasonably Practicable (ALARP) which is compliant with International Risk Management Regulations.

Spills on AES Levant Jordan are likely to be minor spill such as a drum of chemicals punctured by the forklift, therefore this procedure will address the more hazardous of the these chemicals on the Plant in this eventuality.

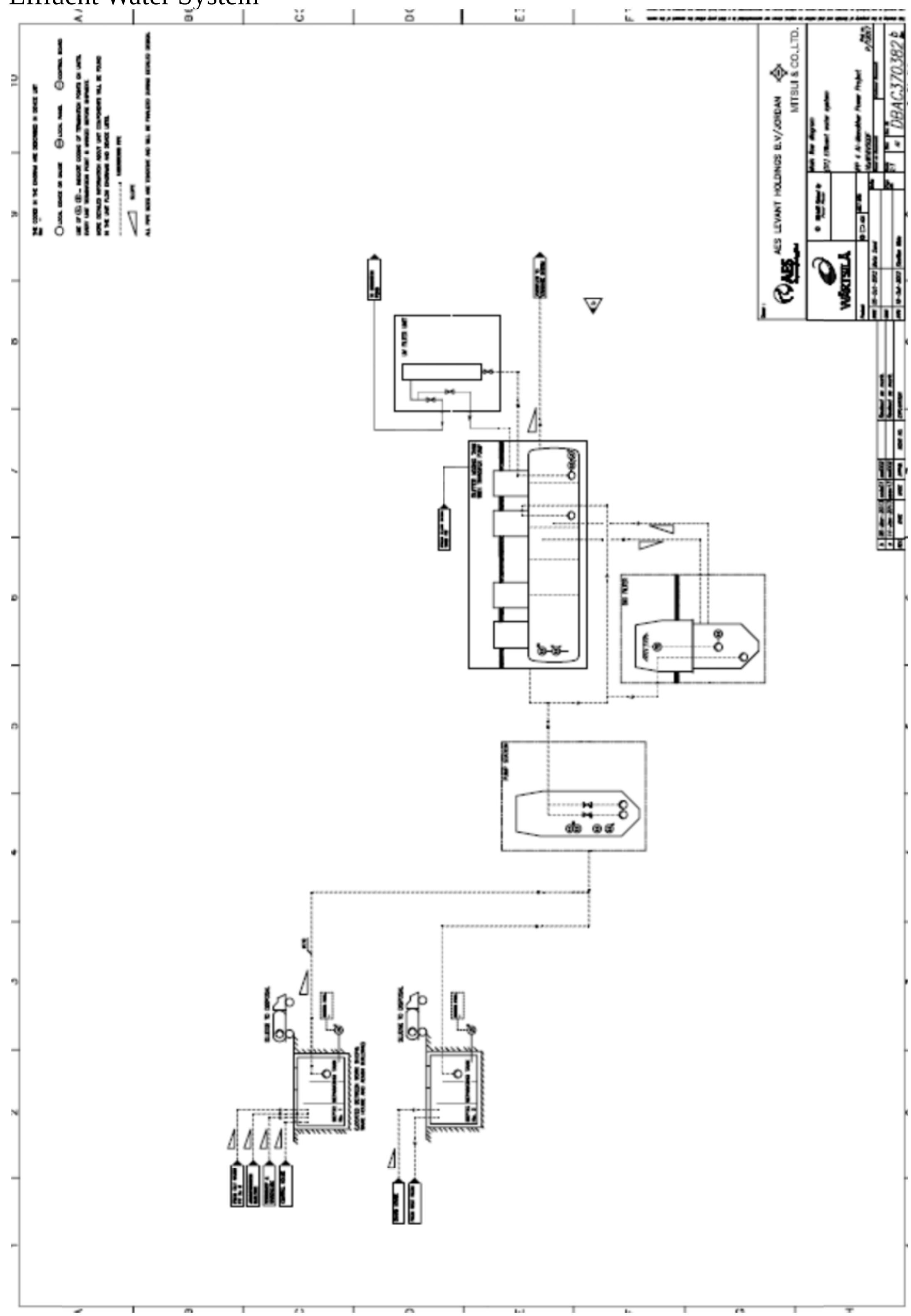
In case of spill stop leak or spill if you can do so without risk. Ventilate area.

Carefully use specified protective equipment. Contain and absorb on absorbent material. Place in waste disposal container. Flush area with water. Wet area may be slippery

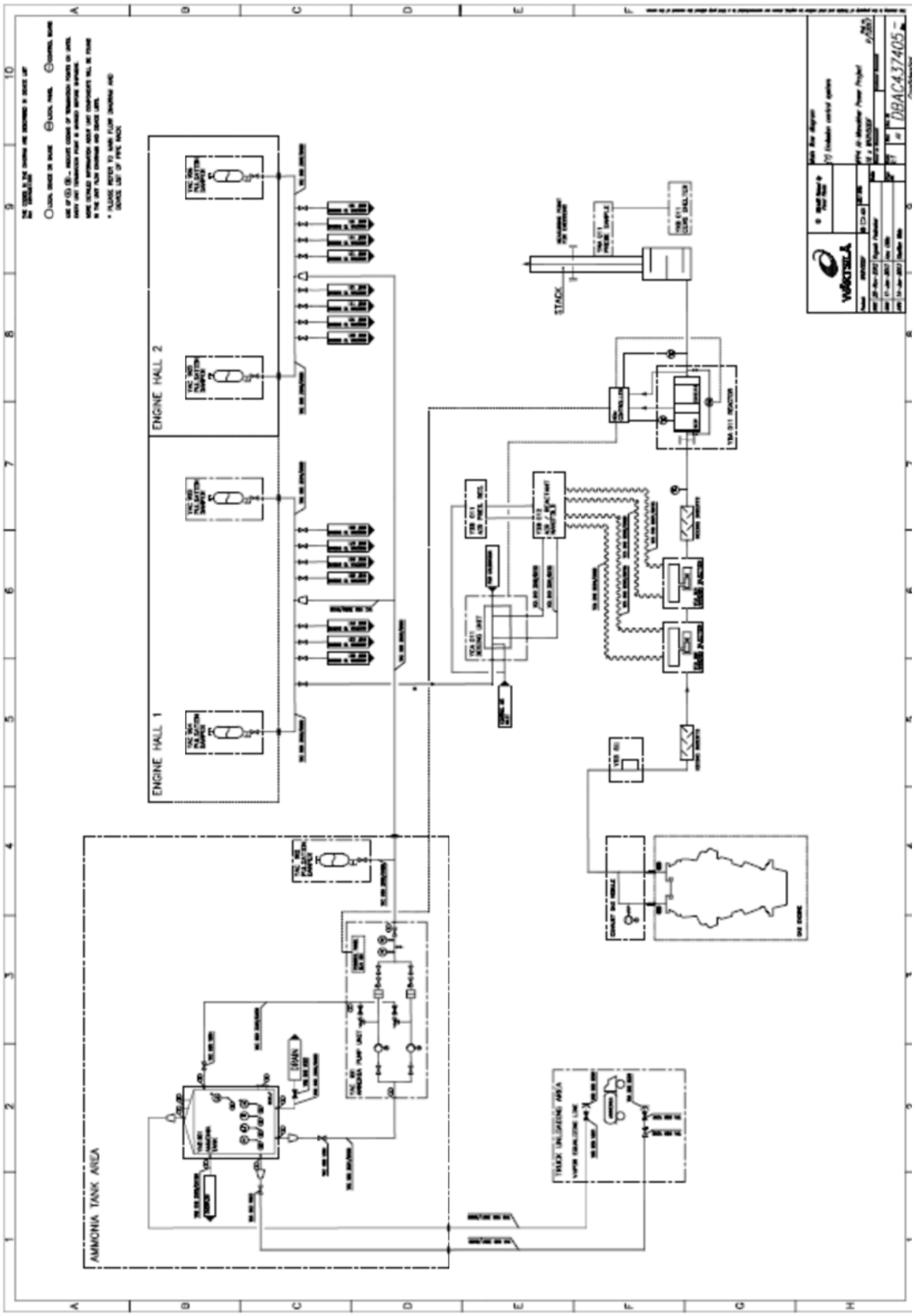
Attachment A:
Facility Diagram



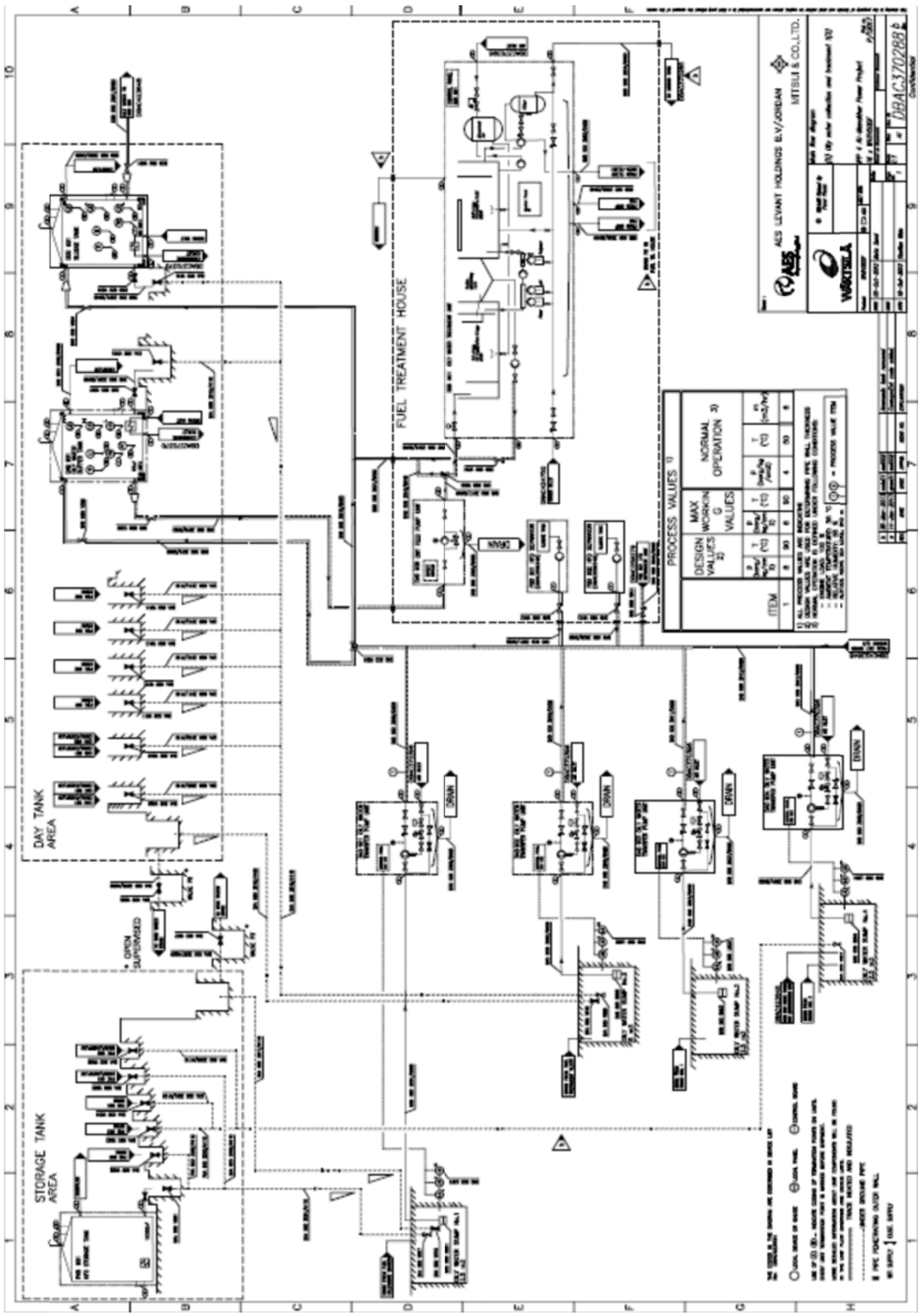
Attachment 2:
Effluent Water System



Attachment: Emission Control System



Attachment 3: Oily waste water drainage piping



Records:

Records shall be retained consistent with EMS/PRO/013.

8.0 Revision / Changes record:

Sr. No.	Revision No.	Reference No.	Details Of Change	Date	Approved By
1					
2					

AES Levant Jordan
Emergency Response Plan

Name	Date	Signature
Prepared by: Aamer Shamim HSE Manager	15-May-2014	
Reviewed by: Khaled Salameh Deputy Plant Manager	20-Jun-2014	
Approved by: Meftaur Rahman Executive Manager	25-Jun-2014	
Reviewed by: Mohammad Al Qudah	1-July-2015	
Reviewed by: Ops. Team	20.Aug.2016	
Next Review: August.2017		

Contents

1.0 AES Levant Jordan Emergency Response Policy

It is AES's Policy to:

Manage emergencies in all its activities and co-operate with external emergency services.

Response to any emergency shall focus on the following priorities:

- Preservation of life, the environment, company assets, company reputation, and assurance of business continuity
- Ensure compliance with relevant national and international laws, including third party liability and insurance.
- Maintain internal and external confidence in AES's commitment and ability to respond to emergencies and assist in the return to normal operations in the shortest possible time.

The Impact of this Policy is:

- AES shall provide appropriate organisation, facilities, procedures and competent personnel to enable immediate action to be taken to manage emergencies in its operations.
- Emergency response procedures shall satisfy the requirements of the laws of Jordan
- Systematic testing of the emergency response system shall be conducted regularly to verify effectiveness, and any identified improvements implemented promptly.
- Mutual emergency aid arrangements shall be maintained with Government and external organisations.
- Contractors shall be required to manage emergency response in line with this policy.

The Purpose of this Policy is to:

- Minimise loss through the implementation of an effective risk management and recovery process.
- Effectively manage business resumption following unplanned disruption of activities.
- Provide assurance to stakeholders of AES's commitment to manage emergencies in its operations.

2.0 Introduction

AES Levant Jordan recognises that even though every effort is made to ensure that accidents do not occur, through the implementation of the Health, Safety and Environmental Protection Policy, the potential for hazardous events still exists.
It is the responsibility of the Company to ensure that plans, procedures and resources are in place to respond swiftly and efficiently to any such emergency situation and to minimise any consequential losses. To this end an Emergency Response Preparedness Procedure Manual has been formulated.

3.0 Purpose

The purpose of this procedure is to specify the requirements for the development, review and practice of emergency preparedness plans. The procedure should be used to assist AES Levant staff in determining the minimum requirements for emergency preparedness plans that address the risk associated with operational risks, man-made emergencies off site, natural disasters and anticipated industry hazards.

This is the top level document in the hierarchy of emergency response documents. The purpose of this manual is to define the ground rules for the management of emergency response issues within the perimeter fence of AES Levant Jordan .
This procedure does not address the day to day production type of emergency, but address's the non routine aspects which will have an adverse effect upon AES's reputation and business profile.

4.0 Scope

This Procedure applies AES Levant, its affiliate companies, its employees, contractors and sub-contractors performing work for AES. This standard describes the safety management requirements for the development, review and practice of emergency preparedness plans. This standard applies to the development of emergency plans for: 1) operational emergencies, e.g. fire, explosions, threats to employees, threats of terrorism, injuries, 2) emergencies involving nature, e.g. severe weather, flooding, earthquakes, tsunamis and 3) emergencies that happen off-site that will have a significant impact to operations or staff, e.g. derailment of chlorine filled rail cars next to the AES facility, fire, explosion or chemical spill in an adjacent facility.

5.0 Definition

AES Operation - A specific business unit (Power Plant, Integrated Utility, or Transmission & Distribution business) responsible for implementing the AES Global Safety Standards.

Accident - An undesired and unplanned event that results in harm to a person, property, or the environment.

Dangerous Substances - Substances accidentally released in such a quantity as may result in serious harm to life, property, or the environment.

Emergency – For the purpose of this AES Safety Standard, emergencies will be classified into three primary categories; natural emergencies (weather, climate, seismic, wild fires, pandemics, etc.), man-made on-site/operational emergencies (explosion, chemical release, fire, etc.) and man-made off-site emergencies (train derailment, chemical release from neighboring industries, threats of terrorism, etc). All emergencies are a present or imminent event that requires prompt coordination of actions or special regulation of persons or property to protect the health, safety, or welfare of people, or to limit damage to property and the environment.

Emergency Response Plan - A written detailed program of action to minimize the effects of an emergency.

Hazard - A situation with a potential for human injury, damage to property, damage to the environment, or some combination of these.

Recovery Time - The time required to bring a situation back to a normal condition or position from that of an emergency. (Generally the objective of the Emergency Response Plan would be to provide sufficient direction to reduce the recovery time.)

Responders - Persons identified in the emergency plan as being responsible for actions that are intended to minimize the risk, loss, and damage resulting from the emergency. These persons can represent external resources (e.g., ambulance, fire, police, contractors, or industry-equivalent) or be the workers or management of AES facilities.

Risk - A measure of the probability and severity of an adverse effect to health, property, or the environment. Risk is often estimated by the mathematical expectation of the consequences of an adverse event occurring i.e. the product of “probability x consequence”.

Risk Reduction - The process of reducing risks either by decreasing the chance and/or the consequences of a hazardous event.

Emergency Operating Centre (EOC) – AES Levant Central Control Room will be the EOC in case of any emergency where the IC is located.

5.0 Guiding Principles and Cardinal Rules

- Although the primary emphasis should be on prevention rather than on reactive or emergency response measures, the level of risk in electrical utilities and the nature of human activity dictates that emergencies can and will occur. Through appropriate preparation or emergency planning, the risk, loss and damage resulting from such emergencies can be minimized.
- AES Levant shall conduct a survey of its facilities to identify those areas or operations where emergencies may occur. AES Levant must also consider the potential of off-site emergencies that may impact operations or staff, and natural emergencies. Operations must develop, communicate and practice emergency plans to respond adequately to these identified emergencies.
- Failure to comply with the provisions of this AES Safety Procedure puts AES facilities, people, contractors, suppliers, visitors and the general public at risk. It is incumbent

upon each operation manager to ensure that the provisions of this AES Safety procedure are effectively implemented within their area of responsibility.

6.0 **Critical Success Factors**

Identification of realistic emergency scenarios will be done based on Risk Assessment procedure (Refer: OSH/PRO/SAF/016: Risk Assessment Procedure).

- Regular and thorough testing of emergency response procedures.
- Appointment of emergency response and support teams, through effective and regular training and drills/exercises.
- Provision of reliable communication and logistic systems to enable the emergency response teams.
- Obtaining the support and participation from the Civil Defence Department of Amman, Jordan, contractors, other operators, local and national government

7.0 Implementation

- Emergency procedures describing all realistic emergency scenarios and detailing the planned response to each of these
- A methodology for determining which assets and activities are critical to the Company's operations and business resumption plans for these
- Normal and emergency backup telecommunications systems covering the whole of AES's operations, allowing communication under all realistically foreseeable conditions
- A programme of drills and exercises affecting all parts of the organization, providing training for personnel and identifying possible improvements to the system
- A training programme for key positions within the emergency response organization, and guidance on training and awareness requirements for the Company as a whole

8.0 Responsibilities

8.1 Plant Manager

The ultimate responsibility for emergency response within the perimeter fence of the AES Levant Jordan is vested in the Plant Manager. The Plant Manager will:-

- Ensure a sound policy is in place with respect to all emergency response matters.
- Lead by example.

When called upon by the Control Room Engineer (CRE) in the Central Control Room, the Plant Manager will be responsible for the logistical support of incident recovery. In the absence of the Plant Manager, the Incident Commander will be responsible.

8.2 Incident Assessor

One of Shift Plant Engineers or any other AES Employee can be an Incident Assessor who needs to go to the Incident location with any kind of communication media (Radio). Incident Assessor will be the person designated at the time of incident by the Incident Commander. At the incident scene he/she will assess the situation, relaying information back to the Incident Commander in Central Control Room and requesting the relevant support service or plant shut down as required.

8.3 Incident Commander (IC) (Day or nightshift)

Two Control Room Engineers (CRE's) will be on duty on any shift whether day or night shift. In the event of an incident occurring one CRE will designate himself as the Incident Commander (IC). He will inform to his Incident Assessor through radio or any kind of communication method to reach to the incident location.
The Incident Assessor will assess the situation and report back to the Incident Commander at Central Control Room with present status and any required actions or back up support teams.
It is essential that within the control room there will be a board to display at a prominent location showing the names of who will function as what within the Emergency response roles to prevent confusion.
The board will display the names of fire fighters, medic first aiders/paramedics and support team personnel
The board will indicate who will be responsible for what position on a monthly rota.

In the event of an incident occurring, the IC will sound the alarm for attention and make an announcement over the Public Addressing system. This will alert all personnel on the plant to the fact that an incident has occurred and that support teams should place themselves on stand-by and that office personnel and contractors may be required to evacuate to the nearest Assembly Point.

It is of the utmost importance that all personnel are aware that no phone calls may be made to the central control room at this stage as this will block the telephone lines and reduce the possibility of the IC performing his duties efficiently

The IC is responsible for alerting the designated Fire Fighters/ First Aiders on requirement of the Incident Assessor and for directing support personal for assistance by radio and for announcing the evacuation of non essential personnel by use of the alarm system to gain attention, supported by the public addressing system. If required

IC will be responsible for informing deputy plant manger to alert villagers and if not possible he will contact their (MOKTAR) on 0772123380, he will be also responsible for alerting AES Levant EHS manager

In the event of the incident escalating further it will be the responsibility of the Incident Commander upon confirmation from Incident Assessor to call for further assistance by either radio or phone and inform the Plant Manager of the current situation.

Once the situation has been brought under control, the IC will be responsible to sound the "all clear" alarm followed by an announcement over the PA to affirm the situation is "safe"

8.4 Log Keeper

The second CRE on shift shall designate as log keeper, who is dedicated to maintaining the emergency control room log. The log should be maintained in a specific Emergency Response Logbook and in the event of a serious incident, a flip chart which will be visible to all team members. Major decisions or confirmed events and information should be summarised on a separate board or chart.

Note: In case of One CRE in the shift he/she may take this action upon himself due to the low level of manning.

8.5 Evacuation Controllers (Head counters)

A sufficient number of trained evacuation controllers will be available for each shift. IC will designate the Evacuation Controllers to the Assembly points. During the sounding of the evacuation alarm, the evacuation controller is responsible for directing the people to evacuate the Plant and report to the nearest Assembly Point. Evacuation controllers in assembly points will conduct the head-counts and inform to CCR log keeper. Log Keeper need to cross check with the day's attendance list and in the event of people being missing, Log keeper is responsible to communicate by radio to Evacuation Controllers.

It is imperative that each AES employee shall ensure they log onto site using Finger Print sign or sign in to the site register and for contractors and visitors to sign in at Security gate.
It is also the responsibility of the AES staff to make them selves familiar with the direction of the wind by observing the windsocks on site and to be aware of the location of their designated assembly points.

8.6 First Aider/Paramedic

On all shifts there will be trained first aid/Paramedic persons. During emergencies the Incident Commander will direct the first aiders/paramedics in conjunction with the Incident Assessor to summon support teams to assist with stretcher bearing, deployment of the emergency vehicle etc.

8.7 Fire fighters

All AES personnel will be trained as fire fighters and will be available on every shift. During an emergency the first responder will assume the role of team leader upon arrival at the scene of the fire and ensure that proper fire fighting and rescue techniques are employed in the effective execution of emergency activities.

Upon the arrival of the Incident Assessor at the scene he will assess the situation and co-ordinate with the IC who will request third party assistance Civil Defence Department, Amman, Jordan

8.8 The Individual Employee

An essential element of an effective emergency response system is the individual awareness and behaviour of personnel. Each employee is responsible for observing the rules and regulations applicable to him as set out in this manual, and to seek advice from his Team Leader if in doubt.
He is responsible for being fully conversant with all procedures and practices relevant to his job.

Notification of emergencies in goes through two telephone number's which are 222 /223 and +962 790215469 or the paging system or radio's These methods of communication will connect to the Central Control Room wherever the caller may be, the CRE will then sound the alarm to alert the response team. It is of the utmost importance that all personnel are aware of this, and of the immediate actions on encountering an emergency.

Information to Third Parties

One aspect of the individual employee's responsibilities stands out: that of ensuring that no false information is released to any outside party. It is absolutely essential that information is verified as correct and suitable for release by senior personnel. To this end **all employees** are instructed to decline to respond to any queries regarding emergencies or incidents from any party other than their own line or known emergency response personnel.
Any statement to third parties shall be made only by the Executive Manager or his designate.

8.9 Administrative Assistant/Telephone Operator

This is a very important role in the emergency response organisation. During a large scale incident, the telephone operator will be under intense pressure from relatives and the media. ***The Telephone Operator when on duty should at all times relay the call to Central Control Room (CCR)***
Further information regarding the telephone response to enquiries is to be found on 6.13 of this document to enable a rapid reply by the central control room.

Important Note At all times it is the responsibility of the Plant Manager, or in his absence, the Incident Commander/ Control Room Engineer to inform our Customers or release information to Third Parties. No employee is authorised to release information to The Public, The Media (ie: Newspaper reporters) relatives or other persons that request information by any method of communication

It should be noted that Senior Management of AES Levant Jordan, recognise that, in the event of a major incident occurring within the AES Levant Jordan, , its personnel may encounter traumatic situations with the potential to have a long term emotional impact upon them. Should this situation occur arrangements are in place to obtain counselling for the employee/s.

8.10 Primary Response Team (dayshift)

The Site Emergency Response Team is tasked with managing all activities to respond to the emergency situation. Each team member shall therefore be familiar with all procedures, arrangements and contacts within their work area that may be relevant in the event of an emergency.

The primary response team member's names shall be posted on a white board in the central control room for each shift period.

ERT names shall be mention on the HSE board CCR

The Incident Commander and Log Keeper during an emergency shall maintain a log of their own actions. This is particularly important when assistance is called in from third parties so that an accurate record of commitment can be established. A detailed log of events is also important for debriefing so that procedures and systems can be analysed and improved if needed.

8.11 Primary Response Team (Nightshift & Weekends)

It is recognised that the plant is manned to a minimum during nightshift and weekends and that the night shift team will be afforded full training in emergency response capability.

However, in the event of an incident occurring during the nightshift or at weekends and escalating into a major/multiple incident further support will be needed from within AES Levant Jordan, .

8.12 Primary Support Team

All dayshift support teams will be taken from the maintenance teams and will provide 24 hour cover if needed. Their home contact numbers in the event of an emergency will be posted in the CCR. and available in Business Continuity Plan.

All Support team members shall ensure that at all times information is readily available on how to contact local contractors and service companies within their discipline who can assist with emergency response and information about manpower and equipment which these contractors can supply. This equipment may include but not be limited to;-

- Cranes for lifting
- Cutting equipment
- Extra security (in the event of unwanted media attention)
- Camp beds (in the event of a long term incident)
- Transportation (multiple injuries to Hospital)

This also applies to outside normal office hours, weekends and holidays etc.

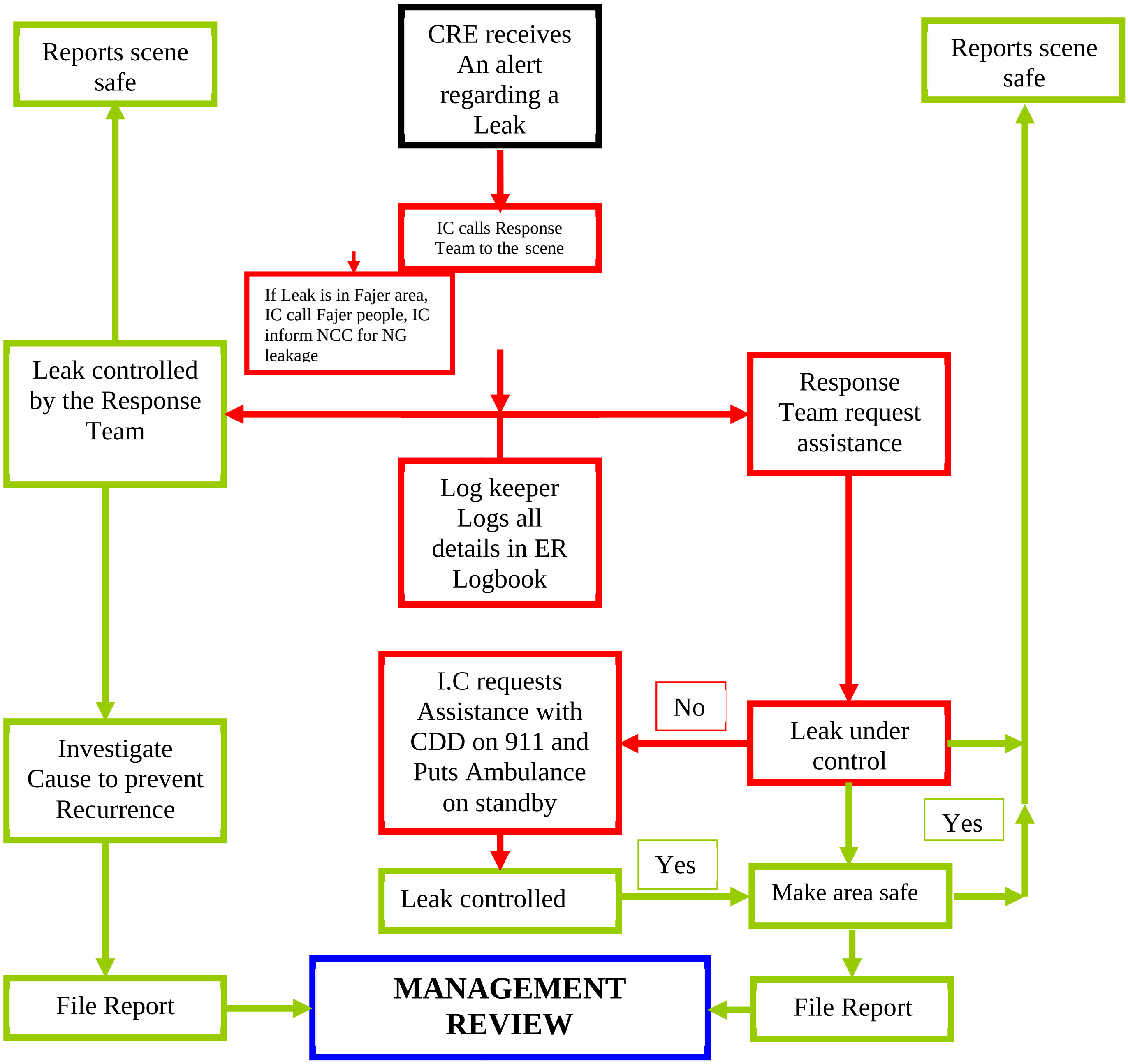
Emergency Equipments

Various equipments like SCBA, Fire alarm system, PA system, radio, Gas detection system, Fire Extinguishers, eye washers will be used to deal with emergency situation. The inspection and maintenance of the equipments will be as per Fire Protection procedure.

7.0 Natural Gas Leak

EMERGENCY No

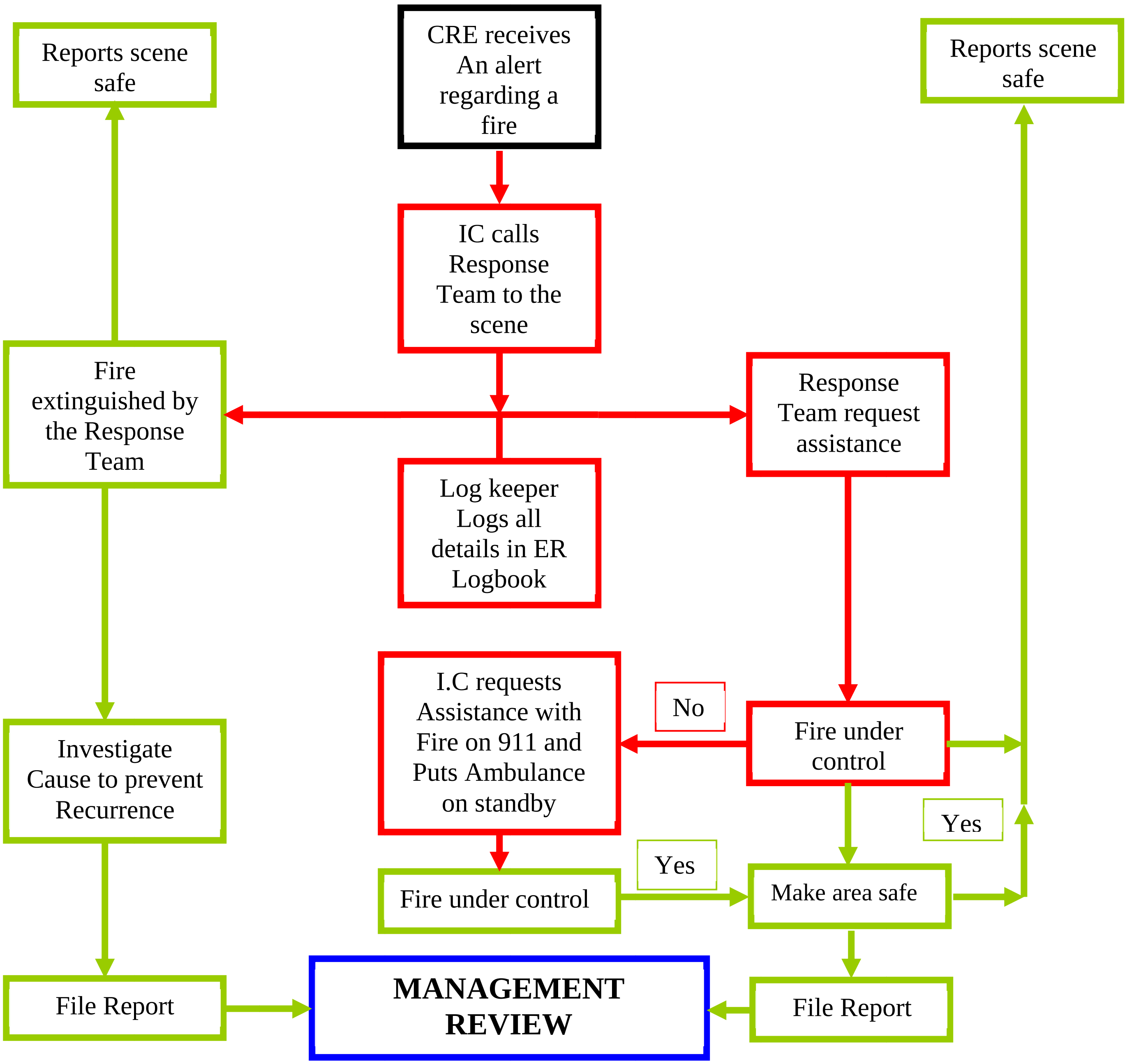
CCR 222 /223and +962 790215469
CIVIL DEFENCE **911**
ALBASHEER HOSPITAL **06 - 4775111**
AMMAN POLICE **911**



6.0 FIRE RESPONSE

EMERGENCY No

CCR 222 /223and +962 790215469
CIVIL DEFENCE **911**
ALBASHEER HOSPITAL **06 - 4775111**
AMMAN POLICE **911**



7.0 MEDICAL RESPONSE

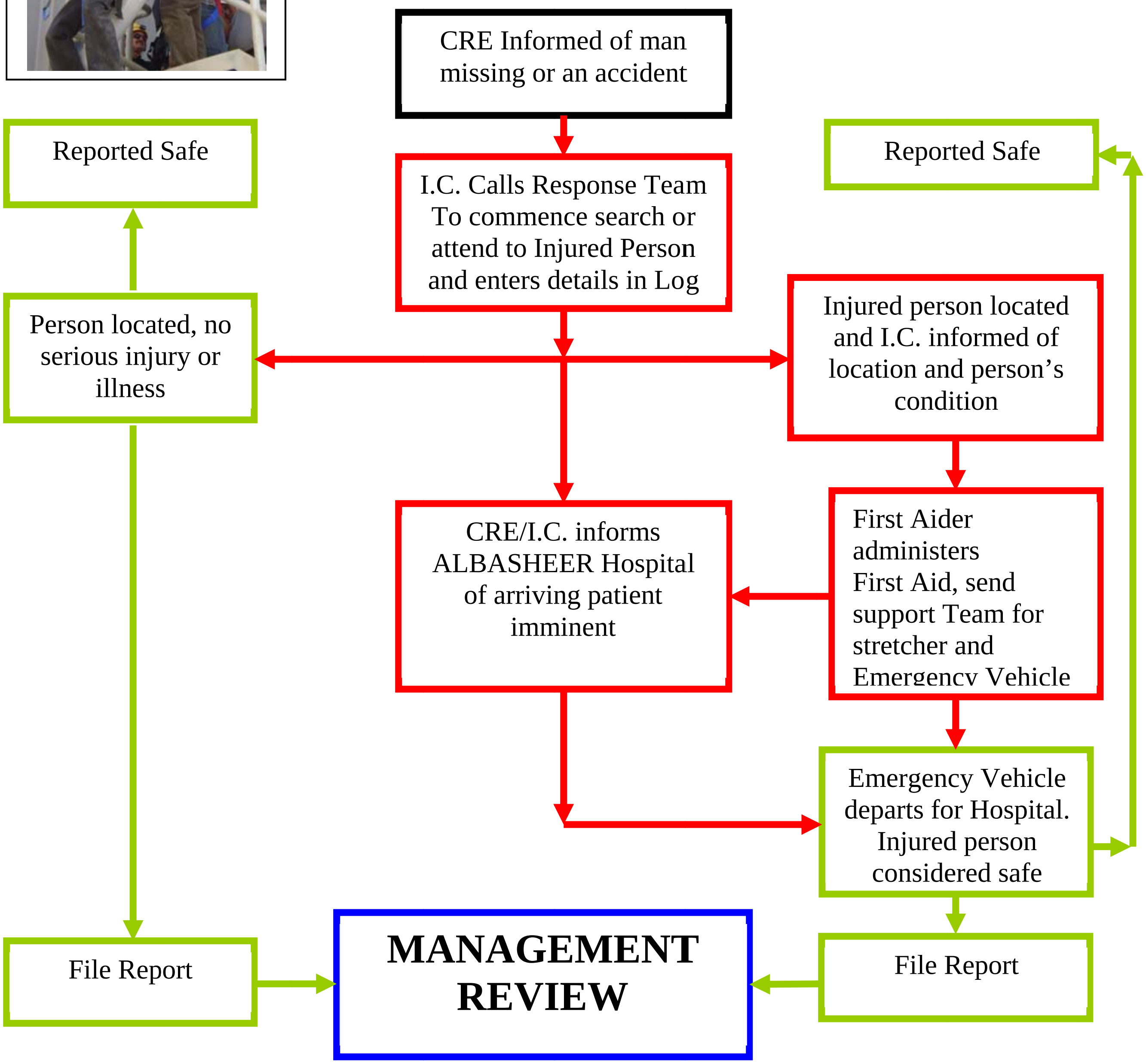
EMERGENCY No

CCR 222 /223and +962 790215469

CIVIL DEFENCE **911**

ALBASHEER HOSPITAL **06 - 4775111**

AMMAN POLICE **911**



8.0 TERRORIST THREAT

EMERGENCY NUMBERS

CCR 222/223 and +962 790215469
AMMAN POLICE: 911
BOMB SQUAD CAN BE CONTACTED BY PHONING THE AMMAN POLICE: 911

CRE/I.C. informed of suspicious Activity or strange device on site

CRE/I.C. requests all people to evacuate from the site. The only Assembly point is near the main gate (if threat is near the main gate I.C will decide where the Assembly Point is)

I.C. contacts bomb disposal Squad on the above numbers

Make area safe until Bomb Squad arrive

Bomb Squad Arrival

Bomb Squad will search for any devices and will give ALL CLEAR signal to I.C.

File Report

MANAGEMENT SECURITY REVIEW

Reported safe

9.0 CHEMICAL SPILLS

EMERGENCY No

CCR	222/223 and +962 790215469
CIVIL DEFENCE	**911**
ALBASHEER HOSPITAL	**06 - 5665131**
AMMAN POLICE	**911**

Chemical Spills on the AES Levant Jordan are not considered to be a major threat due to good segregation of all chemicals, all stored to the guidelines of the information depicted on the Material Safety Data Sheets (MSDS).

A further very prominent aspect of control of the Chemical hazards is the state of art engineering during design. The mechanical process recovery has enabled accidental spills of chemicals to be reduced to As Low As is Reasonably Practicable (ALARP) which is compliant with International Risk Management Regulations.

Spills on AES Levant Jordan are likely to be minor spill such as a drum of chemicals punctured by the forklift, therefore this procedure will address the more hazardous of the these chemicals on the Plant in this eventuality.

For all spills stop leak or spill if you can do so without risk. Ventilate area. Carefully use specified protective equipment. Contain and absorb on absorbent material. Place in waste disposal container. Flush area with water

11.0 Natural Disaster (Earthquake):

11.1 evacuate to an open area
11.2 the use of elevator is not allowed
11.3 evacuation should be in a calm way , people should not get panic

12.0 Telephone Response to Enquiries

The IC/Log Keeper should respond to enquiries regarding an incident in the following manner, dependant upon the current situation;-

- We have no knowledge of an incident within our operations, however, should we be informed of such an occurrence, may I have your name and phone number and we will get back to you.

- We are aware of a minor incident having occurred, but details have yet to be confirmed. May I have your name and phone number and we will get back to you when we have more information.

- We have reports of an incident. However, we have a highly trained emergency response team on location at this moment in time assessing the situation. May I have your name and phone number, and we will get back to you when we have confirmed information.

13.0 **Training:** AES employees identified in the emergency plans shall be thoroughly familiar with the emergency plans and specific response procedures and equipment. Personnel included in the emergency plans shall be trained in their respective roles identified in the plans.

Training and retraining in First Aid, CPR, use of AED must be provided to appropriate staff and rescue personnel.

The AES Levant shall certify in writing that employee training has been completed and is being kept up to date. The certification shall contain each employee's name and dates of training.

14.0 Testing the Plans AES Levant shall test the emergency plans to ensure it is current, comprehensive and effective at least annually. Exercises should be used to test the plans and selected to:

a. achieve the purpose of the emergency plan;
b. reinforce previous training;
c. ensures simplicity of operation;
d. provide the maximum lessons to be learned; and
e. be cost effective

1. **Distribution of the Emergency Plans** – Copies of the emergency plan shall be accessible to all employees, departments or agencies having responsibilities in the plan. A formal record of distribution and amendments shall be kept.

2. **Updating** – Emergency plans should be kept current by establishing a regular review period (at least annually). Plan holders should be notified immediately of any key changes to the plan

3. **Auditing:** Emergency Preparedness will be audited annually. The AES Levant should conduct reviews of after testing the plans to assess the effectiveness of the plans.

References:

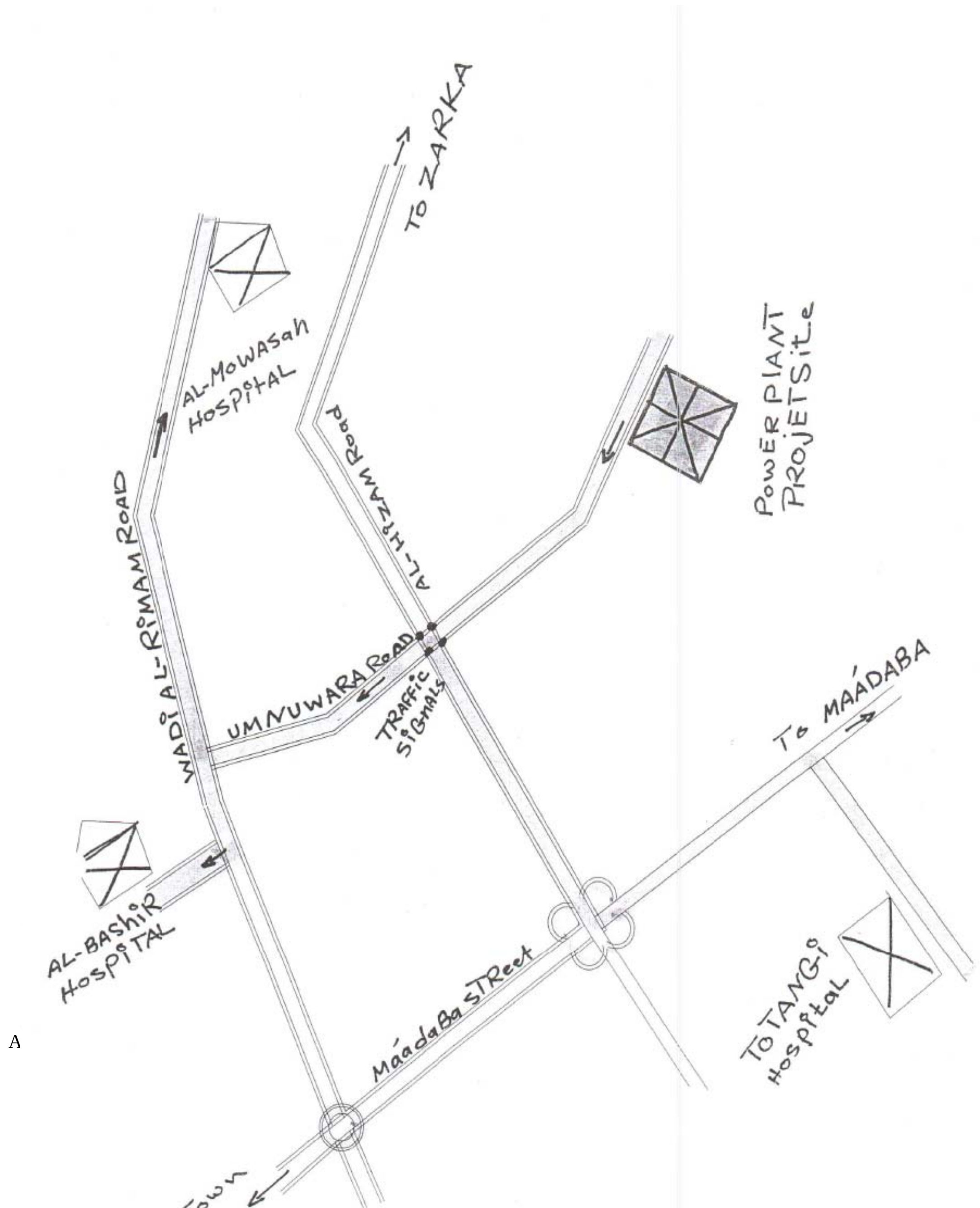
This AES Safety Standard was developed using the following publications as the source of the requirements contained herein:

1. Occupational Safety and Health Administration (OSHA) 29 CFR 1910.38 paragraph (a) through (f) Emergency Action Plans.
2. Canadian Standards Association (CSA) Standard CAN/CSA-Z731-95, Emergency Planning for Industry.
3. Commission of European Communities, Emergency Planning for Industrial Hazards.

Other Resources:
The follow resources will provide guidance in the development of your facility specific Emergency Preparedness plans:

1. NFPA 1600 – Standard on Disaster/Emergency Management and Business Continuity Program, 2004 Edition
2. FEMA 141 – Emergency Management Guide for Business and Industry
3. FEMA 452 Risk Assessment – A How-To Guide to Mitigate Potential Terrorist Attacks Against Buildings.
4. FEMA – Multi Hazard Identification and Risk Assessment, 1997
5. FEMA – Risk Assessment Approaches

http://www.fema.gov/business/guide/index.shtm


TO ZARKA
AL-MOWASAH HOSPITAL
WADI AL-RIMAM ROAD
AL-HIZAM Road
POWER PLANT PROJET SITE
UMNUWARA ROAD
TRAFFIC SIGNALS
To MAÁDABA
AL-BASHIR HOSPITAL
MáadaBa STReet
TOTANGI Hospital
A

15.0 Fire System Testing and Preventive Maintenance Plan:

Item	Activity	Responsible	Frequency	Reference NFPA 25
Sprinklers	1. Inspection for corrosion, paint, physical damage 2. Replace faulty one.	Maintenance	Annually	2-2.1.1
	1. Nozzle discharge pattern and direction. 2. Automatic & Manual system test. 3. Record the response Time.	ERT, Operation	Annually	7-3.1.3 7-4.3 7-4.3.1
Alarm Devices	Inspection for physical damage and calibration.	I&E	Annually	2-3.3
	1. Testing the water flow alarms 2. Pressure switches signals	I&E, ERT, Operation	Quarterly	2-3.3
Gauges	1. Calibration	I&E	5 yearly or when required	9-2.8.2
Strainers, Filters	Inspection & Cleaning	Maintenance	Annually	4-4.2
Monitor Nozzles	Lubrication	Maintenance	Annually	4-4.4
	Test	ERT, Operation	Monthly	4-3.2
Fire Hoses	Test	ERT, Operation	Monthly	4-2.2.7 NFPA 1962
Hydrants	Test	ERT, Operation	Annually	4-3.2
	Lubrication	Maintenance	Annually	4-4.3.1
Fire Pump	Auto Cut In Test for 30 minutes.	Operation	Weekly	5-3.2.2
	Preventive Maintenance	Maintenance		5-3.2.2
	Performance Test	Maintenance	Annually	
Foam System	1. Foam Sample 2. Foam Concentration Testing 3. System Testing 4. Manual Actuation devices Test	ERT, Operation	Annually Annually Quarterly Annually	8-2.12 8-3.6 8-3.3 8-3.5

Item	Activity	Responsible	Frequency	Reference NFPA 25
Deluge Valves	Full Flow Test	ERT, Operation	Annually but not exceed from 3 years.	9-4.3.2.2
	Preventive Maintenance	Maintenance	Annually	9-4.3.3.2
Foam Chambers at Fuel oil Tanks	Cleaning	Maintenance	Annually	NFPA 25
Valves	Lubrication of outside screw and Yoke.	Maintenance	Annually	9-3.5
Check Valves	Internal Inspection	Maintenance	5 yearly	9-4.2
Heat & Smoke detectors	Preventive Maintenance	I&E	Annually	NFPA
CO_2 cylinders for CCR	Weight & Inspection	ERT, Operations	Monthly	NFPA 1962
Fire Protection System Log	Readings as per standard	Operation	Quarterly	NFPA1962
Pull Stations	Preventive Maintenance	I&E	Annually	NFPA

16.0 Revision / Changes record

Sr. No.	Revision No.	Reference No.	Details Of Change	Date	Approved By
1					
2					
3					

Appendix E

GEOTECHNICAL REPORT

APPENDIX E-1

GEOTECHNICAL REPORT

Report for
Geotechnical Investigation for
Al-Manakher Solar Power Plant
SAHAB- Jordan

Amman - Jordan
July - 2016

Date: July, *10*[h]*, 2016*

Messer: ***WARTSILA***

Report for
Geotechnical Investigation for
Al-Manakher Solar Power Plant
SAHAB- JORDAN

Dear Sirs,

We are pleased to submit to you herewith this final report for the geotechnical investigation for the above-mentioned site of the proposed project at SAHAB - Jordan area. These investigations were conducted in accordance with your order No.S4503454786 dated June, 07, 2016.

We appreciate this opportunity to carry out this study assuring you our best services.

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APPENDIX D

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APPENDIX F

APPENDIX G

1. INTRODUCTION

This investigation was carried out according to the scientific theories and practical experiences in soil mechanics, foundation and engineering geology, which considered essential background for safe and economic foundation design.

1.1 Purpose of Study

The main purpose of this study is to determine the subsurface conditions at the project area, physical, mechanical and chemical properties of the encountered materials.

1.2 Scope of Work

This study was carried out according to the following sequential manner:

1. Studying all available maps and information concerning the site area.
2. Conducting site visits to collect information regarding the geology of the site area, present land use and surface drainage.
3. Drilling of the boreholes in accordance with your requirements.
4. Carrying out standard penetration tests at 1.5 m interval.
5. Collecting disturbed samples and taking rock core samples from boreholes.
6. Performing laboratory tests in drilled boreholes
7. Analysis of the field and laboratory tests results.

1.3 Project Data

Client:	***WARTSILA***
Project Name:	***Al-Manakher Solar Power Plant***
Geotechnical Consultant :	***SOUTHERN ENGINEERING LABORATORIES***

2. PROJECT DESCRIPTION

The project comprise installation of solar panels at area of 15000 m^2

3. GENERAL SITE DESCRIPTION

The investigated site lies at Sahab– Amman area. The surface of the site is covered by silty clay, compacted fill and rock material .

3.1 Existing Structures

The site is boarded by unutilized lands from all sides.

3.2 Site Topography

The site has an approximate elevation of 880 m above sea level. Site is generally sloping towards the east with some variations in elevation.

3.3 Public Service

No public services were provided for the area.

3.4 Land Uses

No current uses of the site area. However, compacted fill materials were spread at some locations of the site

A general site plan, Appendix A shows the site location and the locations of the boreholes.

4. GENERAL GEOLOGY

4.1 Pleistocene Sediments

The investigated sits area is covered with wadi sediment soil (Pleistocene) . The formation of this soil, most probably, is quaternary. It is derived from carbonate rocks by processes of in-situ weathering and erosion include alluvial deposit of ephemeral wadies and associated flood plains. They consist of different fancies of moderate to unsorted , sandy silty clay matrix , gravel and cobbles of limestone and chert. They are sub rounded to sub angular and vary in composition depending on the local bed rocks.

4.2 Amman Silicified Limestone Formation (ASL) (B2)

This formation outcrops at different locations of the pipeline corridor. The period of this formation is Upper Cretaceous - Campanian (Belqa Group).

This formation consists of grey and brown thin to medium bedded chert, silicified limestone, interbedded with limestone , dolomatic limestone , marl and phosphate. The formation was deposited in a shallow marine environment.

5. FIELD INVESTIGATION

5.1 Mobilization

One drilling rig was mobilized to the site on June, 20, 2016. The rig was mobilized to the site with necessary equipments and tools to perform the required drilling works and field testing in accordance with specifications.

5.2 Drilling of Boreholes

The drilling program consists of drilling (13) boreholes. The depths of boreholes are 5.0 m below the existing ground surface.

The boreholes were drilled with truck mounted rotary drilling rigs using compressed air flush. Locations of the drilled boreholes are presented in general site plan attached in (Appendix A).

The number, Coordinates, elevation and depths of each drilled borehole are summarized in (Table 1).

Table 1: Number, Coordinates, Elevation and Depth of Boreholes.

BH No.	**Coordinates**		**Elevation**	**Depth (m)**
BH1	**31° 54.670' N**	**36° 6.009' E**	+810	5.0
BH2	**31° 54.670' N**	**36° 6.132' E**	+816	5.0
BH3	**31° 54.670' N**	**36° 6.267' E**	+812	5.0
BH4	**31° 54.569' N**	**36° 6.009' E**	+816	5.0
BH5	**31° 54.569' N**	**36° 6.132' E**	+822	5.0
BH6	**31° 54.569' N**	**36° 6.267' E**	+814	5.0
BH7	**31° 54.460' N**	**36° 6.009' E**	+816	5.0
BH8	**31° 54.460' N**	**36° 6.132' E**	+823	5.0
BH9	**31° 54.460' N**	**36° 6.267' E**	+815	5.0
BH10	**31° 54.372' N**	**36° 6.009' E**	+814	5.0
BH11	**31° 54.372' N**	**36° 6.267' E**	+817	5.0
BH12	**31° 54.328' N**	**36° 6.132' E**	+826	5.0
BH13	**31° 54.284' N**	**36° 6.009' E**	+811	5.0
Total			65.0	

Description of soils (Visual Manual Procedures) was carried out on the field by our geotechnical engineer in accordance with the local codes, ASTM D 5434.

The daily log of boring contain drilling date, boreholes number, location and final depth were shown together with the identification of the different layers encountered, field tests, drilling equipment, boring method and any other pertinent date.
Final boring log give a detailed description of the various soil strata and include group symbol based on “Classification of Soils for Engineering Purposes” ASTM D 5434, indication of samples tested elevations of water table position.

Geological descriptions were carried out using” Winlog” software. The detailed geological descriptions for borehole drilled are presented in the log of boreholes in (Appendix B).

5.3 *Sampling from Boreholes*

It is our knowledge that sampling of disturbed and undisturbed and core rock samples depends on the geology and the nature of the subsurface materials encountered during drilling.

Disturbed samples were obtained using Tricon roller bits and down the hole hammer at intervals where the cohesion less and mixed nature of materials did not allow for coring.

Rock Core drilling was carried out by the hydraulic driven rotary method utilizing double-tube swivel head type core barrel with inner diameter of 73 mm and PDC drilling bits using air flush.

Core samples were collected and transported and delivered to our laboratories for testing. All samples described briefly at the site, collected in waterproof plastic bags, marked, placed in wooden boxes, transported and delivered to our laboratories for testing.
Detailed litho logical descriptions of the subsurface materials encountered in each borehole and methods of sampling are presented on the logs of borings (Appendix B).

5.4 *Field Testing*

5.4.1 *Standard Penetration Test (SPT)*

N-value is defined as the number of blows required to drive a standard split spoon sampler through the second and third 15cm interval during a Standard Penetration Test (SPT). If rock samples are taken in this manner, it is probably safe to say that the sampled material is a soft rock. Partly depending on the degree of weathering, it is possible that rock can be sampled by SPT within the transition zone, particularly with argillaceous, evaporitic or poorly cemented rocks. Spoon refusal from SPT sampling, which is typically 100 blows/300mm, is often interpreted as bedrock. This can be a useful tool, but only if the subsurface geology of the area is well known. Otherwise, defining bedrock in this manner can be risky. A soil with a large percentage of boulders cannot be sampled effectively by SPT. It may be possible to take SPT samples in the poorly cemented layers and then core through a more cemented layer.

Standard Penetration Tests (S.P.T) using 2-in.split barrel sampler was performed at each 1.5 m depths in the drilled boreholes. (S.P.T) tests were carried out in accordance with the test procedure of ASTM D 1586-67 using a 140- lb (63.5 kg). Hammer weight. Penetration resistances for the split-barrel sampler are recorded in the “Blows per 30 cm column on the boring logs. Cone attachment was also used.

The SPT field tests are usually gives an overestimate of relative density. The obtained N-value

$$N60 = (N\ measured * \eta H * \eta B * \eta S * \eta R)/0.60$$

Where:

N60: Standard Penetration Number corrected for field condition.
Nmeasured: Measured Penetration Number.
ηH: Hammer Efficiency (%).
ηB: Correction for Borehole Diameter.
ηS: Sampler Correction.
ηR: Correction for Rod Depth.

SPT Correction

BH No.	Material Type	Depth (m)	SPT N-Value	corrected N60
BH1	Marl	1.5	25	23
	Marl	3.5	40	38
BH2	Mixture	1.5	50	47
	Mixture	3.5	50	47
BH3	Marl	1.5	42	39
	Marl	3.5	43	40
BH4	Mixture	1.5	50	47
	Marl	3.5	42	39
BH5	Marl	1.5	35	33
	Limestone	3.5	50	47
BH6	Mixture	0.5	50	47
	Marl	3.5	39	37
BH7	Marl	1.5	40	38
	Marl	3.5	35	33
BH8	Marl	1.5	35	33
	Marl	3.5	38	36
BH9	Marl	2.5	35	33
	Marl	4.5	38	36
BH10	Limestone	1.5	50	47
	Limestone	3.5	50	47
BH11	Mixture	0.5	50	47
	Limestone	1.5	50	47
BH12	Marl	2	40	38
	Limestone	3.5	50	47
BH13	Marl	2.5	40	38
	Limestone	3.5	50	47

5.4.2 Constant Head Permeability

A constant head test is normally conducted as an inflow test in which arrangements are made for water to flow into the ground under a sensibly constant head. It is essential to use clean water. It will not be possible to achieve a constant head if the ground water level is not constant or the head lost by friction in the pipes is significant. Where a high flow rate is anticipated and where the installation comprises a piezometer tip surrounded by a filter material, two standpipes should be installed, one to supply the water and the other to measure the head in the filter material surrounding the piezometer tip. The rate of flow of water is adjusted until a constant head is achieved and, in the simplest form of test, flow is allowed to continue until a steady rate of flow is achieved. In some ground, this may take a long period of time, and, in such cases the method suggested by Gibson] may be used, in which the actual rate of flow is measured and recorded at intervals from the commence ment of the test

.

Formulae for borehole permeability testes:

$$K = \frac{Q}{F*H_C} .$$

q; is the rate of flow

F: is intake factory

Hc: the constant head

Summary of the results of the water pressure tests in the various boreholes are presented in (Table 2).

Table 2: Summery of Permeability K from Constant Head Tests

Borehole No.	***Depth of test***	***Permeability K (m/sec)***
BH3	1.5	4.801E-04
BH9	1.5	5.655E-04
BH 13	0.25	2.223E-03
BH1	0.50	1.245E-06
BH11	1.25	1.672E-06

The worksheets of constant head permeability tests results are presented in (Appendix C)

6. LABORATORY TESTING

The proposed laboratory testing program was designed to evaluate the pertinent physical, chemical and mechanical properties of the soil and rock units encountered at the site. The following tests were performed according to ASTM and BS:

Type of Test	Standard
- Moisture content	ASTM D2216
- Sieve Analysis (Hydrometer Test)	ASTM 421 & 422
- Liquid Limits, Plastic Limits and Plasticity Index of Soil	ASTM D 4318
- Unconfined Compressive Strength of Soils	ASTM D 2166
- Unconfined compressive strength of rock	ASTM C 170
- Sulphate content	BS 1377, Test 9
- Chloride content	BS 1377
- Collapse Potential	ASTM D 5333

The results of the above tests are summarized in (Table 3).
The results of the Collapse Potential in (Appendix D).
The results of the chemical tests are summarized in (Table 4)

Table 3: Laboratory Test Results of soil sample taken from boreholes

BH No.	*Depth m*	*Bulk Density gm/cm^3*	*Moisture Content %*	*Atterberg Limits*			*Sieve Analysis ,%*			*Axial Pressure*	
				LL	*PL*	*PI*	*sand*	*silt*	*Clay*	*Stress kg/cm^2*	*Strain %*
1	0.50		10.0								
	0.75	1.82	7.5	38.0	22.0	16.0	17.4	50.3	37.3	2.21	2.34
	2.5		5.8								
	3.0	1.933	5.5	35.9	23.8	12.1				2.62	2.81
	4.0	1.924	5.0							2.12	2.23
2	0.5		6.8								
	1.0		4.7								
	2.5		3.5	35.5	23.0	12.5	26.7	44.2	29.1		
	4.5		2.1								
3	0.50		11.5								
	1.4	1.931	8.1							2.35	2.55
	2.5		7.5	35.5	23.0	12.5	--	--	--		
	4.5		2.5								

4	0.5		10.6	34.8	23.6	11.2	25.8	42.5	31.7		
	1.0		7.5								
	3.6	1.934	3.5							2.27	2.48
	4.0		2.0								
5	1.0		10.3								
	2.0	1.905	10.0	36.2	23.3	12.9				2.04	2.49
	3.5	2.13	9.6							82.0	--
	4.0		9.5								
6	0.50		10.1	36.7	22.9	13.8	24.3	41.7	34.0		
	2.5	2.132	3.0							92	--
	3.5	2.209	2.9							120.4	
	4.0		1.9								
7	0.5		7.7								
	1.0		7.5								
	3.5	1.886	6.3							2.08	2.31
	4.5		2.1								
8	1.6	1.822	8.6	35.0	23.0	12.0				2.21	2.34
	2.5		5.7								
	4.0		4.5								
9	0.50	2.35	3.6							106.7	--
	1.5		3.5								
	3.0		3.5	36.0	22.0	14.0					
	4.5		2.0								
10	0.5		3.5								
	1.8	2.243	5.5							86.9	
	3.0	2.221	3.5							97.7	--
	4.0		2.5								
11	0.50		8.5	34.0	23.0	11.0	26.7	42.5	30.8		
	2.0		5.5								
	2.5		3.5								
	4.0	2.265	2.5							85.9	---
12	1.0		11.0								
	2.0	1.83	5.5	41.0	26.0	15.0				2.11	2.23
	3.5		3.5								
	4.0	2.033	2.5							77.8	--
13	1.0		8.4								
	2.4	1.906	5.0							2.6	2.76
	3.6	2.268	3.4							84.7	
	4.0		2.5								

Table 4: Chemical Test Results.

BH No.	Materials Type	Depths , (m)	SO_3, %	Cl^-, %
BH1	Silty Clay	0.5-1.00	0.002	0.001
BH2	Mixture	2.0-2.5	Nill	Nill
BH5	Marl	1.5-2.0	Nill	Nill
BH13	Limestone	3.0-4.0	Nill	Nill

7. ENGINEERING ANALYSIS

7.1 Site Geology

The types of materials encountered in the drilled boreholes comply with the general geology of the site area.

The visual litho logical description of the materials encountered in the drilled boreholes disclosed general similarities.

For more details, reference should be made to the individual logs of borings documented and presented in (Appendix B).

The encountered subsurface materials consist of the following materials starting from the existing ground surface: -

1. Brown,moist stiff to very stiff **silty clay** mixed with (20-30%) gravels of chert .
2. **Mixture** materials composed of brown silty clay with approximately 50% gravel and cobbles of chert and limestone .
3. Creamy very weak **marl** with some nodules of chert .
4. white, moderately weak , fractured limestone with marl filling the fractures and with some nodules of chert.
5. White ,thinly to thickly bedded moderately weak limestone interbedded with strong chert .

7.2 Materials properties

Physical properties of the materials encountered were obtained from the field and laboratory testing program.

7.2.1 Materials *Physical Properties*

The MOISTURE CONTENT shows the relative variation of capacity of different soils to store water. These moisture values are unique to the time of sampling and significant differences are to be expected at other times.

The PLASTICITY of the encountered materials was determined by direct plotting of liquid limits against plasticity indexes on Casagrande Plasticity Chart.

The BULK DENSITY was determined by direct measurements of size and weight of the obtained undisturbed samples.

The results of the PARTICLE SIZE distribution tests of the silty clay material show the relative proportions of the sand, silt and clay fractions in the soil mass. The percentages of these fractions had been plotted on the Textural Classification Chart for determination the TEXTURAL CLASSIFICATION of the soil.

The POTENTIAL FOR EXPANSIVENESS of the silty clay soil was found by plotting the plasticity indexes against the corresponding clay fractions on the WILLIAMS and DONALDSONS, Modified Chart for Expansiveness.

The physical properties of the encountered materials are summarized in (Table 4).

Table 5 Materials Physical Properties

No.	*Type of Materials*	*Moisture*	*Bulk Density gm/cm^3*	*Plasticity*	*Expansiveness*	*Chemical SO_3 & CL*
1.	Silty clay	Moist	1.82	Medium	Low	Not aggressive
2.	Mixture	Moist	--	Low to Medium	--	Not aggressive
3.	Marl	moist	1.82-1.937	low	--	Not aggressive
4.	Limestone	Dry	2.13-2.35	--	--	Not aggressive

**According to BS CP 110, Part 1

7.2.2 *Materials Mechanical Properties*

The MODULUS OF DEFORMATION of the encountered Silty clay and mixture are estimated using typical values and SPT-N correlation listed in (Table C10.4.6.3-1 of the 2010 AASHTO) was determined based on SPT results as follows:

$$E = 0.097*6895*N \text{ (KPa)}$$

E : The modulus of deformation (KPa)
N – Number of blows from SPT results.

STRENGTH of the marl materials was determined using values of the unconfined compression tests results and referring to the Jordanian Code of Practice III, (Table 19).

The smallest MODULUS OF DEFORMATION for the marl was obtained from the stress-strain relationship of unconfined compression tests.

Due to the small site area the ROCK MASS RATING (RMR) for the limestone materials was determined by Bieniawski Method based on the drilling results, unconfined test results and ROCK QUALITY DESIGNATION (R.Q.D.) only.

The MODULUS OF DEFORMATION of limestone material was determined by Bieniawski as follows for RMR < 50:-

$$Em = 10^{(RMR - 10)/40}, \text{ GPa}$$

The mechanical properties of foundation ground material encountered are summarized on (Table 5).

Table 6: Materials Mechanical Properties

No.	*Type of Materials*	*Strength*	*Modulus of Deformation* kg/cm^2	*Poison Ratio*	*Cohesion Kg/cm^2*	*Ø°*	*Collapse potential*
1.	Silty clay	Stiff to very stiff	180	0.35	0.5	15°	*(slightly collapse)*
2.	Mixture	Very Dense	500	0.30	0.0	30°	--
3.	Marl	Very weak	230	0.30	0.5	15°	--
4.	limestone	Moderately weak	10000	0.25	1.0	25°	--

7.3 Backfilling of Boreholes

All boreholes drilled were backfilled by earth materials.

7.4 Ground Water

No free or confined ground water was encountered in any of the drilled boreholes to depths drilled.

7.5 Geological Features and Cavities

No cavities or caves were encountered in the drilled boreholes. Generally the area is mostly stable.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

The following conclusions and recommendations are based on the results of the engineering analysis of the field and laboratory investigations and the nature of the proposed structures. If the nature of the proposed solar power plant will be adjusted or deviated, these recommendations consequently may need adjustment. Therefore, we should be informed at once so that we can reconsider our recommendations where necessary.

8.2 Foundation Ground and Depth

According to the requirements of the design, it is recommended to rest the posts and other structures into the **silty clay, mixture, marl or limestone,** which were encountered in all boreholes at the existing ground surface.

The foundations of buildings, if any, should be placed at a minimum depth of 1.50m below the finished level of the ground surrounding each structure, and should be penetrated to a minimum depth of 1.0m within the recommended foundation ground.
In case that steel posts will be installed then the required technique for installation can be summarized in the table below.

Into silty caly	Ramming
Mixture material	Pre-drilling is required
Marl	Ramming
Limestone	Pre-drilling is required

8.3 Allowable Bearing Pressure :

- The allowable bearing capacity for the **silty clay** materials is determined using Terzaghi equation considering a factor of safety of 3.

  The ultimate bearing capacity was found by Terzaghi Buisman and given as:

$$q\ (ult) = \{ [C * N_C] + [\gamma_o * D * Nq] + [0.5 * \gamma_1 * B * N_\gamma] \} / F.S$$

q (ult) = Gross ultimate bearing pressure,
γ_o = Unit weight of soil above foundation level,
γ_1 = Unit weight of soil below foundation level,
D = Foundation depth,
B = Foundation width,
C = Cohesion of soil; which equal one-half of unconfined compression strength (qu/2).
F.S = Factor of Safety (F.S = 3).

Nc, Nq and N_γ = Terzghi factors depending on the angle of internal friction, which equal zero when the soil is in fully saturation conditions.

$$Nc = 5.7,\ Nq = 1.0 \text{ and } N_\gamma = 0.0$$

ü The allowable bearing capacity of **Mixture** materials is estimated according to our previous experiences with similar materials taking into consideration the results of field SPT tests.

ü The allowable bearing capacity of **marl** material is determined using Terzaghi's equation considering a factor of safety of 3 and the marl material in saturated conditions. The used equation is as follows:

$$q_a = q_u \text{ X } 5.7 \ / \ 2 \text{ X } 3$$

q_a : allowable bearing capacity, kg/cm^2
q_u : unconfined compressive strength, kg/cm^2

ü The allowable bearing capacity for the **limestone** rock materials is determined using Goodman equation considering the factor of safety of 20. The used equation is :-

$$q_a = q_u / F$$

q_a : Allowable bearing capacity, kg/cm^2
q_u : Unconfined compressive strength, kg/cm^2
F : Factor of safety

ü It is recommended that the foundations for structures if any be designed for a net allowable bearing capacity as follows :

Material	net allowable bearing
silty clay	1.80 kg/cm^2
Mixture	2.50 kg/cm^2
Marl	2.0 kg/cm^2
Limestone	3.50 kg/cm^2

8.4 Seismology and Earthquake

According to seismic map in Jordan, this region is located within area 2A. The following parameters shall be taken into consideration during design stage:-

Area 2A

	Silty clay	Mixture & Marl	Limestone
Seismic zone, Z	0.15	0.15	0.15
Type of soil section	S_D	S_c	S_B
Acceleration factor, Ca	0.28	0.18	0.15
Velocity factor , Cv	0.32	0.25	0.15

It is recommended to use the lowest values Sc section

8.5 *Earth Pressure*

Walls retaining granular structural fill will be subjected to lateral earth pressures produced by the weight of the fill and any surcharge load. The thickness of the backfill material between the retaining structure and the parent material shall be taken into consideration.

In case of backfill materials described in item 8.8, it is considered that these materials will be granular in texture and compacted to a dry density of not less than 95 % of the maximum Modified Proctor Density (ASTM D 1557) in case of the structural fill and not less than 90 % in case of general backfill or as specified. The granular backfill materials compacted to these recommended densities will develop an angle of internal friction of approximately 35 degrees. Therefore, the recommended values of coefficients of Earth Pressures of the encountered parent materials can be calculated for as follows:-

Coefficient of “At rest” Earth Pressure

$K_0 = 1 – \text{Sin } Ø$

Coefficient of “Active” Earth Pressure

$K_a = (1 – \text{Sin } Ø) / (1 + \text{Sin } Ø)$

Coefficient of “Passive” Earth Pressure

$K_P = (1 + \text{Sin } Ø) / (1 - \text{Sin } Ø)$

The values for the layers materials encountered are summarized in the table below

Table 7: Recommended Lateral Earth Pressures Coefficients

Item.	Type of Materials	K_0	K_a	K_p
1.	Silty clay	0.74	0.59	1.70
2.	Mixture	0.50	0.33	3.00
3.	Marl	0.74	0.58	1.70
4.	Limestone	0.58	0.41	2.46

8.6 *Excavation*

Most of the excavation operations will be through silty clay, mixture ,marl and limestone materials which can be ripped using conventional machinery such as heavy wheel loaders for Silty Clay, bulldozers with rippers for the Mixture and heavy rock breakers for the Limestone.

It is recommended to excavate the last 10cm above the foundation level by pneumatic manual jackhammers to avoid disturbance of the insitu material. Any loose material remaining on the base and sides of the foundation excavations should be removed by manual technique. In the event that excavations for foundations are taken below the design level this extra depth shall be filled with lean concrete or concrete with 30 % cobbles.

8.7 *Slopes for Temporary Excavations*

To minimize instability problems, which may occur during excavations in side slopes of the foundation excavations, a minimum side slopes shall be performed as follows:

No.	Materials	V	H
1.	Silty Clay	2	1
2.	Mixture	2	1
3.	Marl	2	1
4.	Limestone	4	1

8.8 *Geotechnical Evaluation of the Excavated Materials and Backfilling*

The materials, which will be excavated from the site, are generally suitable for backfilling purposes except silty clay materials. Backfill which will be used shall be imported from out of the site area and shall have the following characteristics:

* Naturally occurred and free from organic impurities and other deleterious substances.

* Not contains stone fragments larger than 10cm nominal size.

* The plasticity index of the materials passing sieve No.40 shall not exceed 10 % and liquid limit not more than 40 %.

The backfill material should be thoroughly mixed before placing it. Placing backfill materials should be in layers not exceeding 25 cm in loose state and should be mechanically compacted with suitable machines to at least 95 % of the maximum density obtained by modified proctor test or 85 % relative density. Hydraulic compaction of the backfill material should not be allowed. The variation in moisture content of these materials should be within a value of +2 % from the optimum moisture content determined by the above mentioned test.

9. DRAINAGE

It is recommended that proper and sufficient drainage system shall be designed to protect the structure, service lines and foundations from reach of water. Special care shall be taken to protect the site from reach of surface water as recommended in the attached hydrological report attached.

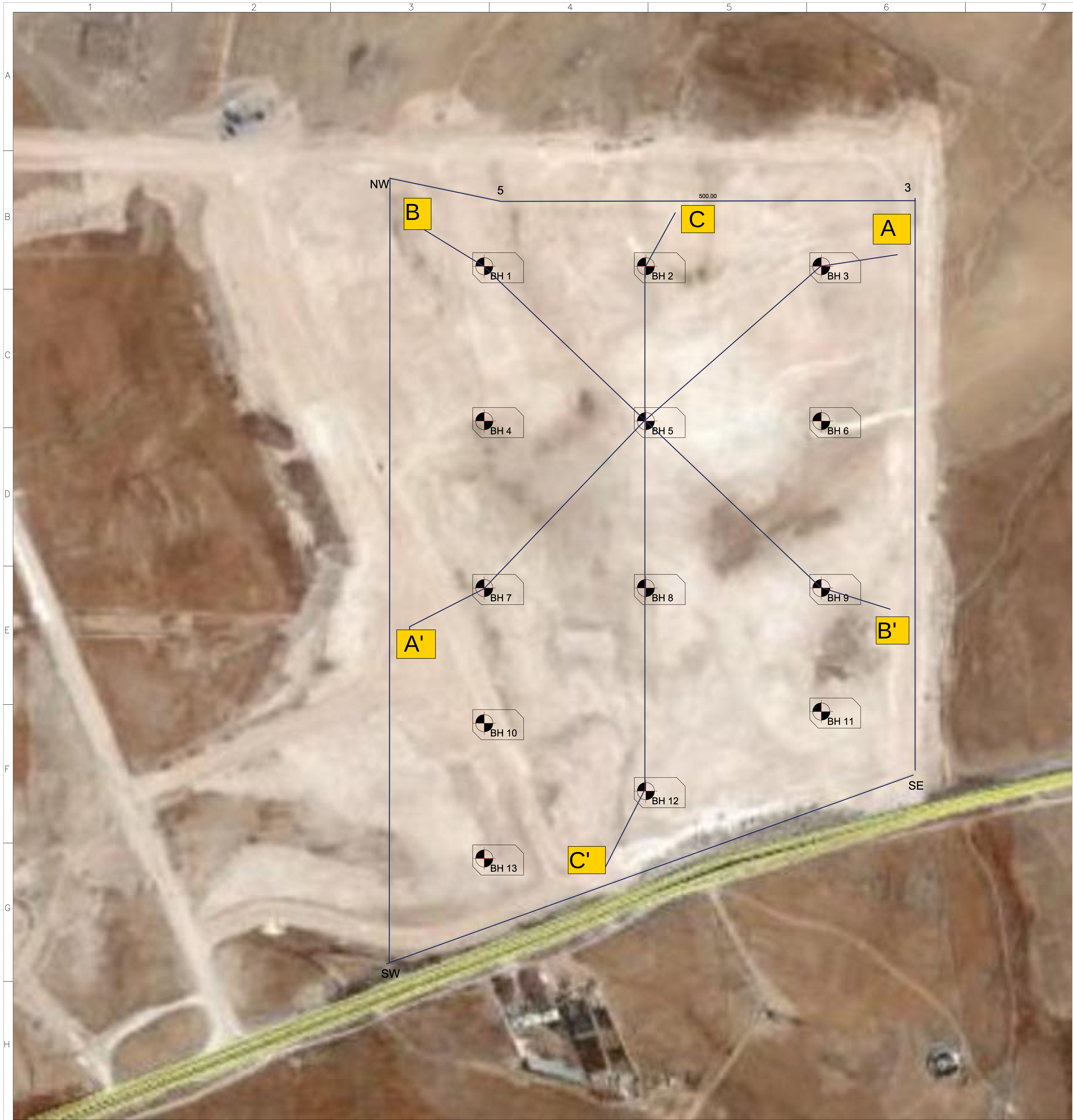
10. ELECTRICAL RESISTIVITY

The primary purpose of carrying out the electrical resistivity measurements is to determine the subsurface physical properties (resistivity or conductivity) of the materials (filling, soil and rocks). One-dimensional (1D) electrical resistivity measurements were conducted with the Iris instruments, Syscal R1 plus resistivity meter to get the ground apparent resistivity. The grounding system for the infra-structure is strongly dependent on the ground conditions. Accurate prediction of these conditions can reduce the planning risk considerably. Resistivity measurements were carried out utilizing a Wenner array (four electrodes, Equally Spaced).
The results attached in Appendix E

11. HYDROLOGICAL STUDY

The hydrological study is aimed to estimate, develop and evaluate the existing drainage patterns and flow rates for the runoff within the Project boundary. The study is attached in Appendix F of this report

APPENDIX A



SITE COORDINATES

Point	LONGITUDE	LATITUDE	ELEVATION (approximate)
Point SW.	31° 54.220' N	36° 5.937' E	812
Point NW.	31° 54.729' N	36° 5.942' E	807
Point 5.	31° 54.714' N	36° 6.025' E	810
Point 3.	31° 54.711' N	36° 6.342' E	802
Point SE.	31° 54.339' N	36° 6.339' E	813

BORE HOLE COORDINATES

BH#	LONGITUDE	LATITUDE	ELEVATION (approximate)
BH 1.	31° 54.670' N	36° 6.009' E	810
BH 2.	31° 54.670' N	36° 6.132' E	816
BH 3.	31° 54.670' N	36° 6.267' E	812
BH 4.	31° 54.569' N	36° 6.009' E	816
BH 5.	31° 54.569' N	36° 6.132' E	822
BH 6.	31° 54.569' N	36° 6.267' E	814
BH 7.	31° 54.460' N	36° 6.009' E	816
BH 8.	31° 54.460' N	36° 6.132' E	823
BH 9.	31° 54.460' N	36° 6.267' E	815
BH 10.	31° 54.372' N	36° 6.009' E	814
BH 11.	31° 54.372' N	36° 6.267' E	817
BH 12.	31° 54.328' N	36° 6.132' E	826
BH 13.	31° 54.284' N	36° 6.009' E	811

2016 Al Manakher Solar Plant
Jordan,

Project Developer
-

Project Customer:
-

Site Description

SIte area:	~50.9 ha
Array area:	xx.x ha
Latitude:	31° 54.522' N
Longitude:	36° 6.102' E
Elevation:	~810 MSL

Project Climatic Conditions
Extreme max:
Extreme min:
Annual Cooling Design Temp:
Annual Heating Design Temp:

Project Design Data

Snow Load:	N/A
Wind Load:	
Seismic Load:	

Project Interconnection
-

Photovoltaic System Parameters
-

Solar Production
-

WÄRTSILÄ

Product:	ACA	ASLY DRG:	Drawing: Site investigation map / Borehole and trial pit location map / Al Manakher Solar Power Plant	Proj. no.
MADE	30-Mar-2016	Markus Sandås	Units:	Based on Document: / Customer Document:
CHKD			Page No.	Scale: 1:2500 1:1 / Size: A0 / Doc. ID: DBAD916769 XX Rev.
APPD				

Confidential

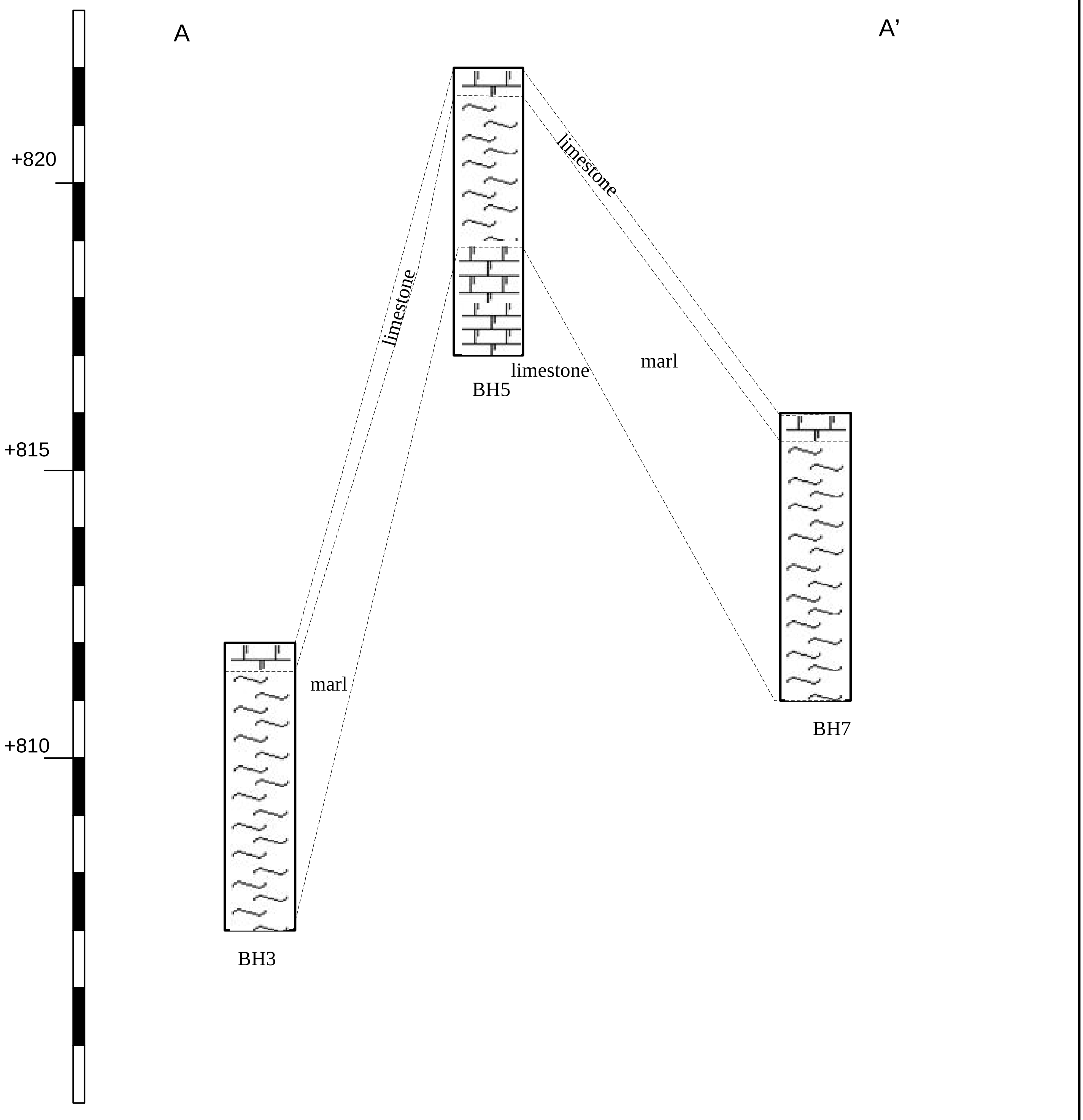


Figure No.	2	Generalized Stratigraphical Profile AA’
Scale	Ver 1 :100	

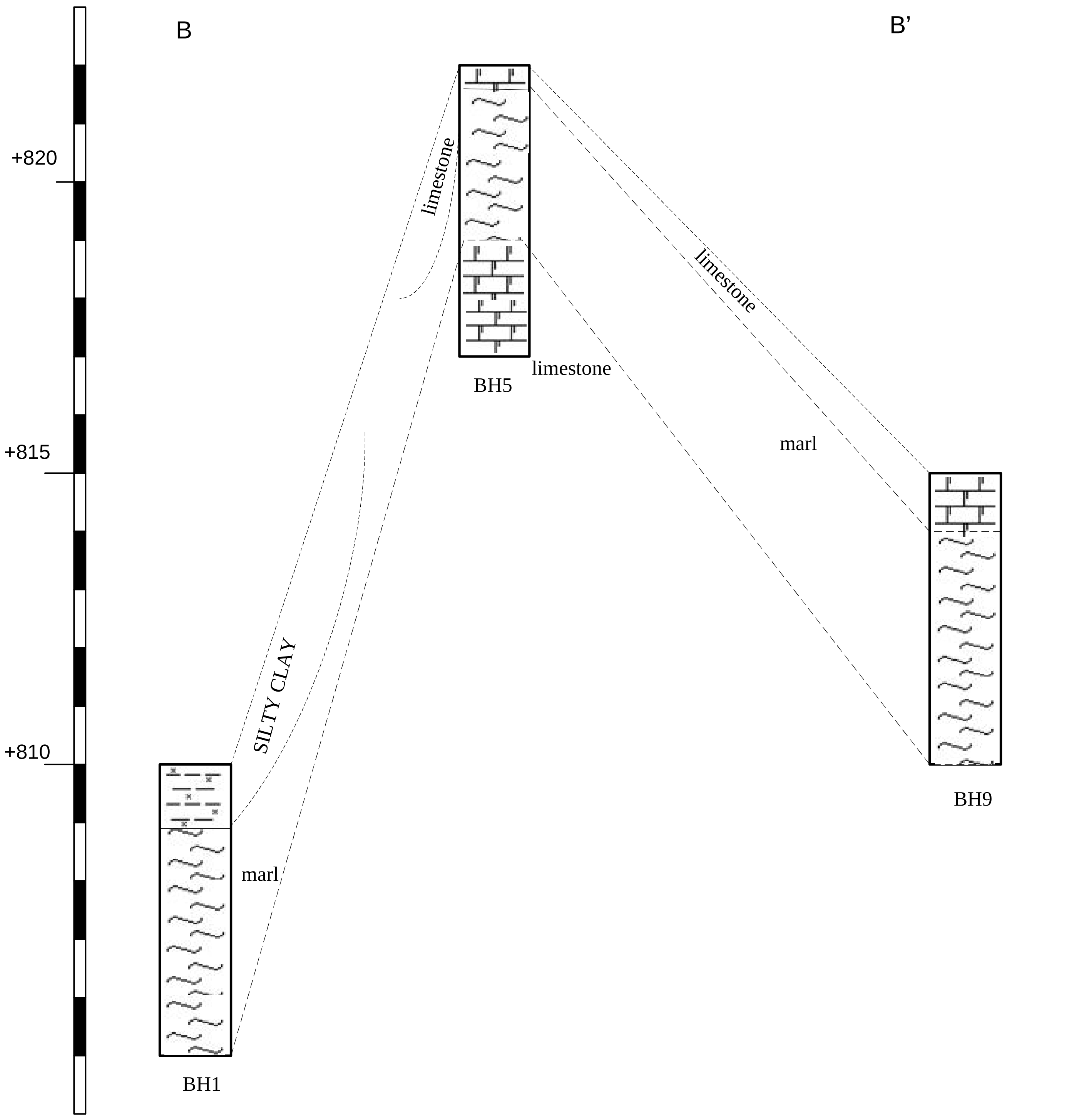


Figure No.	3	Generalized Stratigraphical Profile BB’
Scale	Ver 1 :100	

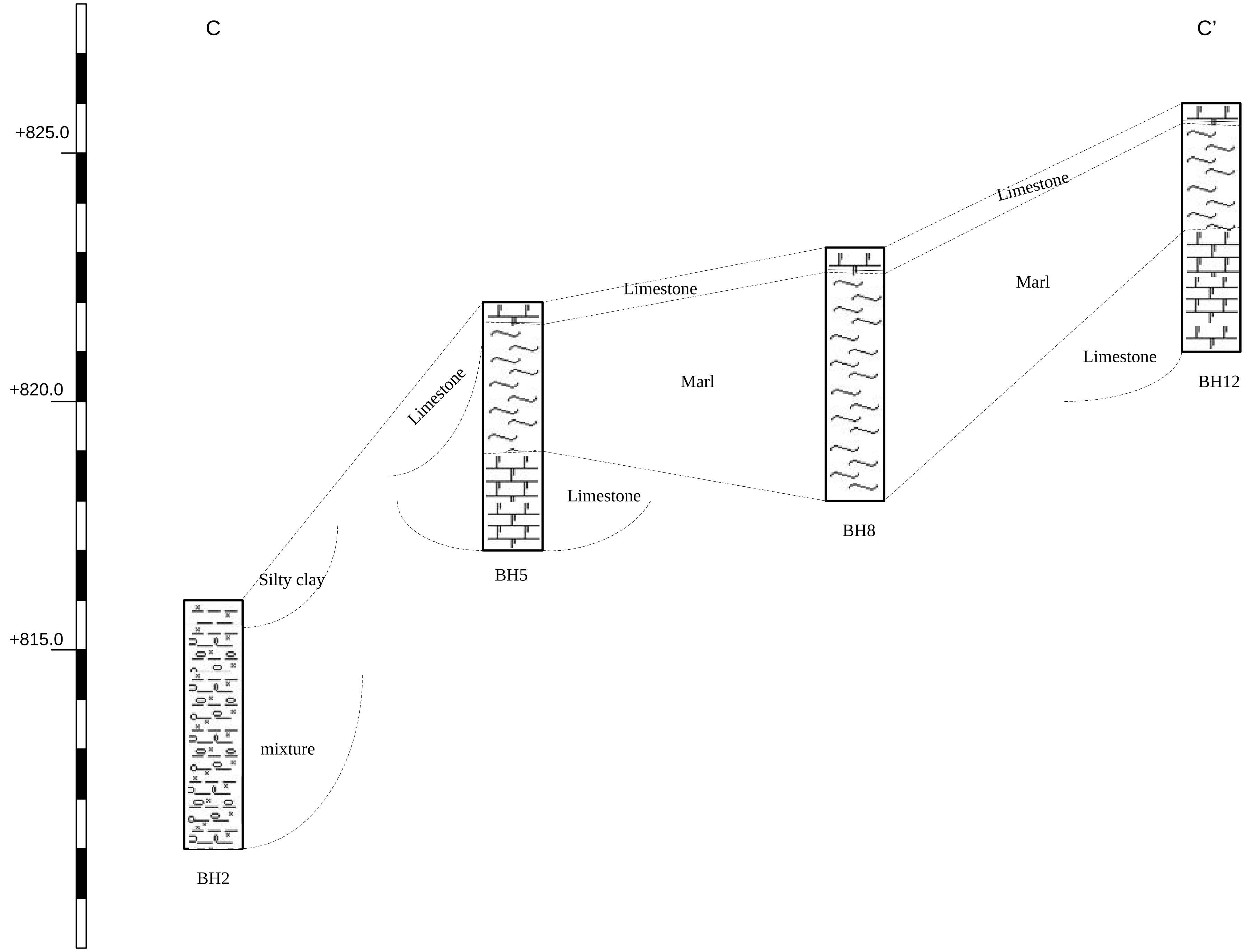


Figure No.	4	Generalized Stratigraphical Profile CC'
Scale	Ver. 1 :100	

APPENDIX B

Logs of Borings

LOG OF BORING

Project : **AL-MANAKHER SOLAR PROJECT**

Location : AL-MANAKHER

Drilling : Rotary - Air flush

Water Table Level : Not enchountered

Coordinates : E : 366.009 **N :** 3154.670

Borehole No. : BH1

Date : 20/6/2016

Elevation : 810

Casing Depth : ---

Total Depth : 5.0m

Depth (m)	Sampling	TCR (%)	RQD (%)	SCR (%)	IF(mm)	Fractures	S.P.T N Blows	DESCRIPTION	Symbol	Dry Density g\cm 3	Point Load I50	Unconfined qu	LL |-------O-------| PL
0–1		88	---					**SILTY CLAY** Brown, moist, stiff to very stiff Silty Clay with (20-30%) gravels of chert					
1–1.5													
1.5–2							6,10 15						
2–3.5		85	15					**MARL** Creamy, very weak to weak Marl with some nodules of chert.					
3.5–4							7,15 25						
4–5		80	20										
5								End of Borehole					

Sheet 1 of 1

Rep. No. :

LOG OF BORING

Project : **AL-MANAKHER SOLAR PROJECT**

Location : AL-MANAKHER

Drilling : Rotary - Air flush

Water Table Level : Not enchountered

Coordinates : E : 366.132 **N :** 3154.670

Borehole No. : BH2

Date : 20/6/2016

Elevation : 816

Casing Depth : ---

Total Depth : 5.0m

Depth (m)	Sampling	TCR (%)	RQD (%)	SCR (%)	IF(mm)	Fractures	S.P.T N Blows	DESCRIPTION	Symbol	Dry Density g\cm 3	Point Load I50	Unconfined qu	LL PL I-------O-------I
0–0.5								**SILTY CLAY** Brown ,moist ,stiff to very stiff silty clay with (20-30%)gravels of chert					
1.5–2							50\4						
3.5–4							50\3	**MIXTURE** Mixture materials composed of brown silty clay with approximately 50% gravel and cobbles of chert and limestone					
5								End of Borehole					

Sheet 1 of 1

Rep. No. :

LOG OF BORING

Project : **AL-MANAKHER SOLAR PROJECT**

Location : AL-MANAKHER

Drilling : Rotary - Air flush

Water Table Level : Not enchountered

Coordinates : **E :** 366.009 **N :** 3154.267

Borehole No. : BH3

Date : 20/6/2016

Elevation : 812

Casing Depth : ---

Total Depth : 5.0m

Depth (m)	Sampling	Rock Mass Rating TCR (%)	RQD (%)	SCR (%)	IF(mm)	Fractures	S.P.T N Blows	DESCRIPTION	Symbol	Dry Density g\cm 3	Pressure Point Load I50	Unconfined qu	LL I-------O-------I PL
0–0.5								**LIMESTONE** White ,moderately weak and fractured limestone with marl filling the fractures and some nodules of chert					
0.5–1.5		75	15										
1.5–2.0							8,12 30						
2.0–3.5		85	20					**MARL** Creamy, very weak to weak Marl with some nodules of chert.					
3.5–4.0							9,15 28						
4.0–5.0		80	20										
5.0–6.0								End of Borehole					

Sheet 1 of 1

Rep. No. :

LOG OF BORING

Project : **AL-MANAKHER SOLAR PROJECT**

Location : AL-MANAKHER

Drilling : Rotary - Air flush

Water Table Level : Not enchountered

Coordinates : **E :** 366.009 **N :** 3154.569

Borehole No. : BH4

Date : 20/6/2016

Elevation : 816

Casing Depth : ---

Total Depth : 5.0m

Depth (m)	Sampling	Rock Mass Rating: TCR (%)	RQD (%)	SCR (%)	IF(mm)	Fractures	S.P.T N Blows	DESCRIPTION	Symbol	Dry Density g\cm 3	Pressure: Point Load I50	Unconfined qu	LL I-------O-------I PL
0.0–3.0							50\4	**MIXTURE** Mixture materials composed of brown silty clay with approximately 50% gravel and cobbles of chert and limestone					
3.0–5.0		85	20				8.15 27	**MARL** Creamy, very weak to weak Marl with some nodules of chert.					
5.0								End of Borehole					

Sheet 1 of 1

Rep. No. :

LOG OF BORING

Project : **AL-MANAKHER SOLAR PROJECT**

Location : AL-MANAKHER

Drilling : Rotary - Air flush

Water Table Level : Not enchountered

Coordinates : E : 366.132 **N :** 3154.569

Borehole No. : BH5

Date : 20/6/2016

Elevation : 822

Casing Depth : ---

Total Depth : 5.0m

Depth (m)	Sampling	TCR (%)	RQD (%)	SCR (%)	IF(mm)	Fractures	S.P.T N Blows	DESCRIPTION	Symbol	Dry Density g\cm 3	Point Load I50	Unconfined qu	LL |-------O-------| PL
0–0.5								**LIMESTONE** White ,moderately weak and fractured limestone with marl filling the fractures and some nodules of chert					
0.5–1.5		85	15										
1.5–2							9,15 20	**MARL** Creamy, very weak to weak Marl with some nodules of chert.					
2–3		75	20										
3–3.5							50\4	**LIMESTONE** White ,moderately weak and fractured limestone with marl filling the fractures and some nodules of chert					
3.5–5		90	65										
5–6								End of Borehole					

Sheet 1 of 1

Rep. No. :

LOG OF BORING

Project : **AL-MANAKHER SOLAR PROJECT**

Location : AL-MANAKHER

Drilling : Rotary - Air flush

Water Table Level : Not enchountered

Coordinates : E : 366.267 **N :** 3154.569

Borehole No. : BH6

Date : 20/6/2016

Elevation : 814

Casing Depth : ---

Total Depth : 5.0m

Depth (m)	Sampling	Rock Mass Rating: TCR (%)	RQD (%)	SCR (%)	IF(mm)	Fractures	S.P.T N Blows	DESCRIPTION	Symbol	Dry Density g\cm 3	Pressure: Point Load I50	Unconfined qu	LL I-------O-------I PL
0–0.5								**MIXTURE** Mixture materials composed of brown silty clay with approximately 50% gravel and cobbles of chert and limestone					
0.5–1							50\4						
1–2		90	65					**LIMESTONE** White ,moderately weak and fractured limestone with marl filling the fractures and some nodules of chert					
2–3		75	15										
3–3.5							10,14 25	**MARL** Creamy, very weak to weak Marl with some nodules of chert.					
3.5–5		85	20										
5–6								End of Borehole					

Sheet 1 of 1

Rep. No. :

LOG OF BORING

Project : **AL-MANAKHER SOLAR PROJECT**

Location : AL-MANAKHER

Drilling : Rotary - Air flush

Water Table Level : Not enchountered

Coordinates : E : 366.009 **N :** 3154.460

Borehole No. : BH7

Date : 20/6/2016

Elevation : 816

Casing Depth : ---

Total Depth : 5.0m

Depth (m)	Sampling	TCR (%)	RQD (%)	SCR (%)	IF(mm)	Fractures	S.P.T N Blows	DESCRIPTION	Symbol	Dry Density g\cm 3	Point Load I50	Unconfined qu	LL |-------O-------| PL
0–0.5								**LIMESTONE** White ,moderately weak and fractured limestone with marl filling the fractures and some nodules of chert					
0.5–1.5		85	15										
1.5–2.0							9,15 25						
2.0–3.5		90	20					**MARL** Creamy, very weak to weak Marl with some nodules of chert.					
3.5–4.0							10,15 20						
4.0–5.0		75	15										
5								End of Borehole					

Sheet 1 of 1

Rep. No. :

LOG OF BORING

Project : **AL-MANAKHER SOLAR PROJECT**

Location : AL-MANAKHER

Drilling : Rotary - Air flush

Water Table Level : Not enchountered

Coordinates : E : 366.132 **N :** 3154.460

Borehole No. : BH8

Date : 20/6/2016

Elevation : 823

Casing Depth : ---

Total Depth : 5.0m

Depth (m)	Sampling	Rock Mass Rating: TCR (%)	RQD (%)	SCR (%)	IF(mm)	Fractures	S.P.T N Blows	DESCRIPTION	Symbol	Dry Density g\cm 3	Pressure: Point Load I50	Unconfined qu	LL I-------O-------I PL
0 – 0.5								**LIMESTONE** White ,moderately weak and fractured limestone with marl filling the fractures and some nodules of chert					
0.5 – 1.5		75	15										
1.5 – 2.0							9,10 25	**MARL** Creamy, very weak to weak Marl with some nodules of chert.					
2.0 – 3.5		85	20										
3.5 – 4.0							8.18 20						
4.0 – 5.0		75	15										
5.0 – 6.0								End of Borehole					

Sheet 1 of 1

Rep. No. :

LOG OF BORING

Project : **AL-MANAKHER SOLAR PROJECT**

Location : AL-MANAKHER

Drilling : Rotary - Air flush

Water Table Level : Not enchountered

Coordinates : E : 366.267 **N :** 3154.460

Borehole No. : BH9

Date : 20/6/2016

Elevation : 815

Casing Depth : ---

Total Depth : 5.0m

Depth (m)	Sampling	Rock Mass Rating: TCR (%)	RQD (%)	SCR (%)	IF(mm)	Fractures	S.P.T N Blows	DESCRIPTION	Symbol	Dry Density g\cm 3	Pressure: Point Load I50	Unconfined qu	LL I-------O-------I PL
0–1		90	65					**LIMESTONE** White ,moderately weak and fractured limestone with marl filling the fractures and some nodules of chert					
1–2.5		80	20										
2.5–3							8,15 20	**MARL** Creamy, very weak to weak Marl with some nodules of chert.					
3–4.5		80	15										
4.5–5							9,15 23						
5–6								End of Borehole					

Sheet 1 of 1

Rep. No. :

LOG OF BORING

Project : **AL-MANAKHER SOLAR PROJECT**

Location : AL-MANAKHER

Drilling : Rotary - Air flush

Water Table Level : Not enchountered

Coordinates : E : 366.009 **N :** 3154.372

Borehole No. : BH10

Date : 21/6/2016

Elevation : 814

Casing Depth : ---

Total Depth : 5.0m

Depth (m)	Sampling	Rock Mass Rating TCR (%)	RQD (%)	SCR (%)	IF(mm)	Fractures	S.P.T N Blows	DESCRIPTION	Symbol	Dry Density g\cm 3	Pressure Point Load I50	Unconfined qu	LL I-------O-------I PL
0–1.5								**LIMESTONE** White ,moderately weak and fractured limestone with marl filling the fractures and some nodules of chert					
1.5–2.0							50\3	**MARL** Creamy, very weak to weak Marl with some nodules of chert.					
2.0–3.5		88	35					**LIMESTONE** white thinly to thickly bedded moderately weak limestone interbedded with strong chert					
3.5–4.0							50\4						
4.0–5.0		80	40										
5.0–6.0								End of Borehole					

Sheet 1 of 1

Rep. No. :

LOG OF BORING

Project : **AL-MANAKHER SOLAR PROJECT**

Location : AL-MANAKHER

Drilling : Rotary - Air flush

Water Table Level : Not enchountered

Coordinates : **E :** 366.267 **N :** 3154.372

Borehole No. : BH11

Date : 21/6/2016

Elevation : 817

Casing Depth : ---

Total Depth : 5.0m

Depth (m)	Sampling	TCR (%)	RQD (%)	SCR (%)	IF(mm)	Fractures	S.P.T N Blows	DESCRIPTION	Symbol	Dry Density g\cm 3	Point Load I50	Unconfined qu	LL I-------O-------I PL
0–1							50\4	**MIXTURE** Mixture materials composed of brown silty clay with approximately 50% gravel and cobbles of chert and limestone					
1–2								**SILTY CLAY** Brown, moist, stiff to very stiff Silty Clay with (20-30%) gravels of chert					
2–3.5		85	55					**MARL** Creamy, very weak to weak Marl with some nodules of chert.					
3.5–4							50\2	**LIMESTONE** White ,moderately weak and fractured limestone with marl filling the fractures and some nodules of chert					
4–5		90	60										
5–6								End of Borehole					

Sheet 1 of 1

Rep. No. :

LOG OF BORING

Project : **AL-MANAKHER SOLAR PROJECT**

Location : AL-MANAKHER

Drilling : Rotary - Air flush

Water Table Level : Not enchountered

Coordinates : E : 366.132 **N :** 3154.328

Borehole No. : BH12

Date : 20/6/2016

Elevation : 826

Casing Depth : ---

Total Depth : 5.0m

Depth (m)	Sampling	TCR (%)	RQD (%)	SCR (%)	IF(mm)	Fractures	S.P.T N Blows	DESCRIPTION	Symbol	Dry Density g\cm 3	Point Load I50	Unconfined qu	LL I-------O-------I PL
0.5–2.0		85	20					**LIMESTONE** White ,moderately weak and fractured limestone with marl filling the fractures and some nodules of chert					
2.0–2.5							8,15 25	**MARL** Creamy, very weak to weak Marl with some nodules of chert.					
2.5–3.5		90	60					**LIMESTONE** White ,moderately weak and fractured limestone with marl filling the fractures and some nodules of chert					
3.5–4.0							50\4						
4.0–5.0		95	65										
5.0								End of Borehole					

Sheet 1 of 1

Rep. No. :

LOG OF BORING

Project : **AL-MANAKHER SOLAR PROJECT**

Location : AL-MANAKHER

Drilling : Rotary - Air flush

Water Table Level : Not enchountered

Coordinates : E : 366.009 **N :** 3154.284

Borehole No. : BH13

Date : 20/6/2016

Elevation : 811

Casing Depth : ---

Total Depth : 5.0m

Depth (m)	Sampling	Rock Mass Rating: TCR (%)	RQD (%)	SCR (%)	IF(mm)	Fractures	S.P.T N Blows	DESCRIPTION	Symbol	Dry Density g\cm 3	Pressure: Point Load I50	Unconfined qu	LL I-------O-------I PL
0.0–0.5								**LIMESTONE** White ,moderately weak and fractured limestone with marl filling the fractures and some nodules of chert					
0.5–2.0		75	15					**MARL** Creamy, very weak to weak Marl with some nodules of chert.					
2.0–2.5							9,15 25						
2.5–3.5		85	60					**LIMESTONE** White ,moderately weak and fractured limestone with marl filling the fractures and some nodules of chert					
3.5–4.0							50\4						
4.0–5.0		90	65										
5.0–6.0								End of Borehole					

Sheet 1 of 1

Rep. No. :

APPENDIX C

Constant Head permeability sheets

PERMEABILITY TEST RESULTS (Constant Head)

BS 5930

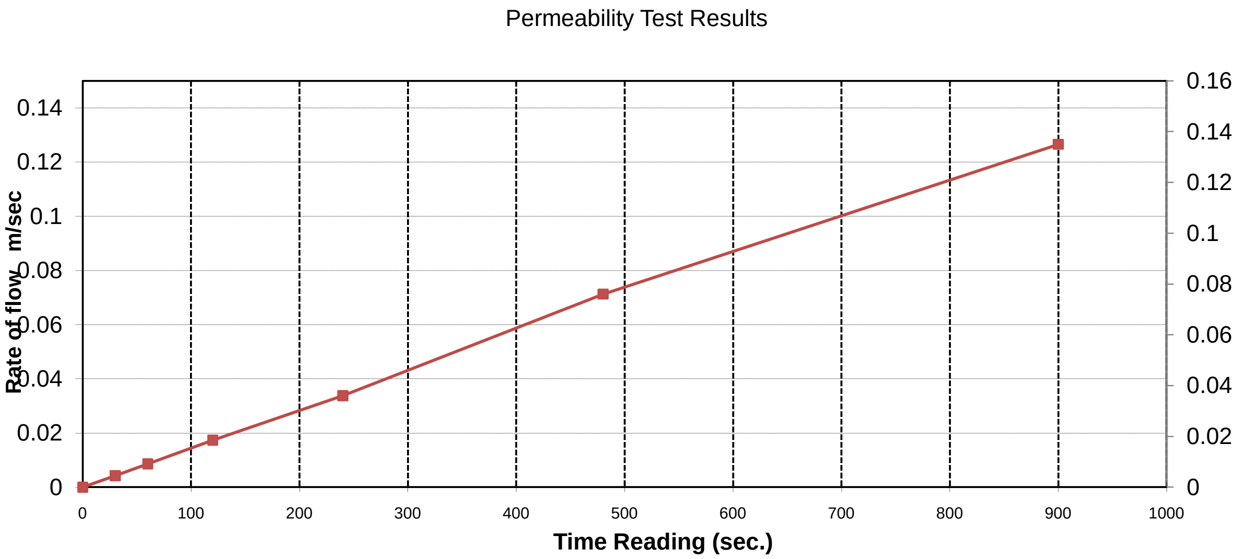
Project : Al-Manakher Solar Power Plant **DATE:20\6\2016**

Project Location .: Sahab **BH NO. : BH-3**

Length of Test Section: (m)	25
Depth Of Test Below Ground Level (L): (m)	10
Diameter Of Test Section(D) : (m)	0.055
Hight Of Measuring Datum Above Ground Level(Hc) : (m)	15
Depth Of water Table: (m)	15

Time (Sec)	Quantity of water (m^3)	Velocity V	Rate of flow (m^3)
0	0	0	0
30.0	0.0045	1.894E+00	4.500E-03
60.0	0.0092	3.872E+00	9.200E-03
120.0	0.0185	7.787E+00	1.850E-02
240.0	0.0360	1.515E+01	3.600E-02
480.0	0.0760	3.199E+01	7.600E-02
900.0	0.1350	5.682E+01	1.350E-01

CALCULATION		
f=2.75D/(1+(11/3.14)*(L/D))	**-**	**0.00023709**
k=Q/F*Hc	**m/sec**	**4.801E-04**



Tested.....	Checked....

PERMEABILITY TEST RESULTS (Constant Head)

BS 5930

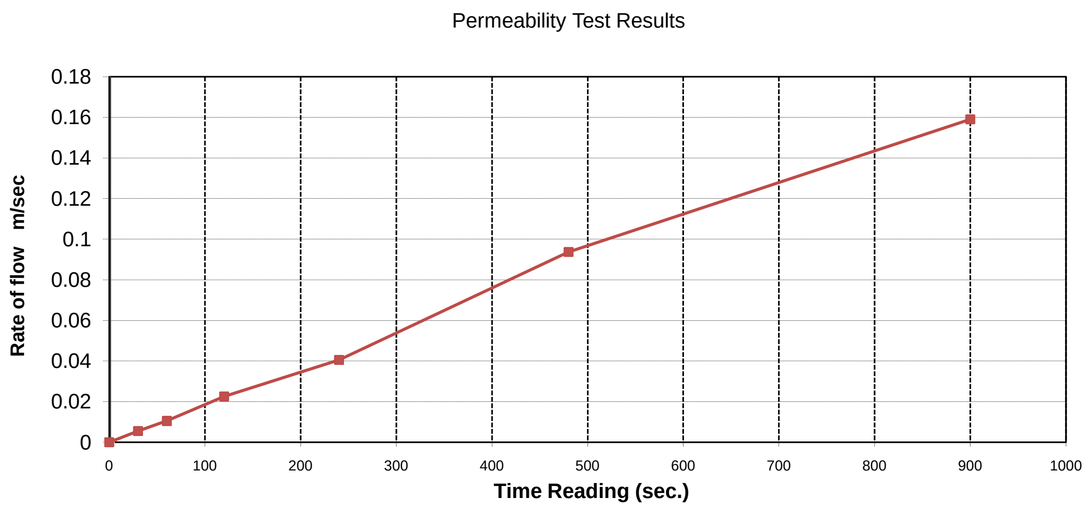
Project : Al-Manakher Solar Power Plant **DATE:20\6\2016**

Project Location .: Sahab **BH NO. : BH-9**

Length of Test Section: (m)	25
Depth Of Test Below Ground Level (L): (m)	10
Diameter Of Test Section(D) : (m)	0.055
Hight Of Measuring Datum Above Ground Level(Hc) : (m)	15
Depth Of water Table: (m)	15

Time (Sec)	Quantity of water (m^3)	Velocity V	Rate of flow (m^3)
0	0	0	0
30.0	0.0055	2.315E+00	5.500E-03
60.0	0.0105	4.420E+00	1.050E-02
120.0	0.0225	9.470E+00	2.250E-02
240.0	0.0405	1.705E+01	4.050E-02
480.0	0.0937	3.944E+01	9.370E-02
900.0	0.1590	6.692E+01	1.590E-01

CALCULATION		
f=2.75D/(1+(11/3.14)*(L/D))	**-**	**0.00023709**
k=Q/F*Hc	**m/sec**	**5.655E-04**



Tested.....	Checked....

PERMEABILITY TEST RESULTS (Constant Head)

BS 5930

Project : Al-Manakher Solar Power Plant **DATE:20\6\2016**

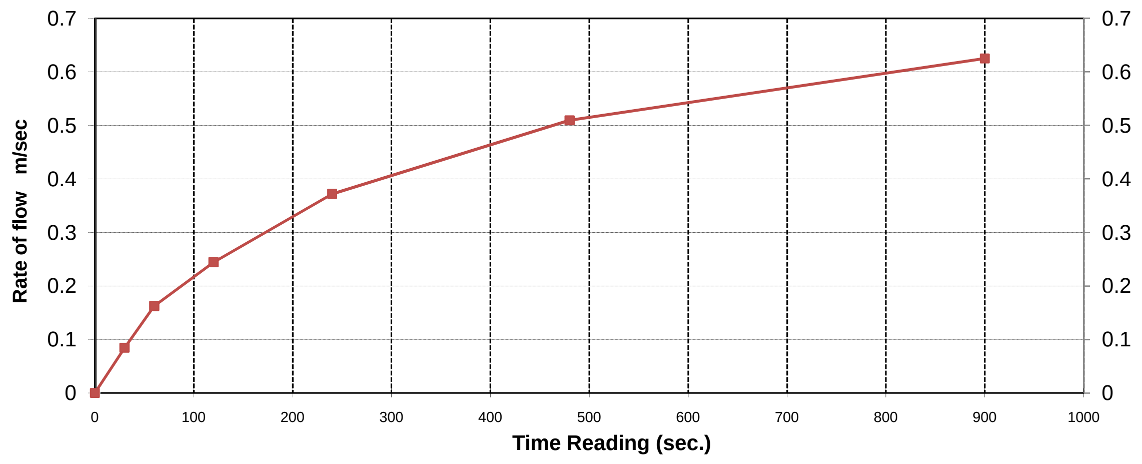
Project Location .: Sahab **BH NO. : BH-13**

Length of Test Section: (m)	25
Depth Of Test Below Ground Level (L): (m)	10
Diameter Of Test Section(D) : (m)	0.055
Hight Of Measuring Datum Above Ground Level(Hc) : (m)	15
Depth Of water Table: (m)	15

Time (Sec)	Quantity of water (m^3)	Velocity V	Rate of flow (m^3)
0	0	0	0
30.0	0.0845	3.557E+01	8.450E-02
60.0	0.1625	6.840E+01	1.625E-01
120.0	0.2445	1.029E+02	2.445E-01
240.0	0.3720	1.566E+02	3.720E-01
480.0	0.5095	2.145E+02	5.095E-01
900.0	0.6250	2.631E+02	6.250E-01

CALCULATION		
f=2.75D/(1+(11/3.14)*(L/D))	**-**	**0.00023709**
k=Q/F*Hc	**m/sec**	**2.223E-03**

Permeability Test Results



Tested.....	Checked....

PERMEABILITY TEST RESULTS (Constant Head)

BS 5930

Project : Al-Manakher Solar Power Plant **DATE:20\6\2016**

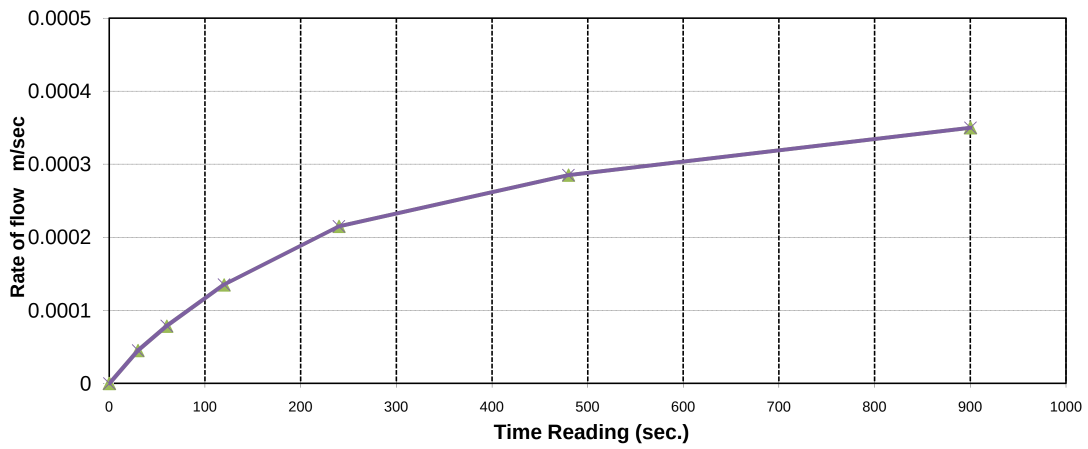
Project Location .: Sahab **BH NO. : BH-1**

Length of Test Section: (m)	25
Depth Of Test Below Ground Level (L): (m)	10
Diameter Of Test Section(D) : (m)	0.055
Hight Of Measuring Datum Above Ground Level(Hc) : (m)	15
Depth Of water Table: (m)	15

Time (Sec)	Quantity of water (m^3)	Velocity V	Rate of flow (m^3)
0	0	0	0
30.0	0.0000450	1.894E-02	4.500E-05
60.0	0.0000785	3.304E-02	7.850E-05
120.0	0.0001350	5.682E-02	1.350E-04
240.0	0.0002150	9.050E-02	2.150E-04
480.0	0.0002850	1.200E-01	2.850E-04
900.0	0.0003500	1.473E-01	3.500E-04

CALCULATION		
f=2.75D/(1+(11/3.14)*(L/D))	**-**	**0.00023709**
k=Q/F*Hc	**m/sec**	**1.245E-06**

Permeability Test Results



Tested.....	Checked....

PERMEABILITY TEST RESULTS (Constant Head)

BS 5930

Project : Al-Manakher Solar Power Plant **DATE:20\6\2016**

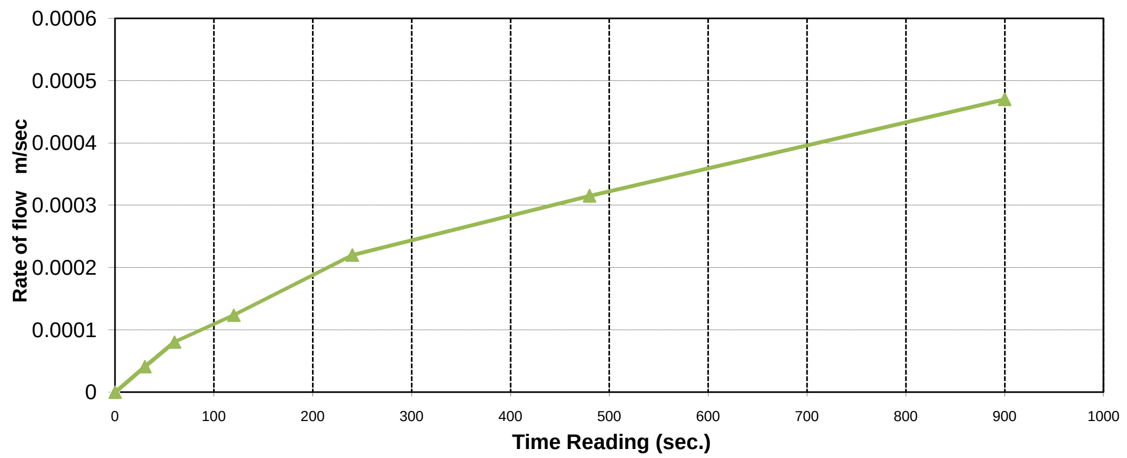
Project Location .: Sahab **BH NO. : BH-11**

Length of Test Section: (m)	25
Depth Of Test Below Ground Level (L): (m)	10
Diameter Of Test Section(D) : (m)	0.055
Hight Of Measuring Datum Above Ground Level(Hc) : (m)	15
Depth Of water Table: (m)	15

Time (Sec)	Quantity of water (m^3)	Velocity V	Rate of flow (m^3)
0	0	0	0
30.0	0.0000410	1.726E-02	4.100E-05
60.0	0.0000805	3.388E-02	8.050E-05
120.0	0.0001235	5.198E-02	1.235E-04
240.0	0.0002200	9.260E-02	2.200E-04
480.0	0.0003150	1.326E-01	3.150E-04
900.0	0.0004700	1.978E-01	4.700E-04

CALCULATION		
f=2.75D/(1+(11/3.14)*(L/D))	**-**	**0.00023709**
k=Q/F*Hc	**m/sec**	**1.672E-06**

Permeability Test Results



Tested..... Checked....

<u>APPENDIX D</u>

Collapse potential sheets

ONE - DIMENSIONAL SWELL OR COLLAPSE POTENIAL TEST

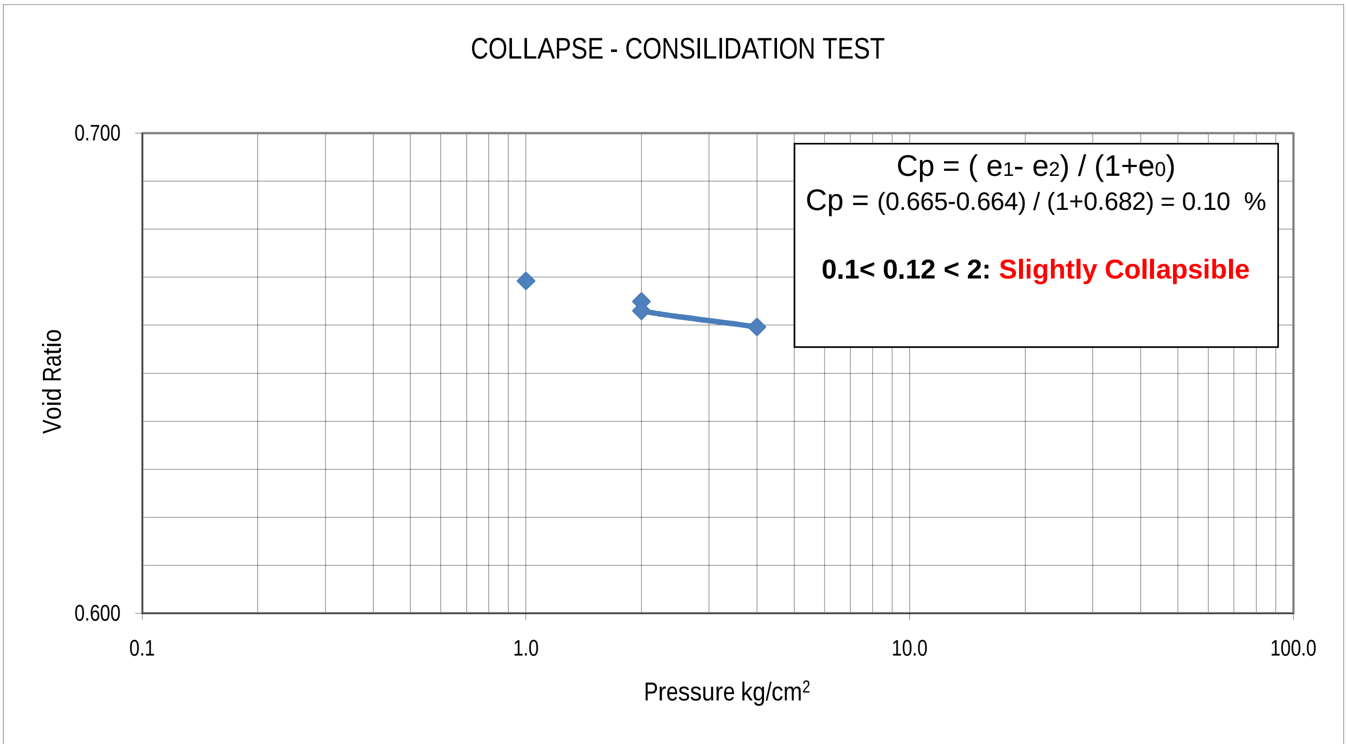
ASTM D 2435

Project Name : Al-Manakher Solar Power Plant   Client : WARTSILA
Location   : Sahab
BH No.: 1   Depth :   0.50 m   Date   : 20/06/2016   Soil Type : Silty Clay

Specimen Data		Apparatus Measurements	
Weight of soil with ring (gm)	124.8	Ring No	1
Final weight of soil with ring (gm)	134.2	Diameter (cm)	5
Dry weight of soil with ring (gm)	123.8	Height (cm)	2
Wet weight of soil (gm)	62.6	Area (cm^2)	19.625
Dry weight of soil (gm)	61.6	Volume (cm^3)	39.250
Initial Moisture content (%)	1.6	Weight (gm)	62.200
Final Moisture Content (%)	16.9		

HS (Solid Height - cm)	1.189	SG (Specific Gravity)	2.592
Sample No.		Initial	Final
Volume of Sample. Cm^3		39.25	38.726
Wet Unit Weight. Gm/cm^3		1.59	1.86
Dry Unit Weight. Gm/cm^3		1.57	1.591
Void Ratio, e		0.682	0.660
Degree of Saturation %		6.28	67.57

Applied pressure kg/cm^2	Swelling $^-$ / Settlement $^+$ $mm*10^{-2}$	Sample height cm (H)	Void Height (cm) HV=H-HS	Void Ratio $e = \frac{H-HS}{HS}$
0	0	2.000	0.811	0.682
1.00	15.3	1.985	0.796	0.669
2/dry	20.4	1.980	0.791	0.665
2/socked	22.7	1.977	0.788	0.663
4.0	26.7	1.973	0.784	0.660



Tested.....   Checked....

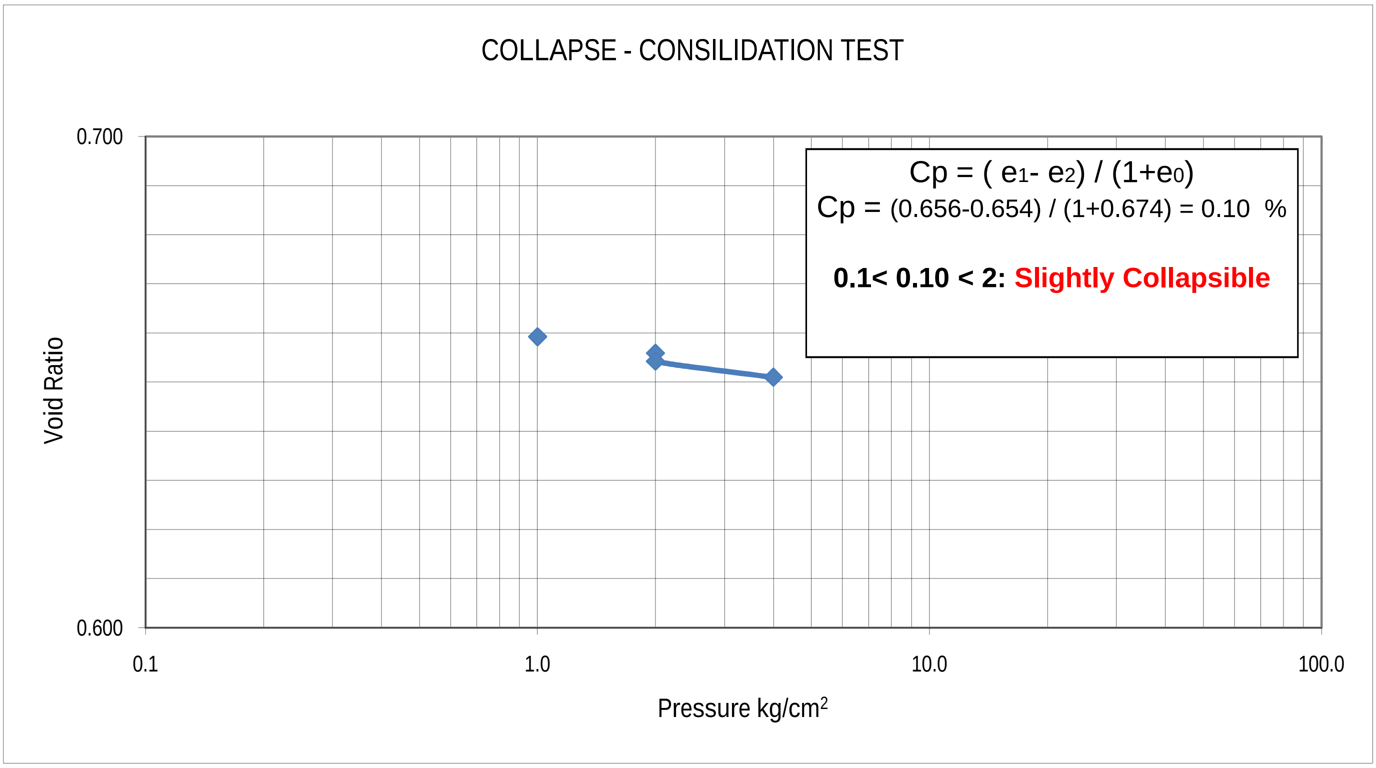
ONE - DIMENSIONAL SWELL OR COLLAPSE POTENIAL TEST
ASTM D 2435

Project Name : Al-Manakher Solar Power Plant   Client : WARTSILA
Location : Sahab
BH No.: 1   Depth : 0.25 m   Date : 20/06/2016   Soil Type : Silty Clay

Specimen Data		Apparatus Measurements	
Weight of soil with ring (gm)	125.1	Ring No	2
Final weight of soil with ring (gm)	133.4	Diameter (cm)	5
Dry weight of soil with ring (gm)	123.6	Height (cm)	2
Wet weight of soil (gm)	62.3	Area (cm^2)	19.625
Dry weight of soil (gm)	60.8	Volume (cm^3)	39.250
Initial Moisture content (%)	2.5	Weight (gm)	62.800
Final Moisture Content (%)	16.1		
HS (Solid Height - cm)	1.195	SG (Specific Gravity)	2.593

Sample No.	Initial	Final
Volume of Sample. Cm^3	39.25	38.718
Wet Unit Weight. Gm/cm^3	1.59	1.82
Dry Unit Weight. Gm/cm^3	1.55	1.570
Void Ratio, e	0.674	0.651
Degree of Saturation %	9.49	64.19

Applied pressure kg/cm^2	Swelling - / Settlement + $mm*10^{-2}$	Sample height cm (H)	Void Height (cm) HV=H-HS	Void Ratio $e=\frac{H-HS}{HS}$
0	0	2.000	0.805	0.674
1.00	17.2	1.983	0.788	0.659
2/dry	21.2	1.979	0.784	0.656
2/socked	23.2	1.977	0.782	0.654
4.0	27.1	1.973	0.778	0.651



Tested.....   Checked....

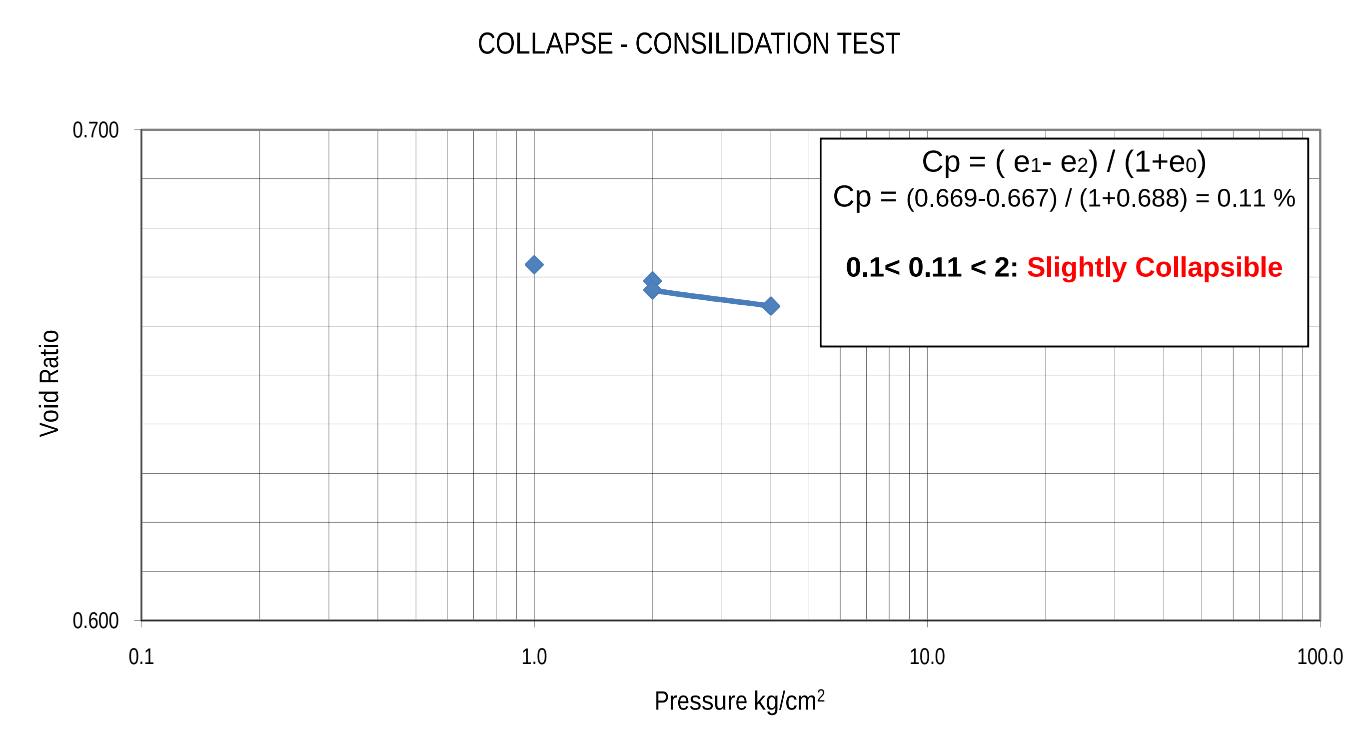
ONE - DIMENSIONAL SWELL OR COLLAPSE POTENIAL TEST
ASTM D 2435

Project Name : Al-Manakher Solar Power Plant   Client : WARTSILA
Location : Sahab
BH No.: 2   Depth : 0.25 m   Date : 20/06/2016   Soil Type : Silty Clay

Specimen Data		Apparatus Measurements	
Weight of soil with ring (gm)	125.3	Ring No	1
Final weight of soil with ring (gm)	136	Diameter (cm)	5
Dry weight of soil with ring (gm)	124.2	Height (cm)	2
Wet weight of soil (gm)	63.1	Area (cm^2)	19.625
Dry weight of soil (gm)	62	Volume (cm^3)	39.250
Initial Moisture content (%)	1.8	Weight (gm)	62.200
Final Moisture Content (%)	19.0		
HS (Solid Height - cm)	1.185	SG (Specific Gravity)	2.595

Sample No.	Initial	Final
Volume of Sample. Cm^3	39.25	38.699
Wet Unit Weight. Gm/cm^3	1.61	1.91
Dry Unit Weight. Gm/cm^3	1.58	1.602
Void Ratio, e	0.688	0.664
Degree of Saturation %	6.88	76.41

Applied pressure kg/cm^2	Swelling - / Settlement + $mm*10^{-2}$	Sample height cm (H)	Void Height (cm) HV=H-HS	Void Ratio $e = \frac{H-HS}{HS}$
0	0	2.000	0.815	0.688
1.00	18.1	1.982	0.797	0.672
2/dry	22	1.978	0.793	0.669
2/socked	24.2	1.976	0.791	0.667
4.0	28.1	1.972	0.787	0.664



Tested.....   Checked....

ONE - DIMENSIONAL SWELL OR COLLAPSE POTENIAL TEST
ASTM D 2435

Project Name : Al-Manakher Solar Power Plant   Client : WARTSILA
Location : Sahab
BH No.: 11   Depth : 1.25 m   Date : 21/06/2016   Soil Type : Silty Clay

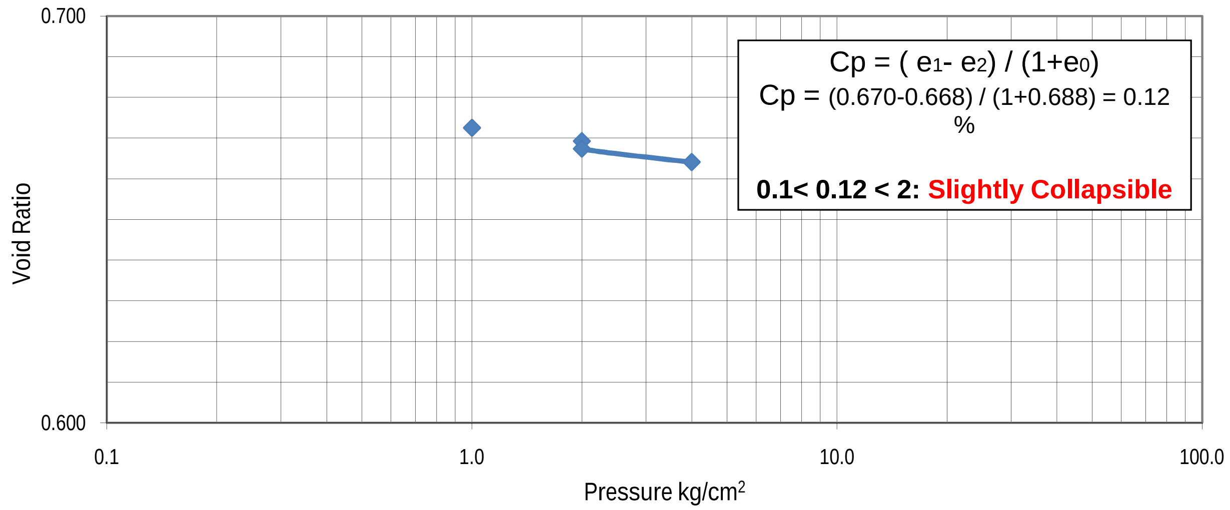
Specimen Data		Apparatus Measurements	
Weight of soil with ring (gm)	125.5	Ring No	1
Final weight of soil with ring (gm)	136	Diameter (cm)	5
Dry weight of soil with ring (gm)	124.2	Height (cm)	2
Wet weight of soil (gm)	63.1	Area (cm^2)	19.600
Dry weight of soil (gm)	61.8	Volume (cm^3)	39.600
Initial Moisture content (%)	2.1	Weight (gm)	62.400
Final Moisture Content (%)	19.1		

HS (Solid Height - cm)	1.185	SG (Specific Gravity)	2.595

Sample No.	Initial	Final
Volume of Sample. Cm^3	39.6	38.651
Wet Unit Weight. Gm/cm^3	1.59	1.90
Dry Unit Weight. Gm/cm^3	1.56	1.599
Void Ratio, e	0.688	0.664
Degree of Saturation %	8.14	76.50

Applied pressure kg/cm^2	Swelling − / Settlement + $mm*10^{-2}$	Sample height cm (H)	Void Height (cm) HV=H-HS	Void Ratio $e=\frac{H-HS}{HS}$
0	0	2.000	0.815	0.688
1.00	18	1.982	0.797	0.673
2/dry	21.5	1.979	0.794	0.670
2/socked	24	1.976	0.791	0.668
4.0	28	1.972	0.787	0.664

COLLAPSE - CONSILIDATION TEST



Tested.....   Checked....

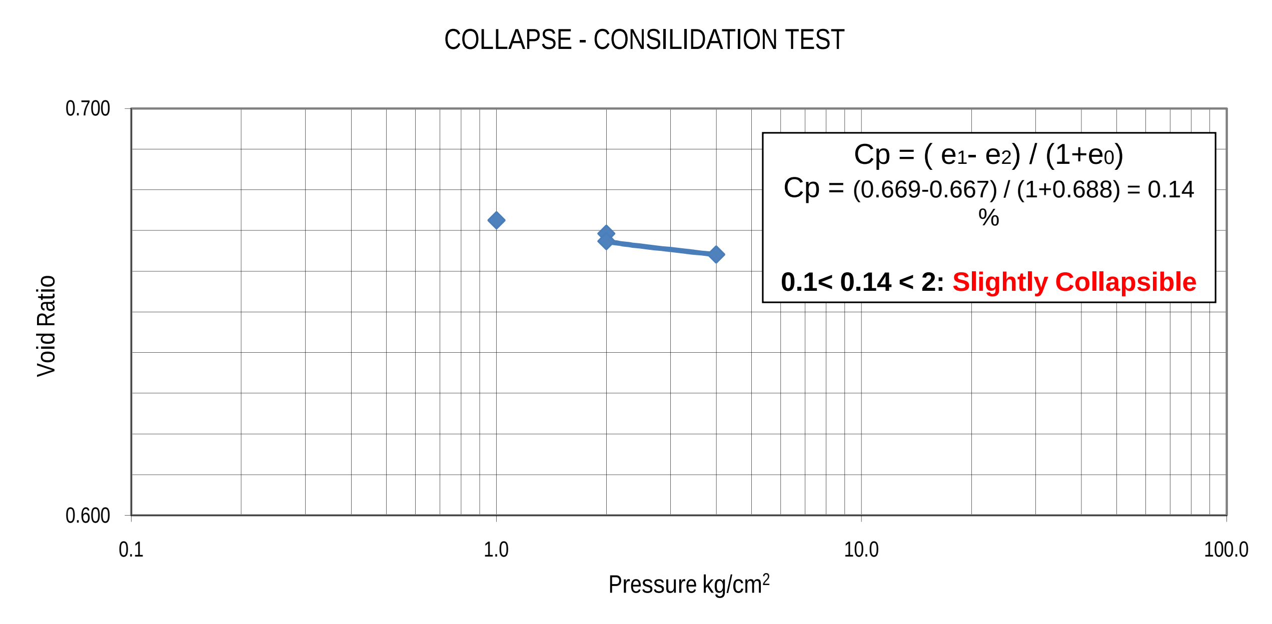
ONE - DIMENSIONAL SWELL OR COLLAPSE POTENIAL TEST
ASTM D 2435

Project Name : Al-Manakher Solar Power Plant   Client : WARTSILA
Location : Sahab
BH No.: 2   Depth : 0.50 m   Date : 20/06/2016   Soil Type : Silty Clay

Specimen Data		Apparatus Measurements		
Weight of soil with ring (gm)	125.9	Ring No		1
Final weight of soil with ring (gm)	139	Diameter (cm)		5
Dry weight of soil with ring (gm)	124.2	Height (cm)		2
Wet weight of soil (gm)	63.4	Area (cm^2)		19.625
Dry weight of soil (gm)	61.7	Volume (cm^3)		39.700
Initial Moisture content (%)	2.8	Weight (gm)		62.500
Final Moisture Content (%)	24.0			
HS (Solid Height - cm)	1.185	SG (Specific Gravity)	2.595	

Sample No.	Initial	Final
Volume of Sample. Cm^3	39.7	38.683
Wet Unit Weight. Gm/cm^3	1.60	1.98
Dry Unit Weight. Gm/cm^3	1.55	1.595
Void Ratio, e	0.688	0.663
Degree of Saturation %	10.63	95.93

Applied pressure kg/cm^2	Swelling - / Settlement + $mm*10^{-2}$	Sample height cm (H)	Void Height (cm) HV=H-HS	Void Ratio $e=\frac{H-HS}{HS}$
0	0	2.000	0.815	0.688
1.00	18.9	1.981	0.796	0.672
2/dry	22	1.978	0.793	0.669
2/socked	24.9	1.975	0.790	0.667
4.0	28.9	1.971	0.786	0.663



Tested.....   Checked....

<u>APPENDIX E</u>

Electrical Resistivity

Measurements of Earth Resistivity at Al Manakher Solar Plant Site

Insitu Determination of Soil and Rock Resistivity Values

ASTM G57 Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method

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Measurements of Earth Resistivity at Al Manakher Solar Plant Site

ASTM G57 Test Method for Field Measurement of Soil Resistivity
Using the Wenner Four-Electrode Method

1.0 PURPOSE

This report is intended as a guide to the application of earth resistivity techniques to shallow subsurface investigation of engineering sites. The primary purpose of the report is to provide the client subsurface physical properties (resistivity or conductivity) of outcrops (filling materials, soil and rocks). One-dimensional (1D) electrical resistivity measurements were conducted with the Iris instruments, Syscal R1 plus resistivity meter to get the ground apparent resistivity. The grounding system for any infra-structure is strongly dependent on the ground conditions. Accurate prediction of these conditions can reduce the planning risk considerably. Resistivity measurements were carried out utilizing a Wenner array (four electrodes, Equally Spaced).

2.0 OBJECTIVES OF TESTS

Measurements of ground apparent resistance or impedance and potential gradients on the surface of the earth due to ground currents are useful for:
1) Estimating the ground resistance of a proposed substation, transmission tower or grounding installation.
2) Estimating potential gradients including step and touch voltages.
3) Computing the inductive coupling between neighboring power and communication circuits and earth surface potentials of a ground system.
4) Designing cathodic protection systems.
5) Geological and Engineering surveys.

3.0 METHODOLOGY AND DATA ACQUISTION

Geoelectrical resistivity methods have proved to be very useful in geological applications like mining exploration, geotechnical investigations, hydrology and others. The electrical resistivity of any material is defined as the resistance (in Ohms) between the opposite faces of a unit cube of that material. The resistivity is expressed by ρ in Ohm meters (Ω.m). In sounding the measured resistance values at the surface reflect the vertical distribution of resistivity values in a geological section. As sounding gives the vertical distribution of resistivity values with respect to various layers in the subsurface at the sounding point.

A soil resistivity survey was performed at the site to evaluate reference potentials and identify possible requirements for grounding protection systems. The soil resistivity survey was performed in accordance with ASTM G57 - 06(2012) Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method. The survey was performed on June 20, 2016.

A thirteen of electrical soundings with Wenner configuration using four electrodes equally spaced (4-pole sounding symmetrical method), figure 1, were conducted utilizing Iris Resistivity Meter (Syscal R1 plus), figure 2 and figure 3, at different locations within the study area at Al Manakher, figure 4. Coordinates of soundings were listed in table 1.

To conduct the survey, an electrode spacing of 0.5, 1, 2, 3, 5, 7, 10, 12, 15, and 20 meters (for a total array length of 1.5, 3, 6, 9, 15, 21, 30, 36, 45 and 60 meters, respectively) was used to acquire resistivity data. Two axes, North-South (N-S) and East-West (E-W) array were measured and recorded for each station in straight line.

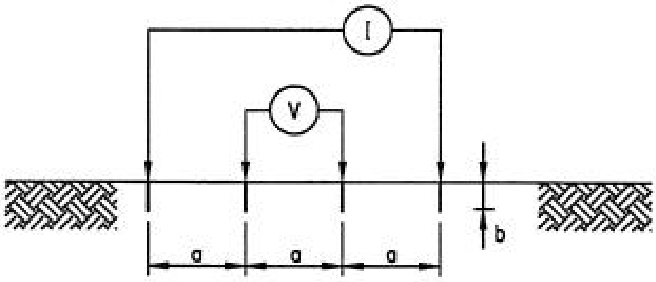

Figure 1. Wenner Array Configuration.

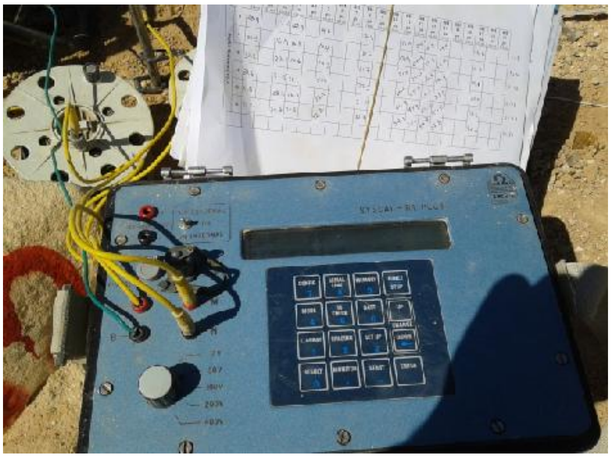

Figure 2. Iris Resistivity Meter (Syscal R1 plus).

Figure 3. Iris Resistivity Meter (Syscal R1 plus) at the site.

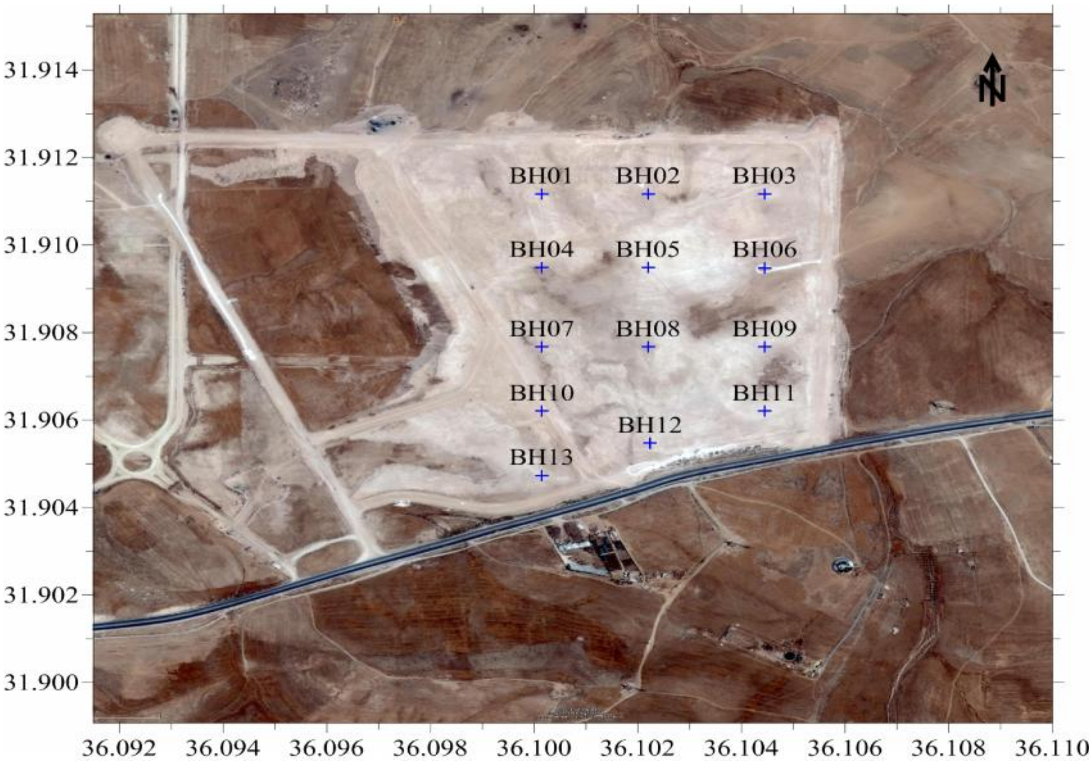

Figure 4. Location of Resistivity soundings based on Aerial image.

Table 1: Geoelectrical Soundings Coordinates

Sounding ID	Longitude	Latitude	Elevation (m)
BH01	36.10015	31.91117	810
BH02	36.10220	31.91117	816
BH03	36.10445	31.91117	812
BH04	36.10015	31.90948	816
BH05	36.10220	31.90948	822
BH06	36.10445	31.90948	814
BH07	36.10015	31.90767	816
BH08	36.10220	31.90767	823
BH09	36.10445	31.90767	815
BH10	36.10015	31.90620	814
BH11	36.10445	31.90620	817
BH12	36.10224	31.90547	826
BH13	36.10015	31.90473	811

The resistivity measurements are normally made by injecting current into the ground through two current electrodes (outer electrodes) and measuring the resulting voltage difference at two potential electrodes (inner electrodes). From the current (I) and voltage (V) values, an apparent resistivity (ρ_a) value is calculated.

$$\boldsymbol{\rho_a = k\, V / I}$$

Where; k is the geometric factor which depends on the arrangement of the four electrodes.

Earth resistivity varies not only with the type of soil but also with temperature, moisture, salt content, and compactness. The values of earth resistivity vary from 0.01 to 1 Ω.m for sea water (saline water) and up to 109Ω.m for sandstone. The resistivity of the earth increases slowly with decreasing temperatures from 25°C to 0°C. Below 0°C the resistivity increases rapidly.

4.0 INSTRUMENT AND TOOLS.

Resistivity meter, Iris Instrument type Syscal R1 plus
Rods (electrodes)
Current cables on reels
Voltage cables on reels
Hummer

- Syscal R1 Plus specifications.

– TRANSMITTER

Automatic fitting of the current and voltage output values:

- ✓ Maximum output voltage: 600 V
- ✓ Maximum output current: 2500 mA

Output current specifications
Resolution:10 µA
Accuracy: Standard 0.3%
Max 1% from –20°C to 70°C
Waveforms: choice of [ON+, ON-] or [ON+, OFF, ON-, OFF] (for IP measurements), with a selectable pulse duration (0.25, 0.5, 1 or 2 s).

– RECEIVER

Input impedance: 10 MΩ
Input overvoltage protection
Input voltage range: -10 V to +10 V
Automatic SP bucking (± 10 V) with linear drift correction
50/60 Hz power line rejection
Voltage measurement specifications:
Resolution: 1 µV after stacking
Accuracy: Standard 0.3%
Max 1% from –20°C to 70°C
Continuous digital stacking up to 255 stacks
Chargeability accuracy: 1% of value for input voltage higher than 10 mV

– GENERAL

LCD display with 2 lines of 20 characters

Power supply (battery):

- ✓ Internal 12 V / 7 Ah rechargeable
- ✓ External 12 V

Operating temperature range:
20°C to 70°C
Storage temperature:
40°C to 80°C
Dimensions: 31x31x21 cm
Weight: 9.5 kg (including battery)

5.0 MEASUREMENTS.

Table.2 include day and date, weather condition, soil condition, tester model and serial number, station number, probe distance and the measurements value (apparent resistivity-ρ_a) for the thirteen electrical soundings with Wenner configuration that have been applied at the site .

Table.2: Field Resistivity Measurements.

DATE: 2016-06-20
DAY: Monday
TESTER MODEL: SYSCAL R1+
SERIAL NO.: 137
SOIL CONDITION: DRY
WEATHER CONDITION: SUNNY

Sounding ID	Direction	Apparent Resistivity Values (Ohm.m) VS Electrode Spacing (a) meter									
		0.5	1	2	3	5	7	10	12	15	20
BH1	N - S	64.2	58.8	77.1	91.5	113.6	127.8	131.3	142.9	133.0	139.4
	E - W	68.2	66.1	80.4	93.6	110.2	121.8	125.5	132.3	124.9	122.8
BH2	N - S	103.6	136.5	182.5	198.0	193.7	181.4	167.3	157.0	142.6	130.8
	E - W	115.2	152.4	193.8	195.2	198.5	176.4	151.0	142.1	132.3	123.4
BH3	N - S	225.7	192.2	148.6	140.5	143.8	151.5	160.0	162.2	158.9	148.9
	E - W	228.5	182.3	138.9	129.4	136.2	144.2	151.7	154.6	156.4	154.8
BH4	N - S	223.4	213.5	197.6	166.2	142.1	154.5	181.7	199.2	228.8	271.6
	E - W	246.5	238.1	204.4	172.0	147.1	149.2	173.3	193.7	224.4	250.1
BH5	N - S	234.1	168.2	131.4	139.8	170.1	188.9	206.4	211.7	213.2	210.8
	E - W	216.3	150.4	118.9	127.5	155.8	180.1	197.6	207.6	210.4	220.1
BH6	N - S	270.5	213.4	170.3	181.7	232.1	278.3	330.6	340.6	370.8	415.5
	E - W	289.2	230.4	183.8	187.2	223.0	263.4	305.0	328.2	356.0	377.0
BH7	N - S	278.0	193.0	126.0	108.0	109.0	120.0	147.0	161.0	186.0	214.0
	E - W	248.0	172.0	114.0	93.0	98.0	110.0	134.0	148.0	169.0	191.0
BH8	N - S	304.0	187.0	119.0	105.0	99.0	103.0	113.0	121.0	128.0	133.0
	E - W	273.0	174.0	107.0	93.0	88.0	93.0	101.0	108.0	114.0	121.0
BH9	N - S	281.0	225.0	145.0	115.0	110.0	126.0	155.0	164.0	190.0	222.0
	E - W	297.0	258.0	170.0	130.0	121.0	133.0	160.0	172.0	197.0	232.0
BH10	N - S	234.0	183.0	213.0	246.0	295.0	340.0	367.0	388.0	409.0	417.0
	E - W	215.0	171.0	199.0	234.0	283.0	322.0	350.0	367.0	394.0	402.0
BH11	N - S	130.1	121.8	119.1	138.8	171.3	193.5	207.6	214.4	210.8	209.1
	E - W	135.2	118.1	113.5	126.4	157.5	177.6	188.1	198.0	201.2	199.3
BH12	N - S	218.0	151.0	132.0	147.0	183.0	208.0	234.0	241.0	254.0	266.0
	E - W	246.0	168.0	145.0	158.0	192.0	214.0	229.0	234.0	239.0	242.0
BH13	N - S	387.0	273.0	135.0	152.0	167.0	183.0	194.0	204.0	215.0	209.0
	E - W	350.0	242.0	157.0	160.0	182.0	195.0	210.0	213.0	220.0	222.0

The measured apparent resistivity values are normally plotted on a log-log graph paper (Figure 5 to Figure 17). To interpret the data from such a survey, it is normally assumed that the subsurface consists of horizontal layers. In this case, the subsurface resistivity changes only with depth. The graph contains the apparent resistivity values (left hand) and layered model (right hand). Interpretation were done using IX1D a licensed software by Interpex Limited.

Table 3 summarized the results of the Interpretation including orderly the layered model, resistivity of the layers and the borehole logs for each sounding.

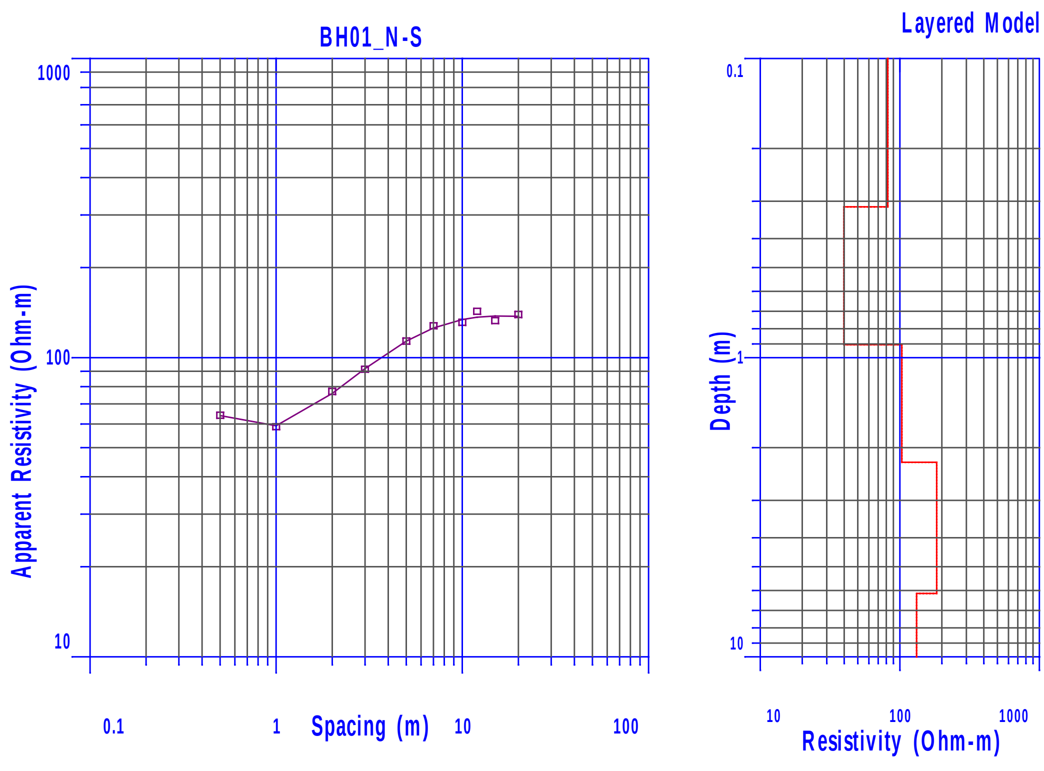

Figure.5. Resistivity measurements (BH01) graph.

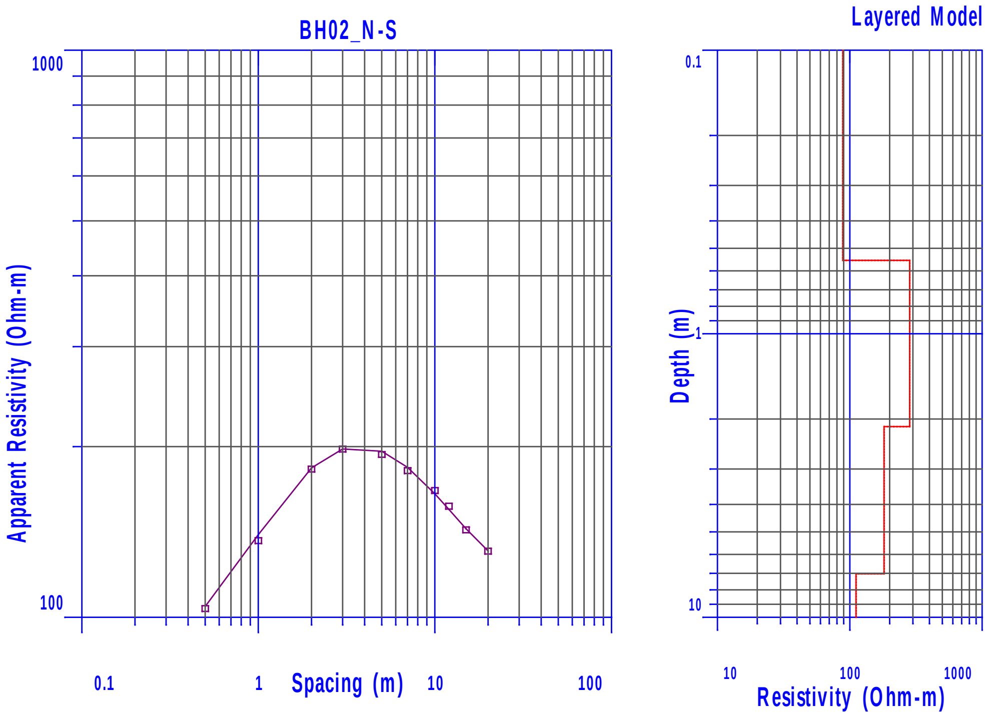

Figure.6. Resistivity measurements (BH02) graph.

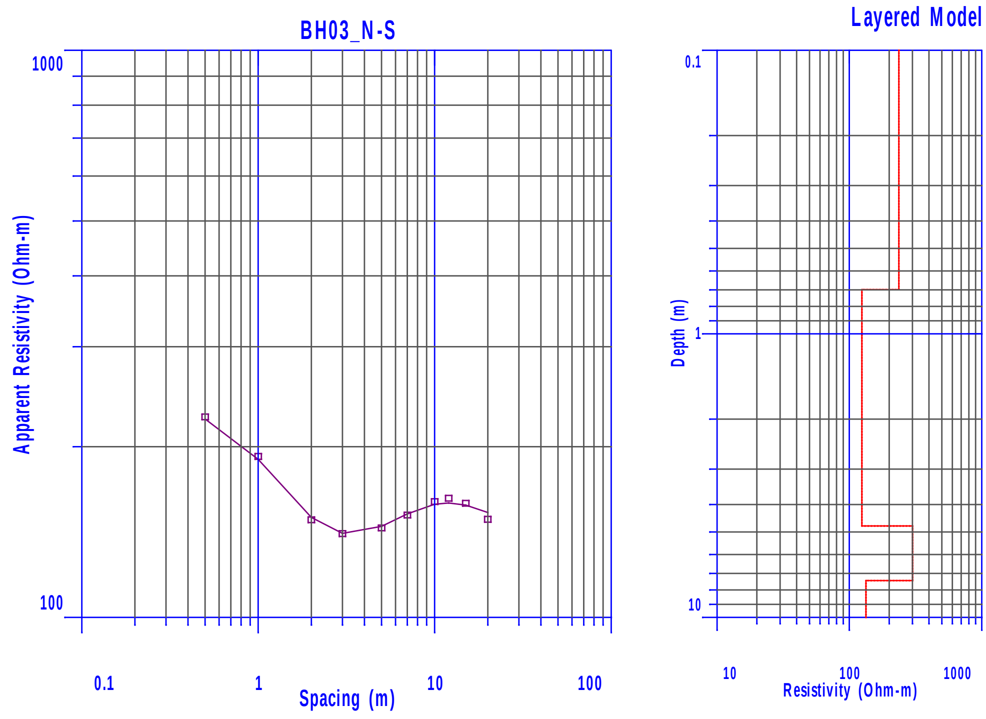

Figure.7. Resistivity measurements (BH03) graph.

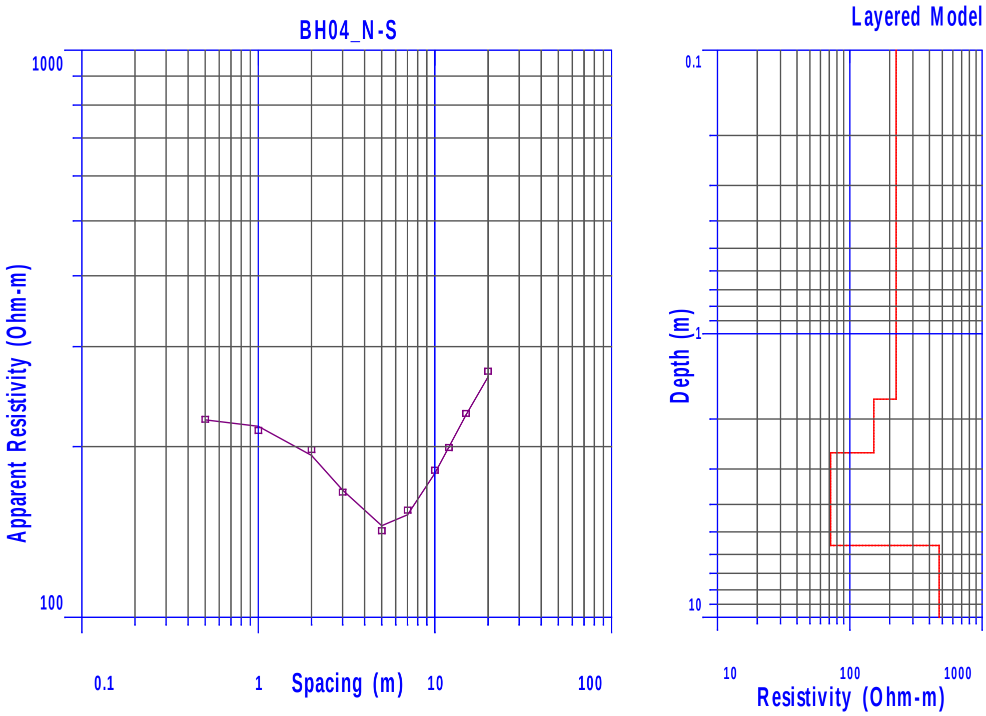

Figure.8. Resistivity measurements (BH04) graph.

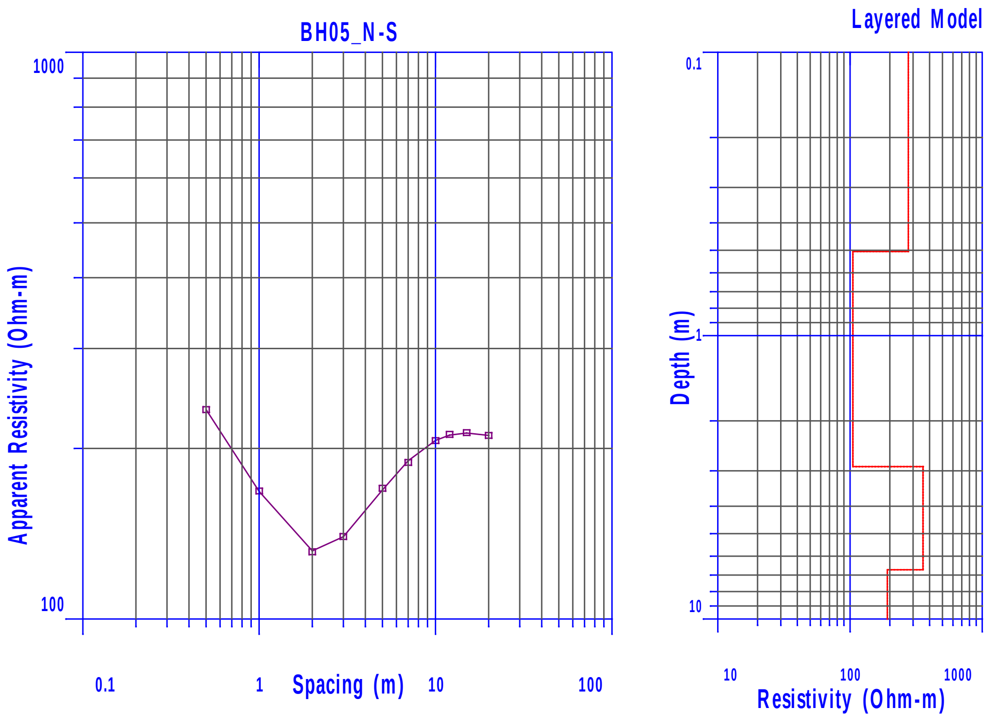

Figure.9. Resistivity measurements (BH05) graph.

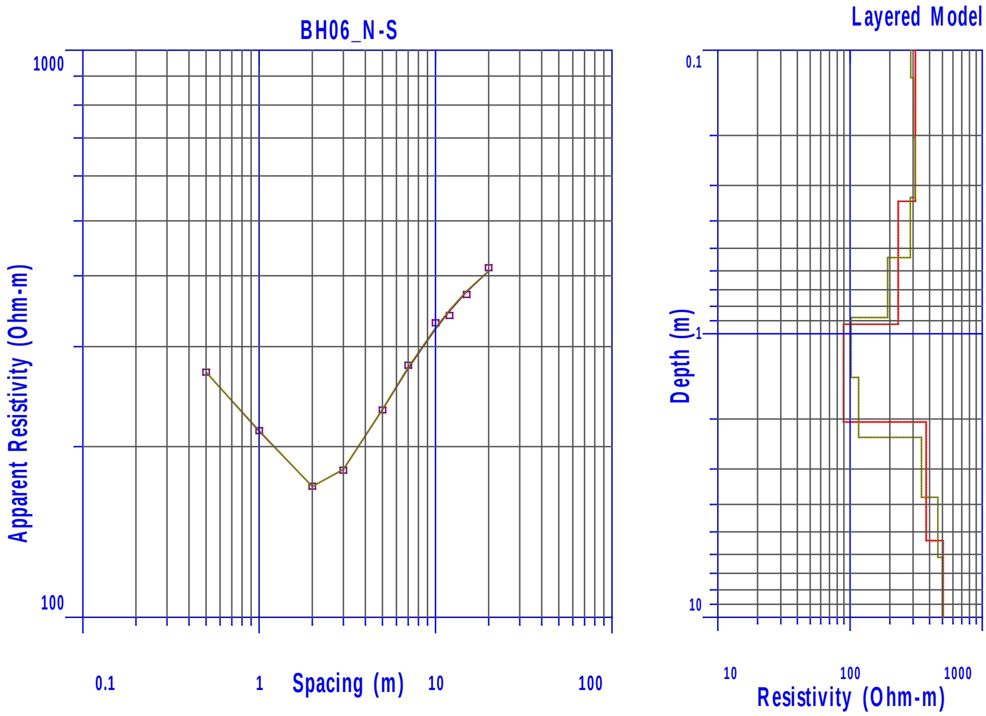

Figure.10. Resistivity measurements (BH06) graph.

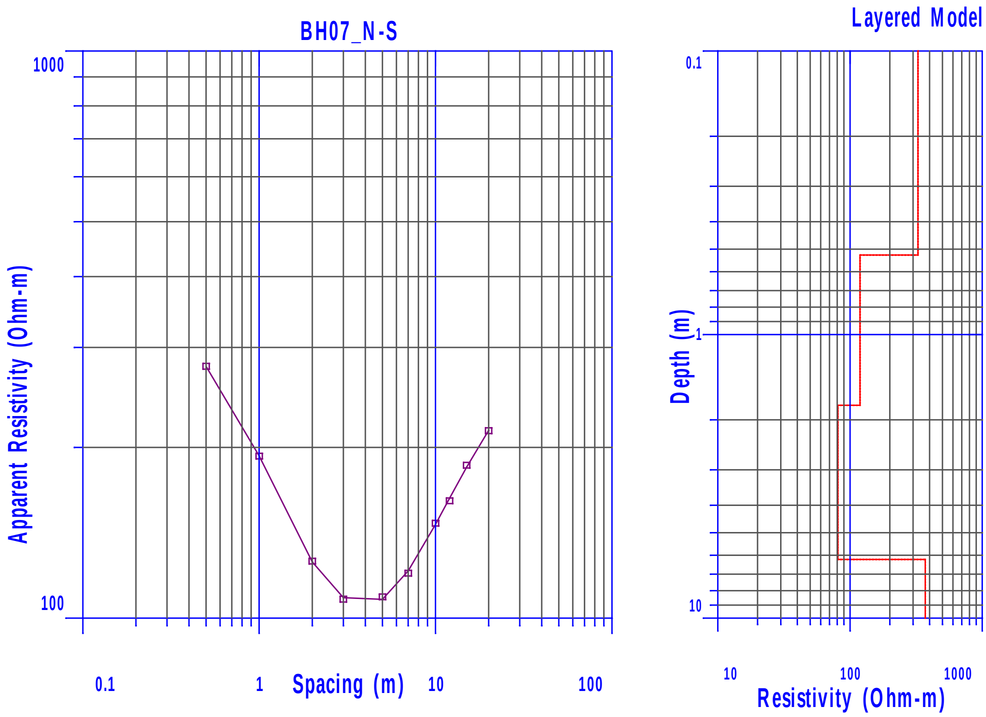

Figure.11. Resistivity measurements (BH07) graph.

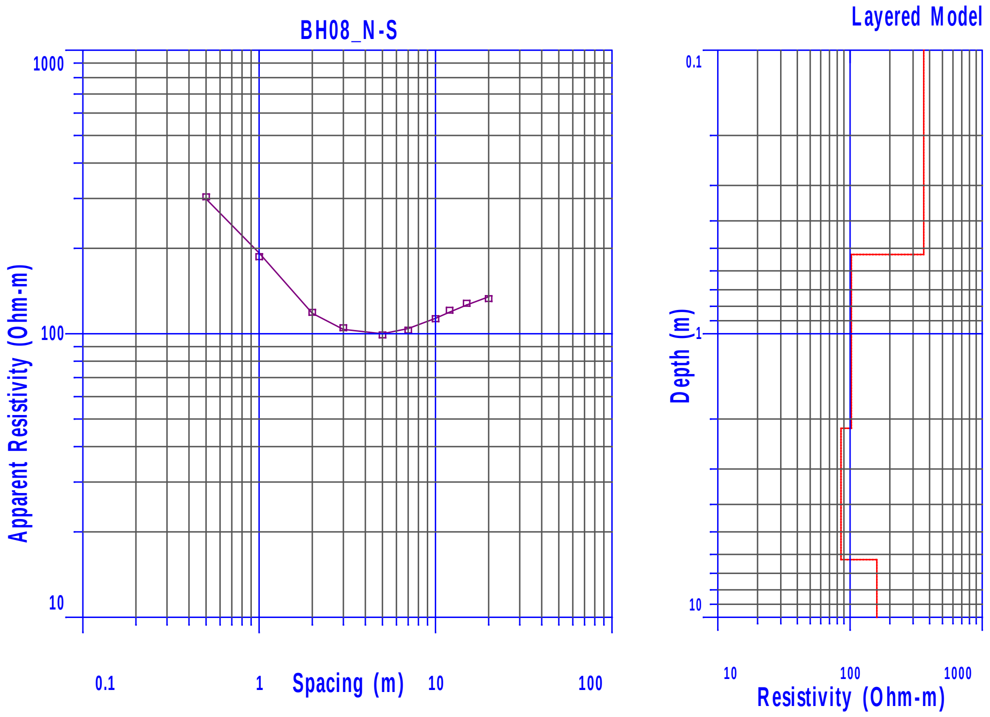

Figure.12. Resistivity measurements (BH08) graph.

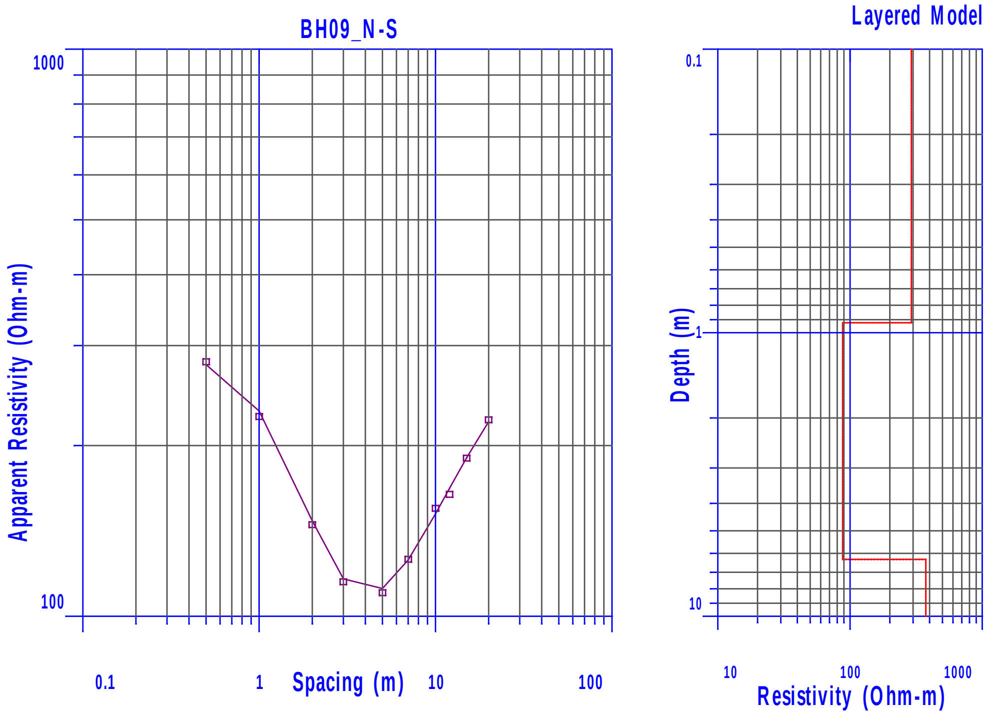

Figure.13. Resistivity measurements (BH09) graph.

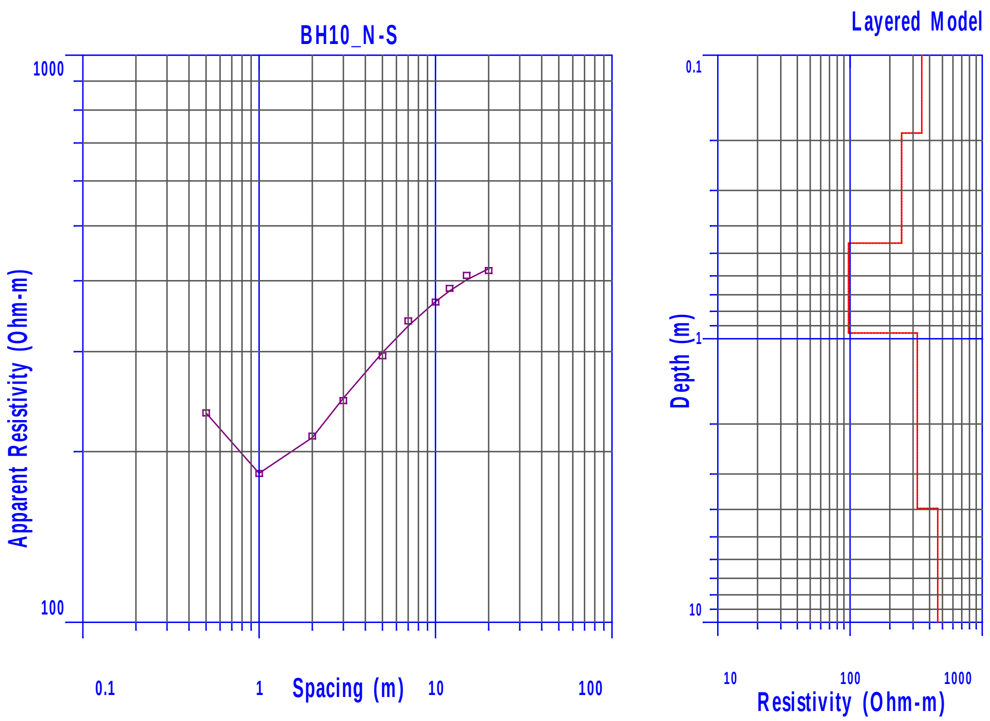

Figure.14. Resistivity measurements (BH10) graph.

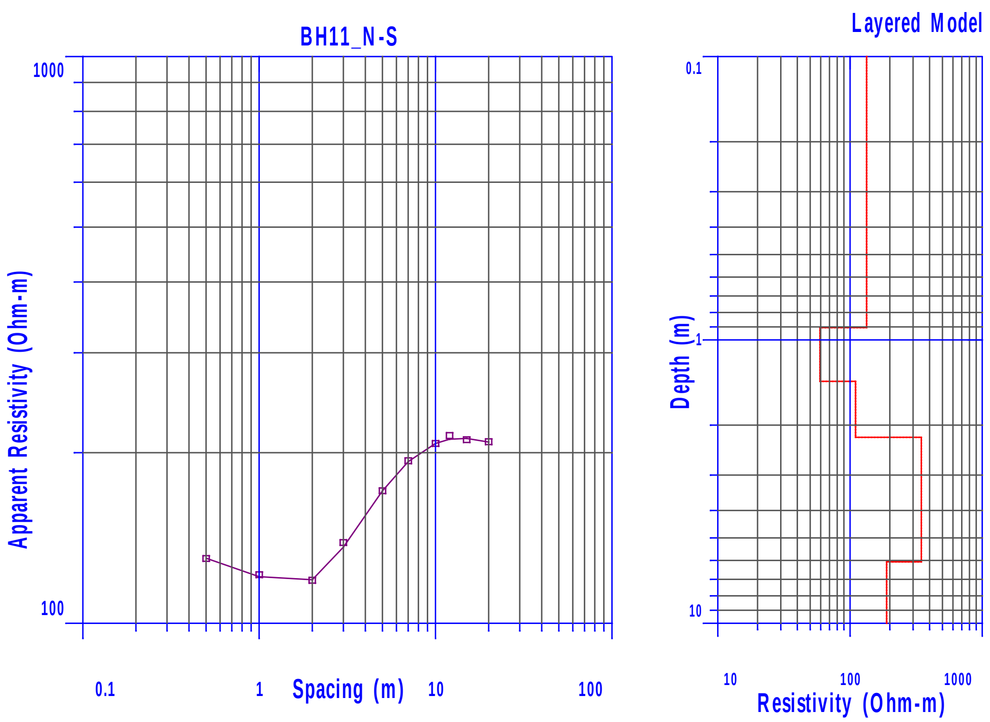

Figure.15. Resistivity measurements (BH11) graph.

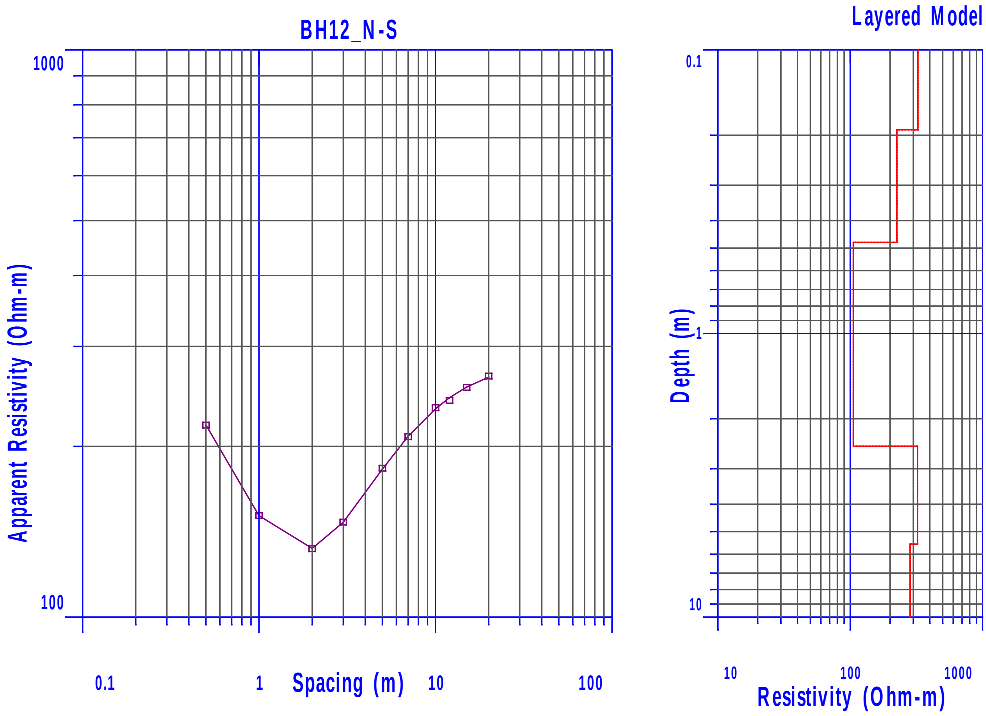

Figure.16. Resistivity measurements (BH12) graph.

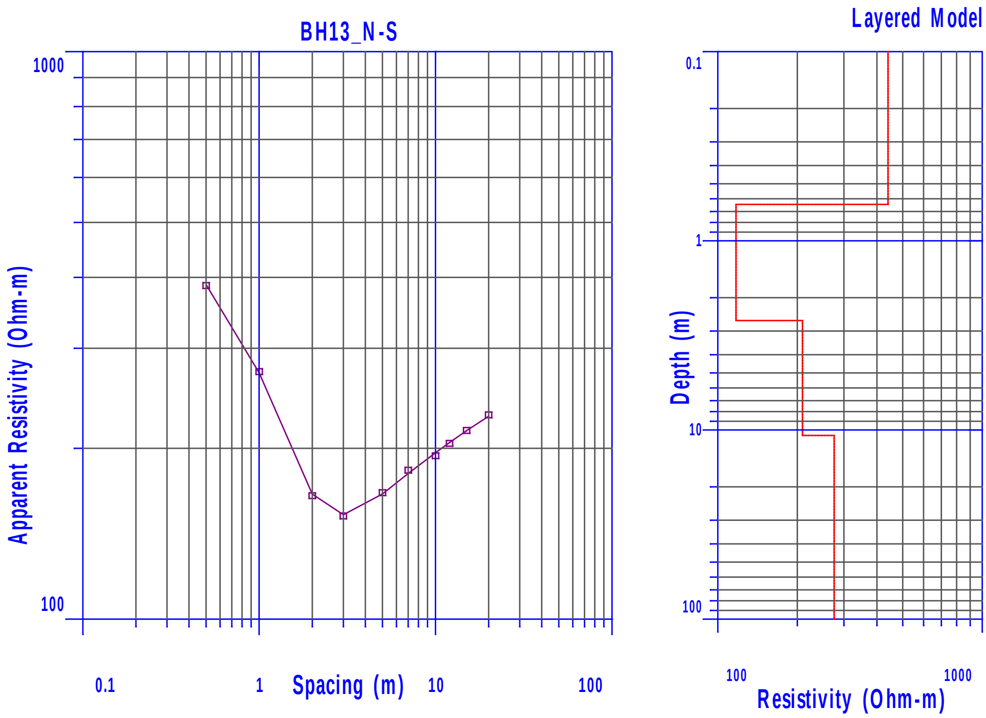

Figure.17. Resistivity measurements (BH18) graph.

Table 3: Summary interpretation of results

<table>
<tr><th rowspan="2">Sounding ID</th><th colspan="3">Layered Model</th><th colspan="2">Borehole Log</th></tr>
<tr><th>Layer No.</th><th>Resistivity (Ohm.m)</th><th>Thickness (m)</th><th>Description</th><th>Thickness (m)</th></tr>
<tr><td rowspan="5">BH1</td><td>1</td><td>81.9</td><td>0.31</td><td rowspan="2">Silty Clay (with 20-30% Gravels of Chert)</td><td rowspan="2">1</td></tr>
<tr><td>2</td><td>39.8</td><td>0.58</td></tr>
<tr><td>3</td><td>103.5</td><td>1.33</td><td rowspan="2">Marl (Very weak to weak marl with some nodules of Chert)</td><td rowspan="2">4</td></tr>
<tr><td>4</td><td>183.6</td><td>3.9</td></tr>
<tr><td>5</td><td>131.8</td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">BH2</td><td>1</td><td>88.7</td><td>0.55</td><td>Silty Clay (with 20-30% Gravels of Chert)</td><td>0.5</td></tr>
<tr><td>2</td><td>283.4</td><td>1.57</td><td rowspan="2">Mixture Materials (silty clay with 50% gravel and cobbles of chert)</td><td rowspan="2">4.5</td></tr>
<tr><td>3</td><td>181.5</td><td>4.90</td></tr>
<tr><td>4</td><td>111.5</td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">BH3</td><td>1</td><td>236.6</td><td>0.69</td><td>Limestone (weak and fractured with marl filling & some nodules of chert)</td><td>0.5</td></tr>
<tr><td>2</td><td>124.3</td><td>4.0</td><td>Marl (Very weak to weak marl with some nodules of Chert)</td><td>4.5</td></tr>
<tr><td>3</td><td>300.5</td><td>2.65</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>4</td><td>133.4</td><td></td></tr>
<tr><td rowspan="4">BH4</td><td>1</td><td>223.9</td><td>1.7</td><td rowspan="2">Mixture Materials (silty clay with 50%gravel and cobbles of chert)</td><td rowspan="2">3</td></tr>
<tr><td>2</td><td>152.0</td><td>0.93</td></tr>
<tr><td>3</td><td>71.7</td><td>2.95</td><td>Marl (Very weak to weak marl with some nodules of Chert)</td><td>2</td></tr>
<tr><td>4</td><td>472.5</td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">BH5</td><td>1</td><td>275.8</td><td>0.5</td><td>Limestone (weak and fractured with marl filling & some nodules of chert)</td><td>0.5</td></tr>
<tr><td>2</td><td>105.2</td><td>2.40</td><td>Marl (Very weak to weak marl with some nodules of Chert)</td><td>2.5</td></tr>
<tr><td>`3</td><td>356.4</td><td>3.8</td><td>Limestone (weak and fractured with marl filling & some nodules of chert)</td><td>2</td></tr>
<tr><td>4</td><td>191.2</td><td></td><td></td><td></td></tr>
<tr><td rowspan="5">BH6</td><td>1</td><td>311.4</td><td>0.34</td><td rowspan="2">Mixture Materials (silty clay with 50% gravel and cobbles of chert)</td><td rowspan="2">1</td></tr>
<tr><td>2</td><td>230.9</td><td>0.58</td></tr>
<tr><td>3</td><td>89.3</td><td>1.12</td><td>Marl (Very weak to weak marl with some nodules of Chert)</td><td>1</td></tr>
<tr><td>4</td><td>375.7</td><td>3.32</td><td rowspan="2">Limestone (weak and fractured with marl filling & some nodules of chert)</td><td rowspan="2">3</td></tr>
<tr><td>5</td><td>504.7</td><td></td></tr>
<tr><td rowspan="4">BH7</td><td>1</td><td>326.1</td><td>0.52</td><td>Limestone (weak and fractured with marl filling & some nodules of chert)</td><td>0.5</td></tr>
<tr><td>2</td><td>118.9</td><td>1.25</td><td rowspan="2">Marl (Very weak to weak marl with some nodules of Chert)</td><td rowspan="2">4.5</td></tr>
<tr><td>3</td><td>81.0</td><td>4.4</td></tr>
<tr><td>4</td><td>370</td><td></td><td></td><td></td></tr>
</table>

BH8	1	361.6	0.5	Limestone (weak and fractured with marl filling & some nodules of chert)	0.5
	2	102.0	1.16	Marl (Very weak to weak marl with some nodules of Chert)	4.5
	3	88.8	4.7		
	4	159.0			
BH9	1	291.3	0.92	Limestone (weak and fractured with marl filling & some nodules of chert)	1
	2	88.0	5.38	Marl (Very weak to weak marl with some nodules of Chert)	4
	3	374.2			
BH10	1	348.7	0.19	Limestone (weak and fractured with marl filling & some nodules of chert)	0.5
	2	245.5	0.27		
	3	97.4	0.49	Marl (Very weak to weak marl with some nodules of Chert)	0.5
	4	322.7	3.10	Limestone (thinly to thickly bedded - with strong chert and some marl)	4
	5	464.0			
BH11	1	133.8	0.90	Mixture Materials (silty clay with 50% gravel and cobbles of chert)	1
	2	60.7	0.49	Silty Clay (with 20-30% Gravels of Chert)	0.5
	3	110.0	0.80	Marl (Very weak to weak marl with some nodules of Chert)	0.5
	4	346.2	3.86	Limestone (weak and fractured with marl filling & some nodules of chert)	3
	5	189			
BH12	1	325.1	0.19	Limestone (weak and fractured with marl filling & some nodules of chert)	0.5
	2	225.5	0.29		
	3	105.7	2.0	Marl (Very weak to weak marl with some nodules of Chert)	2
	4	322.3	3.1	Limestone (weak and fractured with marl filling &	2.5
	5	283.5			
BH13	1	440	0.64	Limestone (weak and fractured with marl filling & some nodules of chert)	0.5
	2	117	2	Marl (Very weak to weak marl with some nodules	2
	3	209	8	Limestone (weak and fractured with marl filling & some nodules of chert)	2.5
	4	275			

APPENDIX F

Hydrological Study

Hydrological Study for solar energy plant in Al Manakher area, Eastern Jordan

12 July 2016

1.0 Introduction

In (semi-)arid regions available water resources are scarce and commonly overused necessitating the need to look for unconventional water resources or for better use of available resources. The Power Project site is located near the village of Al-Manakher, approximately 14 km to the east of Amman on a site leased from the Ministry of Finance / Department of Lands and Survey as shown in Figure (1). The surrounding areas are primarily undeveloped desert land with some residences northeast of the Project Area.

This study was aimed to estimate develop and evaluate the existing drainage patterns and flow rates for the runoff within the Project boundary. This data will be used in the preliminary design of the facilities.

2.0 Objectives of the study

The objective of this study is to develop and evaluate the existing drainage patterns and flow rates for the runoff within the Project boundary. The hydrology will be the base used to determine the location of the natural watercourses within the project area and the amount of runoff the existing watercourses convey. The proposed design of the Project will take into account the location of the existing drainage courses and the amount of flow. This study will also show the change in runoff rates and characteristics due to the development of the Project.

In addition, this study aims to prepare and to make basic hydrological parameters available for the local planning engineers by a precipitation-runoff simulation. This parameter should be a basic input for designing hydrologic design. The maximum possible discharge will be calculated and compared with the simulation results.

3.0 Description of the project area

The Power Project site is located near the village of Al-Manakher, approximately 14 km to the east of Amman on a site leased from the Ministry of Finance / Department of Lands and Survey. The coordinates of the project area is shown in Table (1) and Fig (1). Figure (2) show the proposed Solar Plant Project Area on google earth map.

Table (1): Coordinates of the Project Area

Points	N-Coord	E-Coord	Elevation
Point SW	31° 54.220'	36° 5.937'	812
Point NW	31° 54.729'	36° 5.942'	807
Point 5	31° 54.714'	36° 6.025'	810
Point 3	31° 54.711'	36° 6.342'	802
Point SE	31° 54.339'	36° 6.339	813

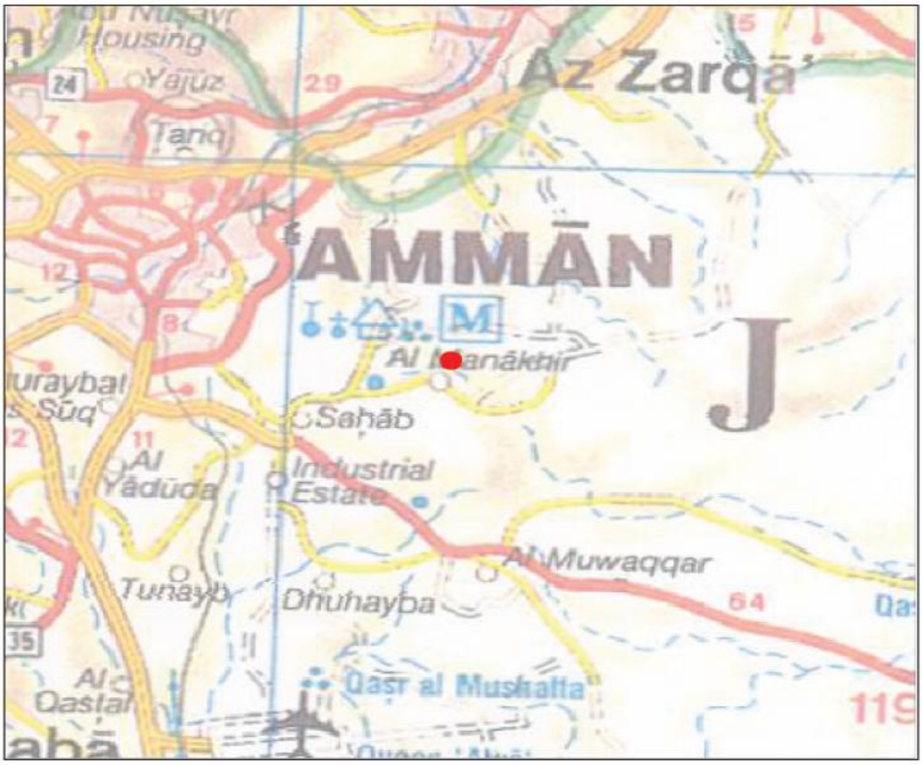

Fig.(1): Site location of Al-Manakher Solar power plant

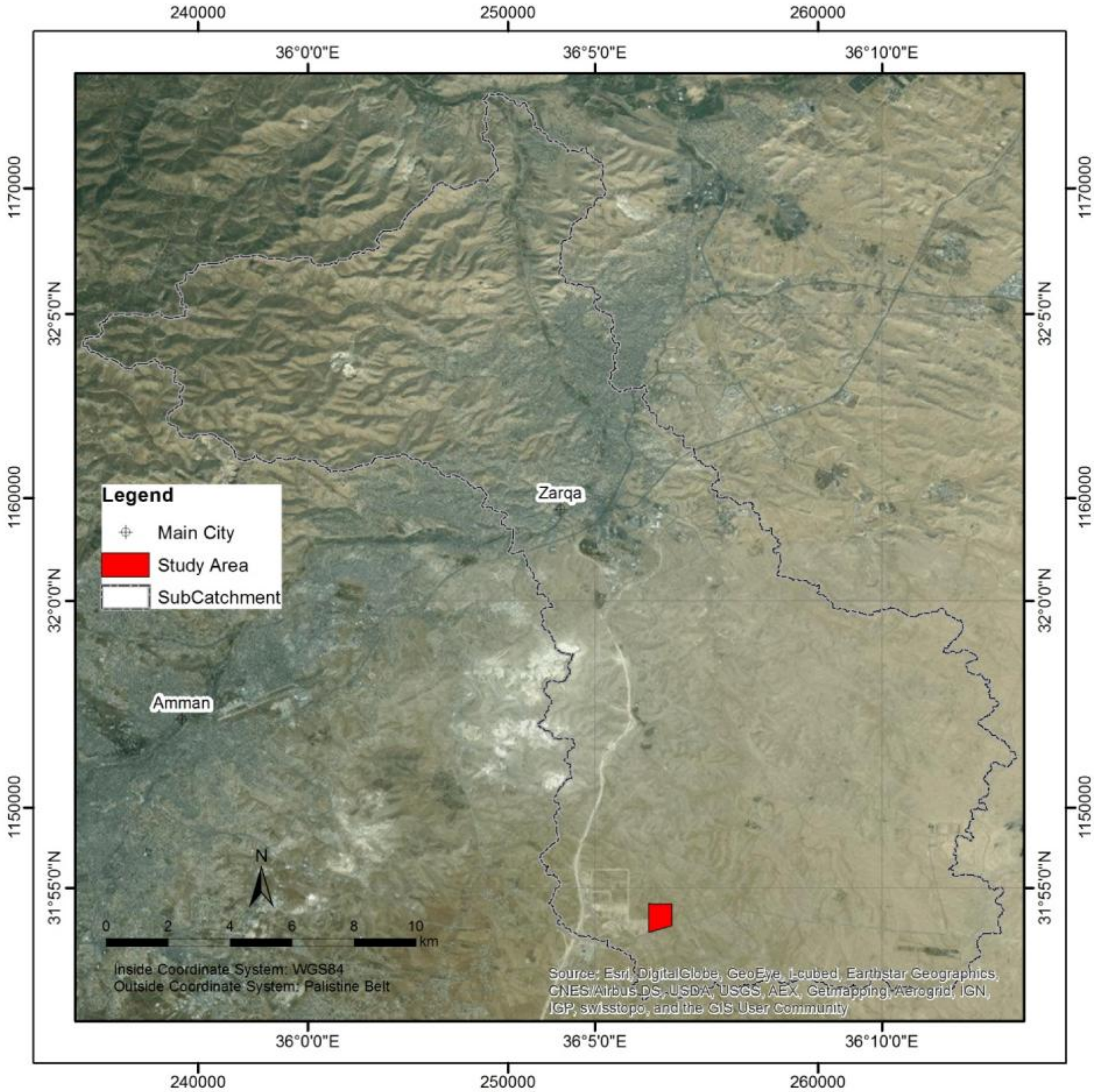

Fig.(2): Google earth map of the Project Area

5.0 Watershed Description of the Project Area

The project area is located within the southeastern part of the Amman Zarqa Basin (AZB). The digital elevation model for AZB is shown in Fig.(3), where the maximum elevation is approximately 1584 m above sea level and the lowest elevation is -199 m in the Ghor area. There are three main sources in AZB for surface water in the area as shown in Fig.(4). These are: springs; treated wastewater; and, dams. These resources are all found around the Amman-Zarqa Basin. None are located within 4 km of the Solar Power Project site. Surface water in the vicinity of the Power Project site is limited to flash storms, which normally occur during the winter months. This surface water is not exploited as most of it either evaporates or percolates into the ground. The average yearly rainwater (taken for the period 1980 to 2009) is approximately 220 mm during the winter months of October through March.

The elevation of the Project area is about 810 m above sea level as shown in the topographic map of the catchment area where the project area is located (Fig 5). The stream network is deduced from the digital elevation model of the sub-catchment where the project area is located as shown in Fig.(6). There is a main stream passing near the project area.

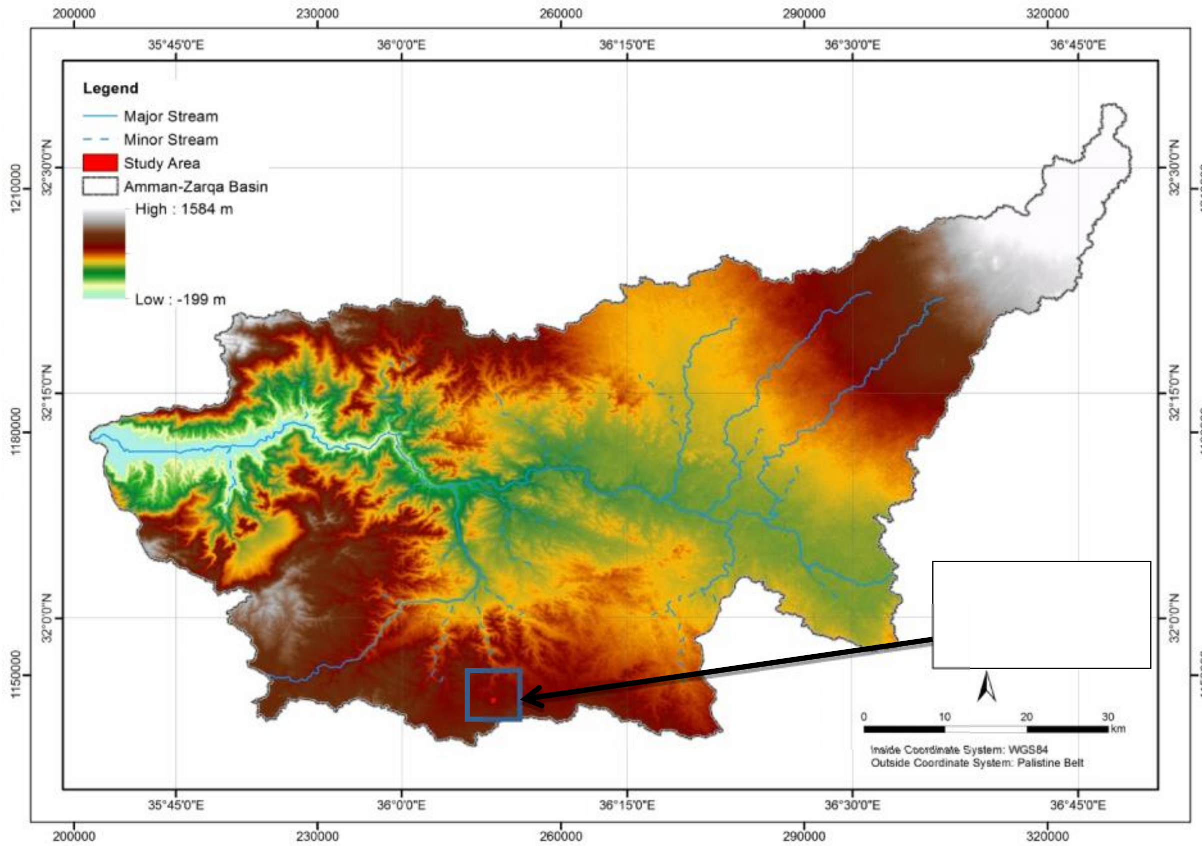

Figure (3): Digital Elevation Model (DEM) of the Project area

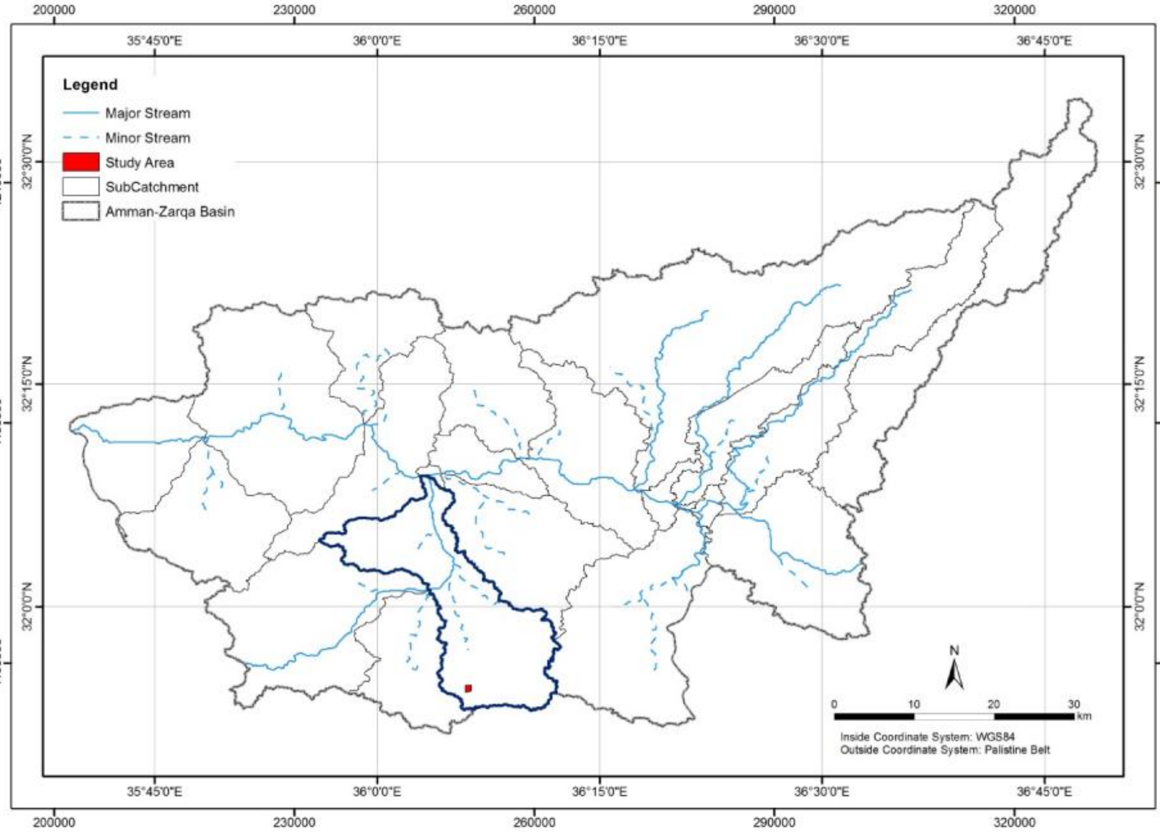

Figure (4): Location map of the sub-catchment of the Project Area

Figure (5): Topographic map of the Project sub-catchment area

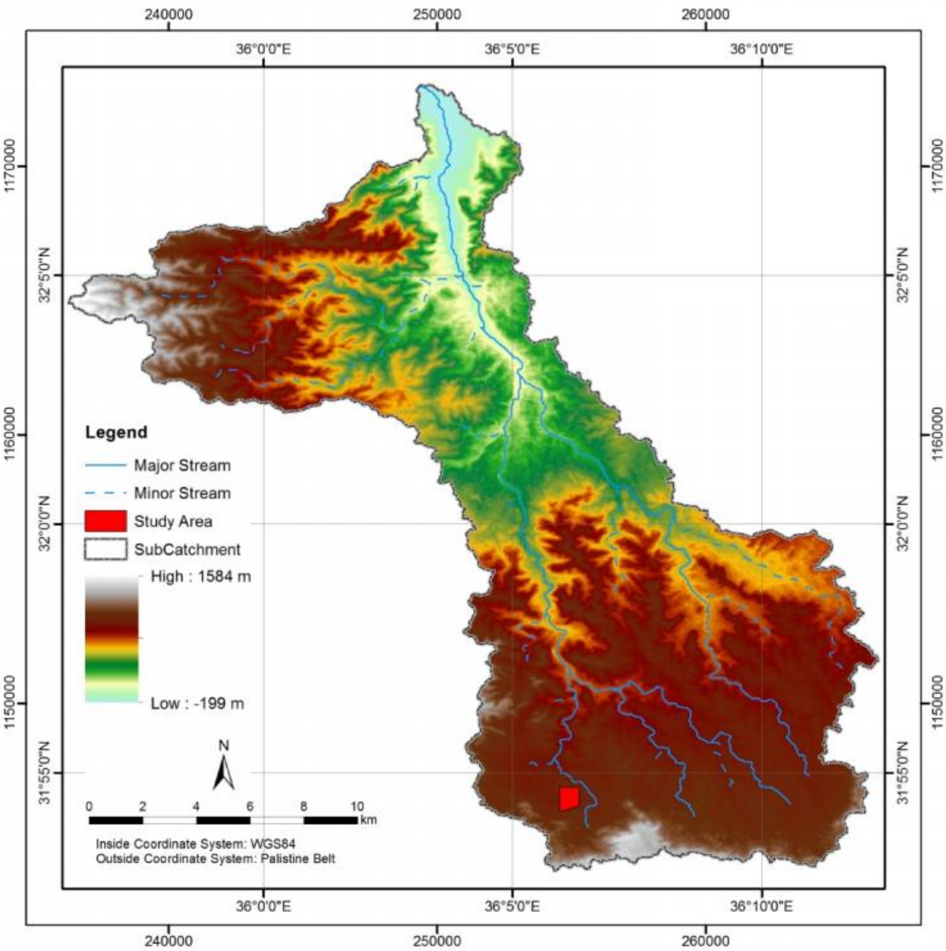

Figure (6): Digital elevation model showing the main streams in the Project Area

5.1 Climate

The climate in Jordan is predominantly of the Mediterranean type: hot and dry summer and cool wet winter with two short transitional periods in autumn and spring. During the short transitional periods most convective activity occurs producing thunderstorms. Precipitation pattern is both latitude and altitude dependent. Rainfall decreases from North to South, from West to East and from higher elevation to lower ones (JMD 2003). Table (2) shows the list of representative climatological stations and Table (3) shows List of representative rainfall stations in AZB.

Amman-Zarqa Basin is bordered by the highlands in the west and the foothills of Jabal Al Arab in the Northeast. Thus, the basin is located in a rain-shadow area, where moist air masses can only enter through two different conditions, one near Amman–Zarqa and the other near Mafraq. Hence, Amman-Zarqa Basin is located between humid climatic conditions in West and Saharian type of arid climate in the Southeast and East regions (USAID and WAJ 1989).

Table 2: List of representative climatological stations in AZB

Station Name	Station ID	PGN	PGE	Altitude (m asl)	Recording period	Missing records
Amman Airport	AL0019	538	4043	790	1970-2	1975-1979,
K.H. Nursery	AL0035	550	3910	700	1971-2	1985-1986
King Talal Dam	AL0053	563	3898	218	1972-1	1977,
Um El-Jumal	AL0059	575	4382	650	1970-2003	
Khirebit	AL0066	558	4194	540	1985-2003	

Table 3: List of representative rainfall stations in ZRB

Station ID	Station name	PGN	PGE	Recording period
AL0018	DEIR ALLA (NRA)	117850	209500	1960-2009
AL0035	K.H.NURSERY	116540	230000	1964-2009
AL0036	PRINCE FEISAL NURSERY	118050	234500	1964-2009
AL0047	SIHAN	117180	221600	1967-2009
AL0054	HASHIMIYA	117170	255200	1968-2009
AL0055	WADI DHULEIL NURSERY	117400	271000	1973-2009
AL0057	WADI ES-SIR (NRA)YARD	115160	230200	1979-2009
AL0059	UM EL-JUMAL EVAP .ST	119040	276800	1968-2009
-	Mafraq	119500	264000	1961-2005
AL0019	Amman Airport			1937-2010

The average annual rainfall varies from less than 200 mm Northeast to more than 500 and 600 mm Northwest close to Bal'ama station and West close of Salt station over the basin, respectively. Table (4) summarizes the average monthly climatic data representing the Project Area (1970 - 2012). The average of maximum rainfall is 61.8 mm/d in January, the average daily temperature is 12.4 °C during the wet season (from November to April) and 23.2 during the dry season (from May to October), whereas the average daily minimum temperature in the basin occurred in January is about 4.1 °C and about 33.1 °C as an average daily maximum temperature. The prevailing wind direction in the study area is west-southwestern in winter and shifting to west-northwestern in summer. The average daily wind speed is 2.1 m/s, ranging between 1.9 and 2.3 m/s in winter and 1.6 and 2.4 m/s in summer. The average daily relative humidity varies from 65.2 to 82.6% in winter and from 59.2 to 71% in summer.

Table (4): Average Monthly Climatic Parameters Representing the Study Area (1970 - 2012).

Parameters/Month	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Minimum daily temperature °C	13.3	8.9	6.1	4.1	4.7	6.7	9.7	13.1	16.0	18.0	17.8	16.3
Maximum daily temperature °C	27.5	20.4	16.3	13.6	15.9	18.3	23.9	28.4	31.5	33.1	32.5	31.4
Mean daily temperature °C	20.4	14.7	11.2	8.8	10.3	12.5	16.8	20.7	23.7	25.6	25.2	23.9
Sunshine duration (hrs/day)	8.3	6.8	5.4	5.3	6.2	7.2	8.2	10.1	11.1	11.4	10.8	9.3
Wind speed (m/s)	1.6	1.9	1.9	1.9	2.2	2.2	2.3	2.3	2.4	2.4	2.1	1.7
Wind direction	W-SW	W SW	W SW	W SW	W SW	W NW	W NW	W NW &NE	W NW &NE	W SW	W SW	W SW
Relative humidity (%)	71.0	73.4	81.1	82.6	81.1	73.5	65.2	59.2	59.8	63.7	68.0	69.3
Rainfall (mm)	7.3	25.1	48.9	61.8	55.1	42.9	12.8	1.	0.0	0.0	0.0	0.0
Class-A pan (mm/d)	7.6	5.2	3.2	2.8	3.8	5.2	8.1	11.0	12.5	13.4	11.8	10.0
Potential evapotranspiration (mm/d)	4.2	2.5	2.3	2.1	2.6	3.9	5.7	6.	7.6	8.1	7.2	5.6

5.2 Precipitation

Rainfall is the most important parameter in the hydrological cycle. Generally, the amount of rainfall is mainly governed by the topographic elevation of a location. In addition, the dominant conditions for precipitation to form may be summarized as follows: supply of moisture, cooling to below point of condensation, condensation and growth of drops.

5.2.1 Rainfall stations

The first rainfall station in Jordan was established in Amman Airport which is located in Amman-Zarqa Basin during the year of 1922/23. The density of the rainfall stations is 62 km2/station. According to the World Meteorological Organization Guide (WMO 1994), this density is sufficient to evaluate the hydrological situation in the study area. However, because of lack in documentation of rainfall data, measurement accuracy and incomplete data set, not all rainfall stations have been selected to represent and evaluate the hydrological situation in the study area. Figure (7) shows the distribution of rainfall stations in the vicinity of the Project Area with recording gauges that measure daily rainfall. Table (5) shows the Average monthly rainfall for the representative rainfall stations in AZB. The average rainfall in the Project Area is approximately 220 mm per annum as shown in the isohyetal map of the Project Area (Fig.8).

Table (5): Average monthly rainfall for the representative rainfall stations in mm

Station	Jan	Feb	Mar	Apr	May	Oct	Nov	Dec	Annual
AL0019	63.4	56.1	43.3	15.4	4.6	10.0	24.3	49.3	253.2
AL0035	77.2	72.5	64.2	14.5	5.8	12.0	36.1	63.0	324.1
AL0036	81.3	74.6	66.4	18.3	6.2	12.0	34.2	67.1	343.8
AL0047	91.0	80.3	75.6	24.2	6.6	11.6	42.4	69.9	374.6
AL0054	29.5	28.7	22.2	8.0	8.0	7.4	15.0	22.2	116.4
AL0055	32.3	29.8	21.1	7.5	3.0	8.9	18.1	24.5	132.7
AL0057	126.3	116.7	91.2	20.9	8.6	16.3	53.0	101.7	475.9
AL0059	32.3	29.8	21.1	7.5	3.0	8.9	18.1	24.5	132.7
Mafraq	36.0	30.6	27.8	8.6	4.5	7.5	19.5	29.4	158.7
Total	50.0	45.4	37.1	11.9	5.0	9.4	23.7	39.2	204.4

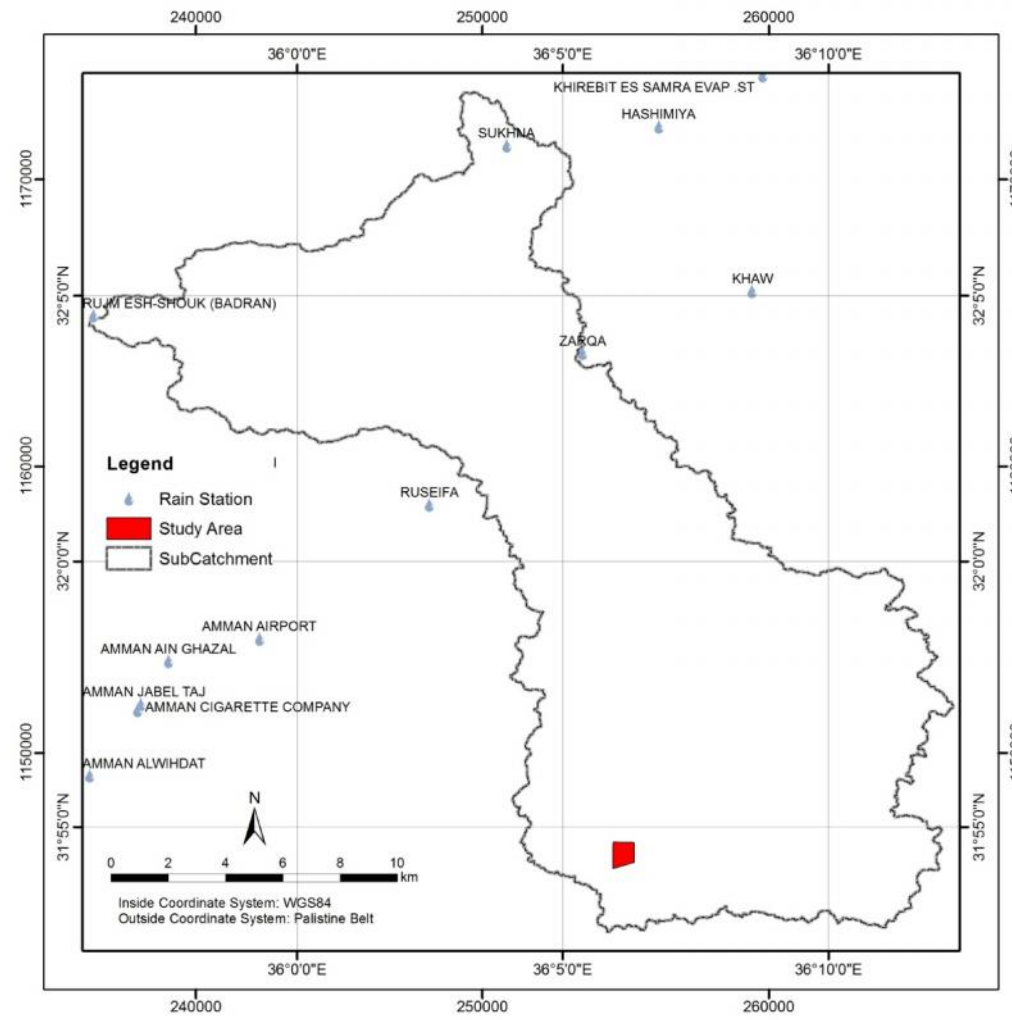

Figure (7): Location map of the rainfall stations in the vicinity of Project Area

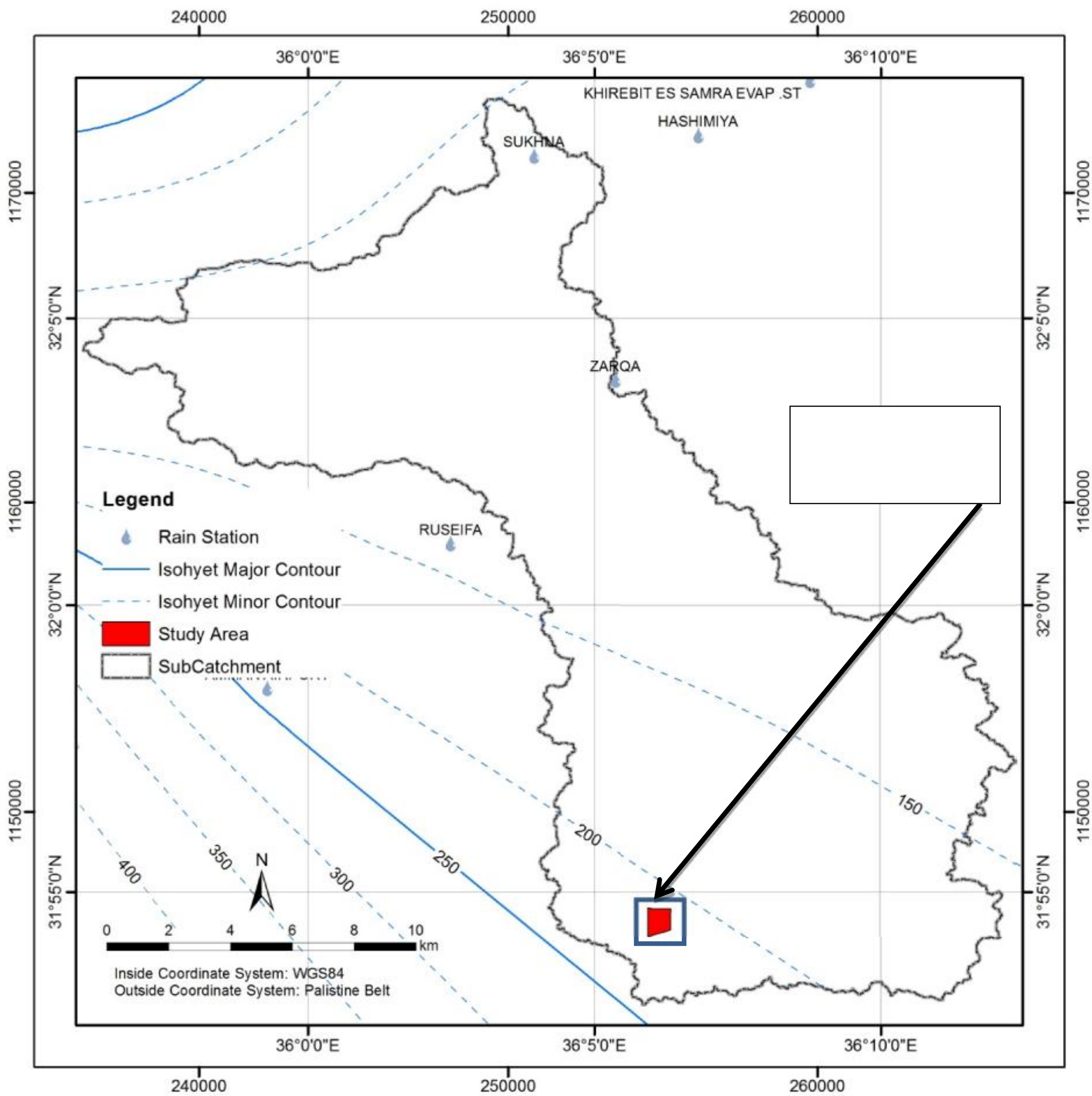

Figure (8): Isohyetal map of the Project Area

5.3 Evaporation

Evaporation is the transfer process of water from liquid state into water vapor which requires energy to provide the latent heat of vaporization (Chow et al. 1988). The combination process of the evaporation from surface ground and plants is known as evapotranspiration. According to the location of Jordan in arid and semi arid zone, the evapotranspiration (ET) plays an essential role in order to evaluate the hydrological situation (aside from the surface runoff) and to estimate the infiltration rate.

5.3.1 Evaporation stations

The first evaporation station established in Amman-Zarqa Basin was Amman Airport station in 1959 (USAID and WAJ 1989). During the sixties three other stations were installed in the study area (AL0035: King Husein Nursery, AL0059: Um El-Jumal and AL0053: King Talal Dam). Moreover, during the seventies three stations were added in the study area (Mafraq Airport, AL0004: Jarash Bridge and AL0055: Wadi Dhuleil). In 1985, another station was added (AL0066: Khirbet As-Samra Evap. Station) parallel with the biggest treatment plant built in Jordan (Khirbet As-Samra). According to the WMO standards, the density of the evaporation stations over the study area is sufficient (436 km2/station) because the minimum network required in arid areas is one station per 30000 km2. Two methods have been applied to evaluate and analyze the process within the evaporation and evapotranspiration in this study; i.e. evaporation pan (Class-A pan) and Penman's equation. Table (6) shows the monthly average evaporation in the Project Area.

5.3.2 Evaporation pans

The standard of USA Weather Bureau Class-A pan evaporation (EP) is widely used in Jordan. It consists of a galvanized iron pan, 122 cm in diameter, 22.4 cm deep and is placed 15 cm above ground on a wooden frame that allows air to circulate under it. Generally, water level is kept between 19 and 20 cm (MWI 2003). Also, Piche Evaporimeter used to measure the evaporation amounts but it is not commonly used for computations of water budget but it could be used to check the Class-A pan or to cover the gaps in the pan measurements. According to the Class-A pan evaporation measurements, the long-term average of annual evaporation varies from less than 2500 mm in the southwestern parts to more than 3200 in the northeastern and eastern parts of the study area (Fig. 9). The average annual Class-A pan evaporation at the Project Area is around 2600 mm/Year. In addition, the shape of the evaporation contours lines have been changed in the southwestern parts because of the transitional zones between the high lands in the west to desert in the east. Since the temperature increases from west (hills zone) to east (desert zone).

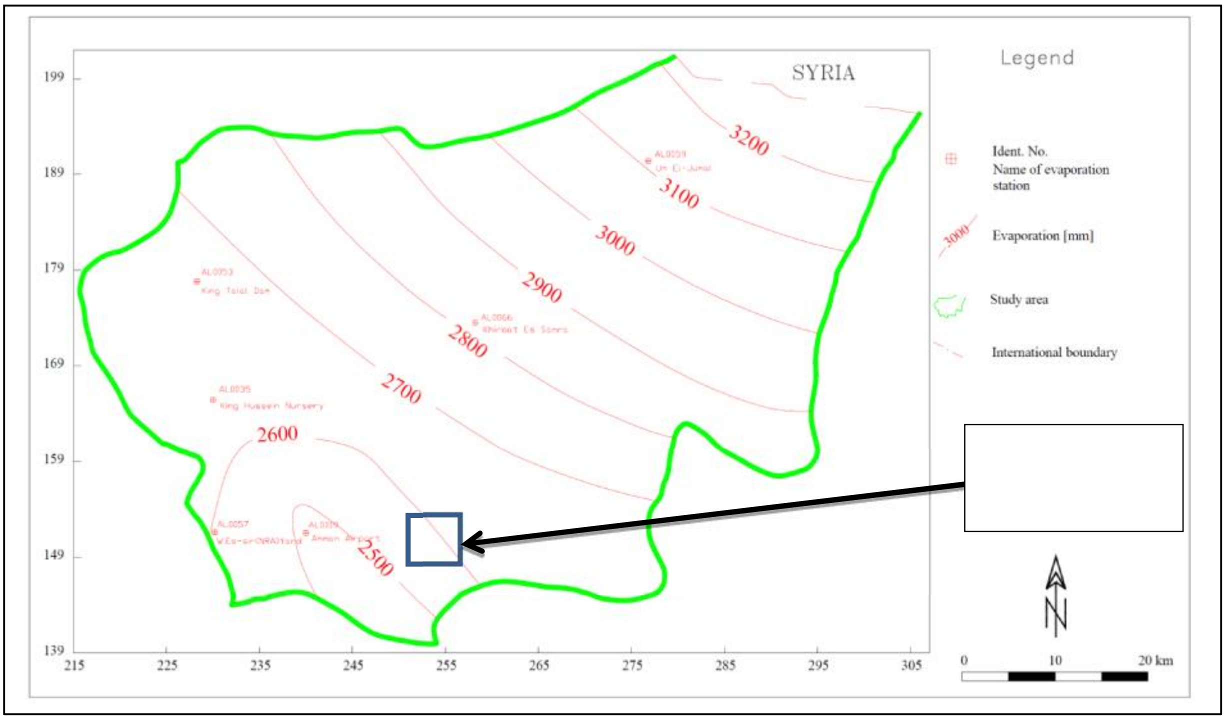

Figure (9): Contour map of long-term average annual Class-A pan evaporation over AZB

Table (6): Monthly average evaporation in mm per day

Station ID	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
AL0019	5.9	3.4	2.5	2.2	2.9	4.2	6.5	9.3	11	11.4	10.3	8.0
AL0035	6.7	4.5	2.6	2.3	3.2	4.4	6.9	9.4	11.8	12.4	11	9.2
AL0053	7.3	5.1	3	3	3.3	4.2	6.4	9.2	11	11.7	10.2	9.6
AL0059	8.1	5.8	3.6	3.6	4.2	5.8	9.3	12	13.1	13.8	12.1	10.2
AL0066	5.1	3	1.7	1.7	2.1	3.5	5.5	8.3	10.4	10	9.1	8.0

5.3.4 Potential evapotranspiration

In order to estimate the infiltration volumes of the study area, the total evaporation (evapotranspiration) has to be computed over a hydrological year. The potential evapotranspiration (ET) was calculated based on Penman's equation (Jensen and Allen 1990). According to Penman's equation, the potential evapotranspiration (ET) was calculated for the period (1970/71-2011/12). Table 7 shows the long-term average monthly evapotranspiration over the study area. It is concluded that the evapotranspiration according to Penman ranges between 65 and 170 mm/month in winter season (from the first of November tell the end of April) and between 129 and 250 mm/month in summer season (from the first of May tell the end of October). It is found that the potential evapotranspiration in winter season (normal year) varies from less than 380 mm in the southwestern parts to more than 640 mm in the northeastern parts of the study area (Fig. 10). In addition, the potential evapotranspiration in the Project Area is approximately 420 mm.

Table 7: Long-term monthly averages of ET, EP and PC for Amman-Zarqa Basin

Months	Class-A pan Evaporation [mm]	Evapotranspiration [mm]	Pan Coefficient
October	236	129	0.55
November	156	76	0.49
December	99	71	0.72
January	88	65	0.74
February	106	74	0.70
March	160	120	0.75
April	244	170	0.70
May	3	212	0.62
June	375	227	0.61
July	415	250	0.60
August	365	224	0.61
September	299	167	0.56

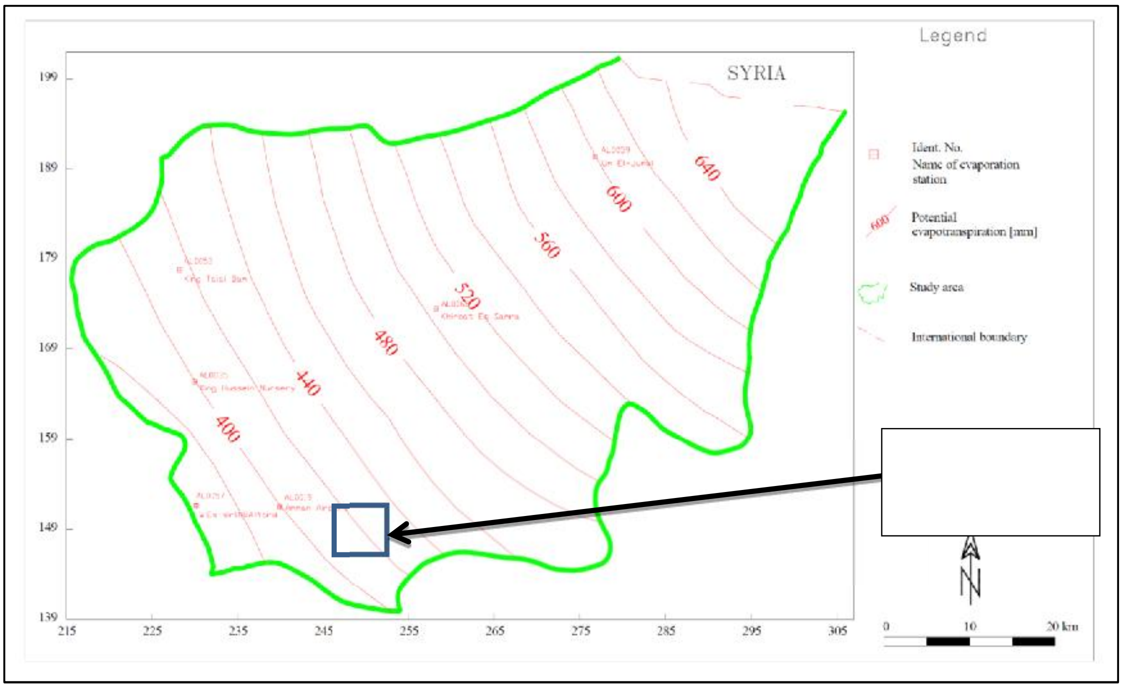

Figure (10): Contour map of potential evapotranspiration for normal year over AZB

5.4 Runoff

In order to estimate the water budget of the study area, the runoff parameter is considered as an important element for computation of water budget. Three main flow streams occurred in the study area: 1. Wadi Dhuleil (flood flows), which drains the eastern parts of Amman-Zarqa Basin 2. Seil el Zarqa (flood and base flows), which drains the western parts of Amman-Zarqa Basin and 3. Zarqa River (the second largest river in Jordan), discharges Wadi Dhuleil and Seil el Zarqa after confluence at Sukhna area. There are six gauging stations distributed over the study area. However, the distribution of the stream flow gauging network does not cover all the subcatchments areas specifically in the northern parts of the study area.

5.4.1 Runoff estimation

As mentioned, no gauging of wadi flow in the project area is exist, therefore, runoff is estimated using the SCS Curve Number method, which relates storm runoff to rainfall. This relationship depends on the potential abstraction of water by soil storage. High potential abstractions means less runoff for a given rainfall, represented by lower curve number.

The more sophisticated a model, the more input data are commonly required. Due to lack of data the Soil Conservation Service Curve Number (SCS-CN) method is still widely used, even though it has a number of disadvantages.

The SCS Runoff Curve Number method is developed by the United States Department of Agriculture (USDA) Soil Conservation Service (SCS) and is a method of estimating rainfall excess from rainfall (Hjelmfelt, 1991). The method is described in detail in National Engineering Handbook (2004). The chapter was prepared originally by Mockus (1964), and was revised by Hjelmfelt (1998) with assistance from the NRCS Curve Number work group and H.F. Moody. Despite the wide use of the curve number procedure, documentation of its origin and derivation are incomplete (Hjelmfelt, 1991).

The conceptual basis of the curve number method has been the object of both support and criticism (Ponce and Hawkins, 1996). The major disadvantages of the method are sensitivity of the method to Curve Number (CN) values, fixing the initial abstraction ratio, and lack of clear guidance on how to vary Antecedent Moisture Conditions (AMC). However, the method is used widely and is accepted in numerous hydrologic studies. The SCS method originally was developed for agricultural watersheds in the mid-western United States; however it has been used throughout the world far beyond its original developers would have imagined.

The basis of the curve number method is the empirical relationship between the retention (rainfall not converted into runoff) and runoff properties of the watershed and the rainfall. Mockus found equation 1 appropriate to describe the curves of the field measured runoff and rainfall values (National Engineering Handbook, 2004). Equation 1 describes the conditions in which no initial abstraction occurs.

$$\frac{F}{S} = \frac{\mathrm{Q}}{\mathrm{P}} \qquad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\ 1$$

Where $F = P - Q$ = actual retention after runoff begins;

Q = actual runoff

S= potential maximum retention after runoff begins.

P = potential maximum runoff (i.e., total rainfall if no initial abstraction).

For most applications, a certain amount of rainfall is abstracted. The three important abstractions for any single storm event are rainfall interception (Meteorological rainfall minus throughfall, stem flow and water drip), depression storage (topographic undulations), and infiltration into the soil. The curve number method lumps all three abstractions into one term, the Initial abstraction (Ia), and subtracts this calculated value from the rainfall total volume. The total rainfall must exceed this initial abstraction before any runoff is generated. This gives the potential maximum runoff (rainfall available for runoff) as $P - Ia$. Substituting this value in equation 1 yields the following equation:

$$\frac{P - I_a}{S} - Q = \frac{Q}{(P - I_a\ )} \quad \text{..................................... (2)}$$

It is important to note the potential maximum retention term, *"S",* excludes *Ia*. Hence, for a given storm, maximum loss of rainfall is *S* plus *Ia.*Rearranging terms in Equation 2 for Q gives:

$$Q = \frac{(P - I_a)^2}{(P - I_a + S)} \quad \text{.. (3)}$$

stablishing the relation to estimate *Ia* was challenging. The SCS provided the following empirical Equation 4 based on the assumption *Ia* was a function of the potential maximum retention *S*.

Ia = 0.2S..(4)

The potential maximum retention *S* is related to the dimensionless parameter CN in the range of 0 <= CN <= 100 by Equation 5.

$$S = \frac{25400}{CN)} - 254 \quad \text{.. (5)}$$

Substituting Equation 4 into Equation 3 yields,

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8\,S)} \quad \text{.. (6)}$$

P – quantity of precipitation;
S – maximum capacity of retention;
I_a – initial abstractions (evapotranspiration, vegetation retentions, other retentions);
CN – f (soil, vegetation, land use, soil moisture conditions)

Although a list of CNs corresponding to dry and wet antecedent moisture conditions is available, typically only the medium antecedent soil condition is applied. In the natural system infiltration rates and runoff coefficients vary with rainfall intensity and duration, micro topography leading to surface ponding, sealing patterns and plant cover (Langhans et al., 2011).

As mentioned previously, no gauging of wadi flow in the Project Area was exist. Runoff is estimated by using the SCS Curve Number Method, which relates storm runoff to rainfall by a relationship that depends primarily upon the potential abstraction of water by soil storage. High potential abstraction means less runoff for a given rainfall represented by a lower curve number (A l-Zubi *et al.,* 2006).

The daily rainfall from Amman Airpotr rainfall station has been analyzed in terms of storm. The Curve Number (CN used for the project area are 85 (normal year) . The runoff calculations are based on the CN method and not on real measurements, it can be seen that the runoff coefficient increases with increasing rainfall volumes until about 100 mm/a of rain. This is due to the fact that the initial losses are high in dry years and runoff generation is higher, when the soil is already wetted. The soil which underlies the Power Project site is considered to be relatively impermeable. It is also considered to be not conducive to the mobility / transport of heavy metals constituents.

The hydrologic parameter on which the SCS model was based on their hydrologic soil groups is a minimum infiltration rate, obtained for a bare soil after prolonged wetting. Four groups, A, B, C , and D, were defined by SCS soil scientists, we have assumed that the conductivity parameters (K) of the green and Ampt infiltration equation , which is approached after prolonged wetting, corresponds to the minimum infiltration rate used in the SCS classification of soils.

The hydrologic grouping of soil textures are shown in Table (8). The runoff curve numbers for selected landuse are summarized in Table (9).

Table 8: Hydrologic grouping of soil Textures.

Hydrologic soil Grouping	Soil Texture
A	Sand, Loamy sand, and sandy loam.
B	Silt Loam and loam .
C	Sandy clay loam.
D	Clay loam, silty clay loam

Table 9: Runoff Curve Numbers for Selected Agriculture, Suburban, and Urban Land Use (Antecedent Moisture Condition 2 and Ia = 0.2S) (Soil Conservation Service, 1986).

Land Use Description		Hydrologic Soil Group			
		A	B	C	D
Cultivated land[1]: Without conservation treatment		72	81	88	91
With conservation treatment		62	71	78	81
Pasture or range land: Poor condition		68	79	86	89
Good condition		39	61	74	80
Meadow: Good condition		30	58	71	78
Wood or forest land: Thin stand, poor cover, no mulch		45	66	77	83
Good cover[2]		25	55	70	77
Open spaces, lawns, parks, golf courses, cemeteries, etc. Good condition Grass cover on 75% or more of the area		39	61	74	80
Fair condition Grass cover on 50% to 75% of the area		49	69	79	84
Commercial and business areas (85% impervious)		89	92	94	95
Industrial Districts (72% impervious)		81	88	91	93
Residential:[3] (house + drive + lawn)					
Average lot size	Average % Impervious				
1/8 acre or less	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
Paved parking lots, roofs, driveways, etc.[5]		98	98	98	98
Streets and roads:					
Paved with curbs and storm sewers[5]		98	98	98	**98**
Gravel		76	85	89	**91**
Dirt		**72**	**82**	**87**	**89**

1 For a more detailed description of agricultural land use curve numbers, refer to National Engineering Handbook, Section 4, Hydrology, Chapter 9, August 1972.

2 Good cover is protected from grazing and litter and brush cover soil.

3 Curve numbers are computed assuming the runoff from the house and driveway.

4 The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

5 In some warmer climates of the country, a curve number of 95 may be used.

CN: is the curve number, which depends on the topography of the project area landscape and soil texture. Table (10) shows the Hydrologic Soil Group (HSG), while table (5.1.3) shows the runoff curve number;

Table 10: Runoff Curve Number

Soil Group	Description	Final Infiltration Rate (mm/hr)	Soil Texture
A	Lowest runoff potential, Includes deep sands with very little silt and clay , also deep , rapidly permeable loess	8-12	Sand, Loamy sand, sandy Loam
B	Moderately low runoff potential .Mostly sandy soils less deep than A, and loose less deep or less aggregated than A, but the group as a whole has above – average infiltration after through wetting	4-8	Silt loam , Loam
C	Moderately high runoff potential. Comprises shallow soils and soils containing considerable clay and colloids, though less than those of group D. The group has below – average infiltration after presaturation	1-4	Sandy clay Loam
D	Highest runoff potential. Includes mostly clays of high swelling percent, but the group also includes some shallow soils with nearly impermeable sub horizons near the surface.	0-1	Clay loam, silty clay , Loam , sandy clay , silty clay , clay

The proposed project site is part of the main wadi which drains the Solar plant site towards in Al Manakher area . The 1-day maximum daily rainfall of the nearest rainfall station to the proposed Project area which belongs to Amman Airport rainfall station (AL0019) the maximum runoff is calculated as the following:

P = 132.5 mm;

S: Calculated from CN; which is also calculated from the Hydrologic Group and soil texture;

CN: 85

S= 1000/CN-10 = 1.76 inch X 25.4 **= 44.82 mm**

From which, **Ia = 0.2 S = 0.2 X 44.82 mm = 8.96 mm**

Q= $(\mathbf{P}-0.2\,S)^2/(\mathbf{P}+0.8\mathbf{S})=\ (132.5-8.96)^{\mathbf{2}}(132.5-0.8*44.82)=\ 90.64\ \mathbf{mm}$ on each square meter

The proposed project comprises a surface area of about 50 dunum. The volume of the runoff formed from the maximum rainfall during 24 hours on the proposed project site in cubic meter is:

V= $\mathbf{0.0}906\ \mathbf{X}\ 50\mathbf{000}=\ 4532.4\ \text{m3}$ = $\mathbf{0.0045\ MCM}$

The maximum runoff from the proposed project site is calculated to be **0.0045 MCM**.
The maximum flood flow volume for the whole catchment which has a surface area of about **270.9 km^2** is
V= 0.096 m X 270.9 X 10^6 m^2= **24.5 MCM**

5.4.2 Estimation of Peak discharge

In this study the synthetic hydrograph can be applied. The most common method of deriving unit hydrograph synthetically is the SCS dimensionless unit hydrograph method. It is worthy to mention that there is no actual flood runoff measurements are available in the project area, however, the peak discharge and the unit hydrograph of the sub-catchment area where the project area is located were estimated based on the watershed characteristics. The peak discharge was estimated using SCS method, where the runoff volume was estimated to be 24.5 MCM (= 90.6 mm/year) of runoff would be generated in the catchment area.

5.4.3 SCS Dimensionless Hydrograph

SCS dimensionless hydrograph is a synthetic unit hydrograph. The discharge is expressed by the ratio of discharte q to peak qp and the time by the ratio of time t to the time of rise of the unit hydrograph, Tp (Fig.11).

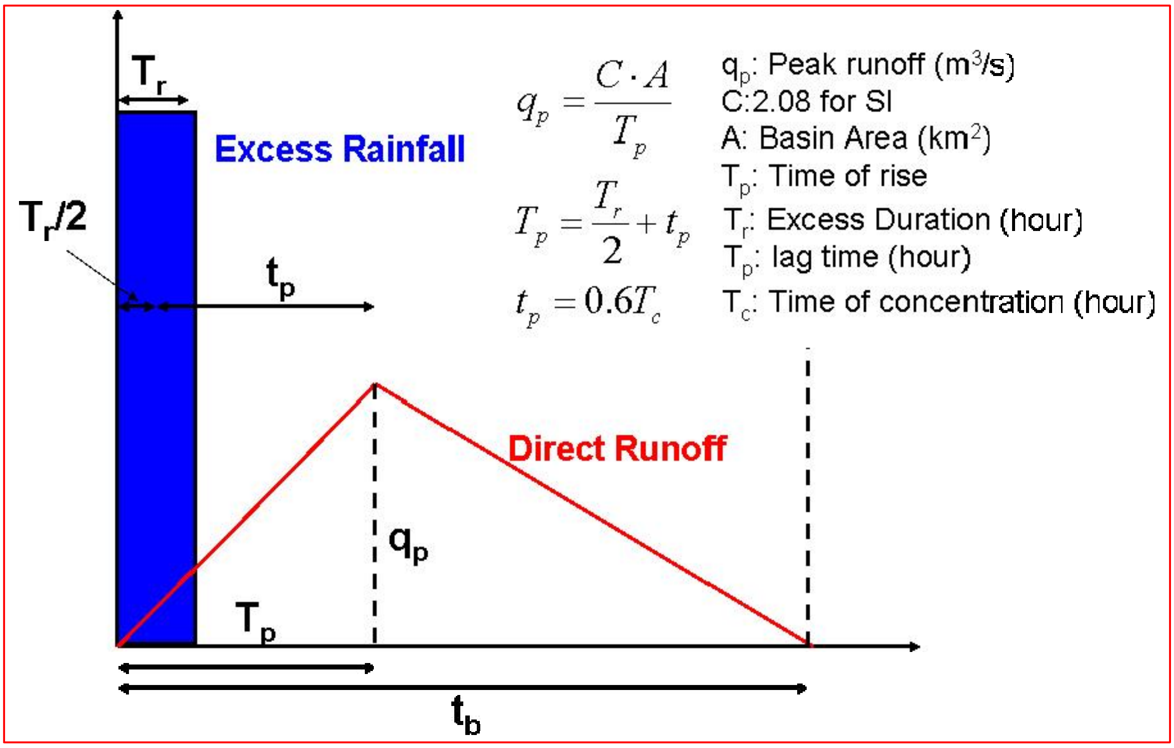

Figure (11): SCS Dimensionless Unit Hydrograph

The T/Tp and Q/Qp values of the generalized dimensionless UH of the SCS are used to derive the synthetic hydrograph of the Project Area as illustrated in Figure (12). The peak discharge estimated for the catchment area is 112.9 m^3/s.

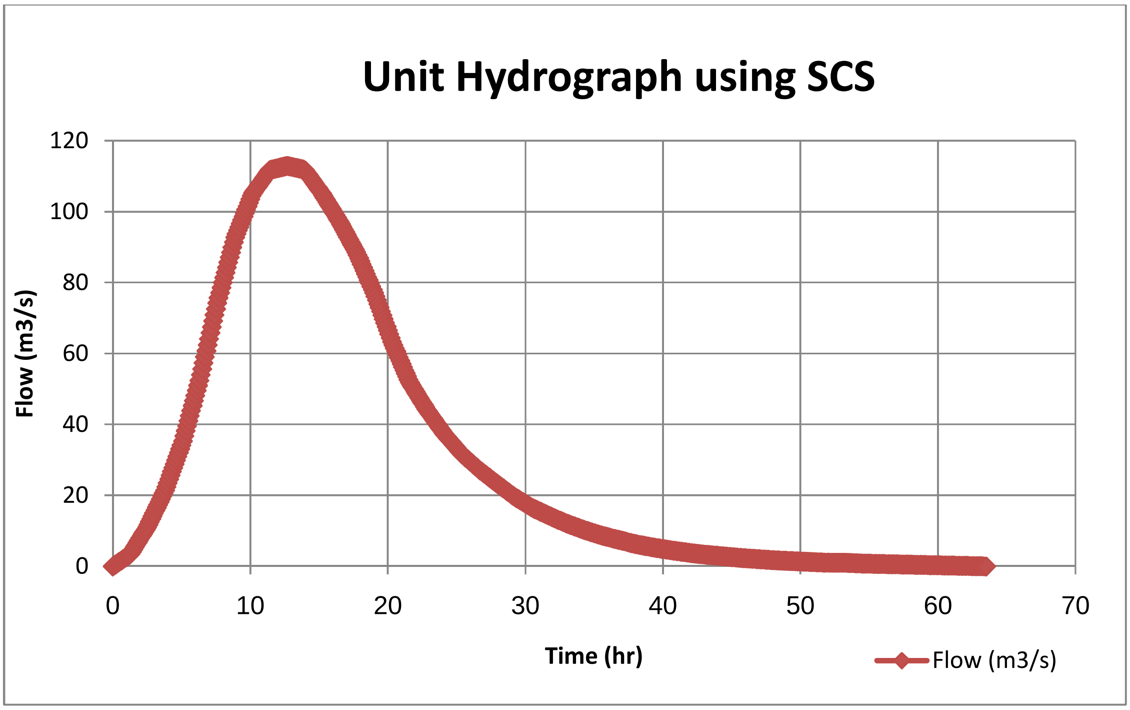

Figure (12):Synthetic SCS Dimensionless Unit Hydrograph of the Project Area

6.0 Regional Geology

The geological formations outcropping in the study area belongs to Upper Cretaceous age, which comprises Ajlun and Balqa Groups except the wadi fill deposits, which belong to Quaternary age as shown in the generalized geologic map (Figure 4.1). The Amman formation consists of limestones with chert interbedded with phosphatic layers and marls. Its thickness ranges from 80 m to 150 m (Howard and Humphreys 1983). The distinguished feature of this formation is its undulations in addition to fracturing and jointing of the chert beds. This formation is subdivided into two units: the lower unit is Silicified limestone unit and the upper unit is the Phosphorite unit. The Silicified limestone unit is characterized by thick chert beds. The Phosphorite unit forms part of the Phosphorite belt in which the phosphate horizons were mined at Russeifa area. The wadi fill deposits overlie the Amman and Wadi Sir formations at the

HTPS and consist of sands and gravels with variable thickness from 15 to 20 m (Bender, 1974). The main structures encountered at the study area are the faults which are related to the Amman-Hallabat structure which extends from southwest of Amman towards the northeast (Mikbel and Zacher, 1986).

The outcropping geological formations of Amman-Zarqa Basin extends from Lower Cretaceous (except for the wadi fill deposits which are of Quaternary) to recent age, which is belonging to the Ajlun and Belqa Groups according to Jordanian classification (Table 11).

6.1 Site Geology

The geology of the area is dominated by sedimentary rocks related to Cretaceous age that subdivided in two main sequences. These are Lower and Upper Cretaceous rocks. The Lower Cretaceous rocks are locally known as Kurnub. The Upper Cretaceous rocks are further sub-divided into Ajlun and Belqa groups. In the area, the sedimentary (carbonate series) are the Belqa and the older Ajlun groups, from the Upper Cretaceous period. Figure 13 shows a Geological Map. This series consists of limestone, dolomatic limestone, marly limestone, chalky limestone.

6.2 Upper Cretaceous Rocks

The Upper Cretaceous rocks are the most abundant rocks exposed at the Power Project site, and they overly the Lower Cretaceous rocks. The Upper Cretaceous rocks are further sub-divided in two groups, Ajlun and Belqa.

6.2.1 Ajlun Group

This group represents all the marine sediments of the Cenomanian-Turonian age and consists of: carbonate rocks; limestone; dolomite; marl; shale; chalk; and, sometimes sand stone. The group reaches a maximum thickness of 500 to 550 m, with the group thickness decreasing gradually northwards, towards the river Zerqa and southwards towards Suweilih Flexure. There are three principal formations of the Ajlun group which act as aquifers, these formations are the: Naur (A1/2); Hummar (A4); and, Wadi Sir (A7). The other principal formations of the Ajlun group act as aquitards, these formations are the: Shueib (A5/6); and, Fuheis (A3).

6.2.2 Belqa Group

This group represents all the sediments of the Paleocene- Eocene age and consists of chert; limestone; chalk; marl; and, marly limestone. The younger Balqa group consists of five formations, these are the: W.Shallah (B5); Rijam (B4); Muwaqar (B3); Amman (B2); and, W.Ghudran (B1).

The carbonate formations (of the Ajlun and Belqa groups) are classed as separate from each other based upon: the presence of fossil records; the mineralogical composition of the limestone; and, the presence of marl and chert. According to the geological map, the site is located within the out crops of (B3) formation that is considered as a confining bed protecting the aquifer in the Power Project area from any possible pollution that may occur as shown in Fig.(14).

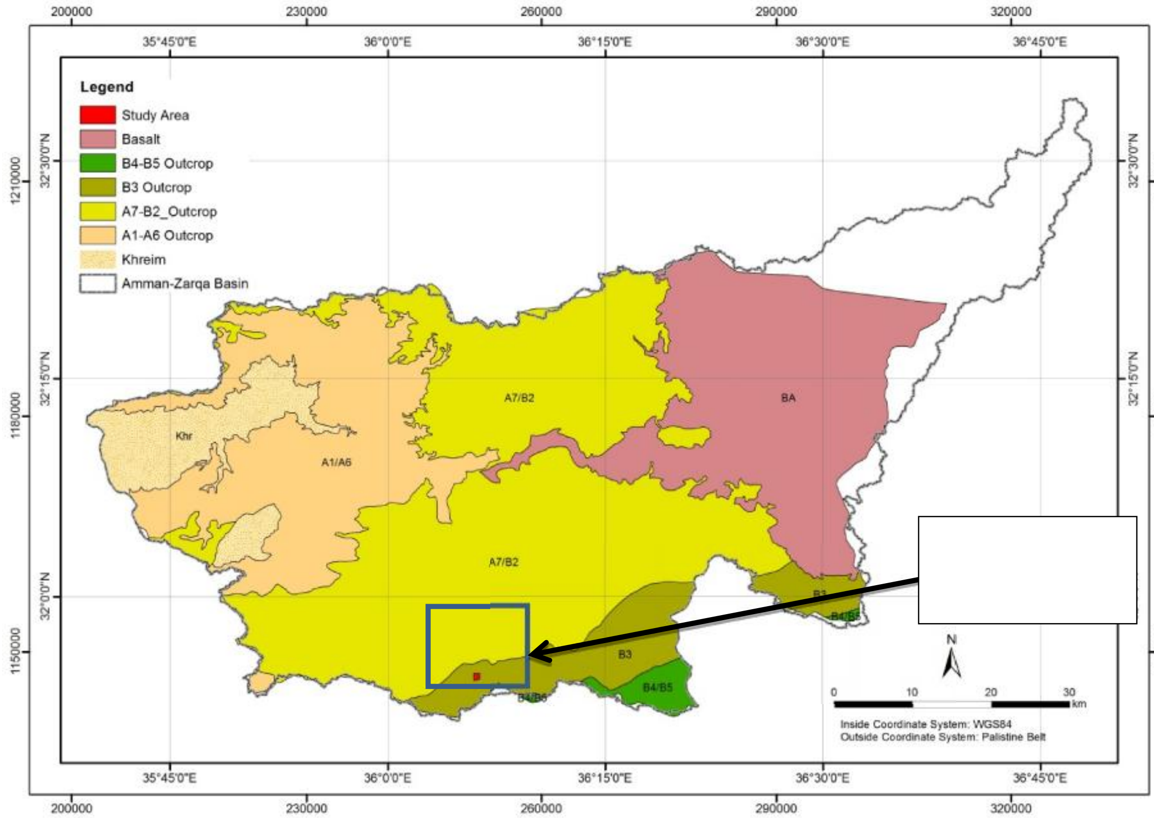

Figure (13) : Geological map of the AZB including Project Area

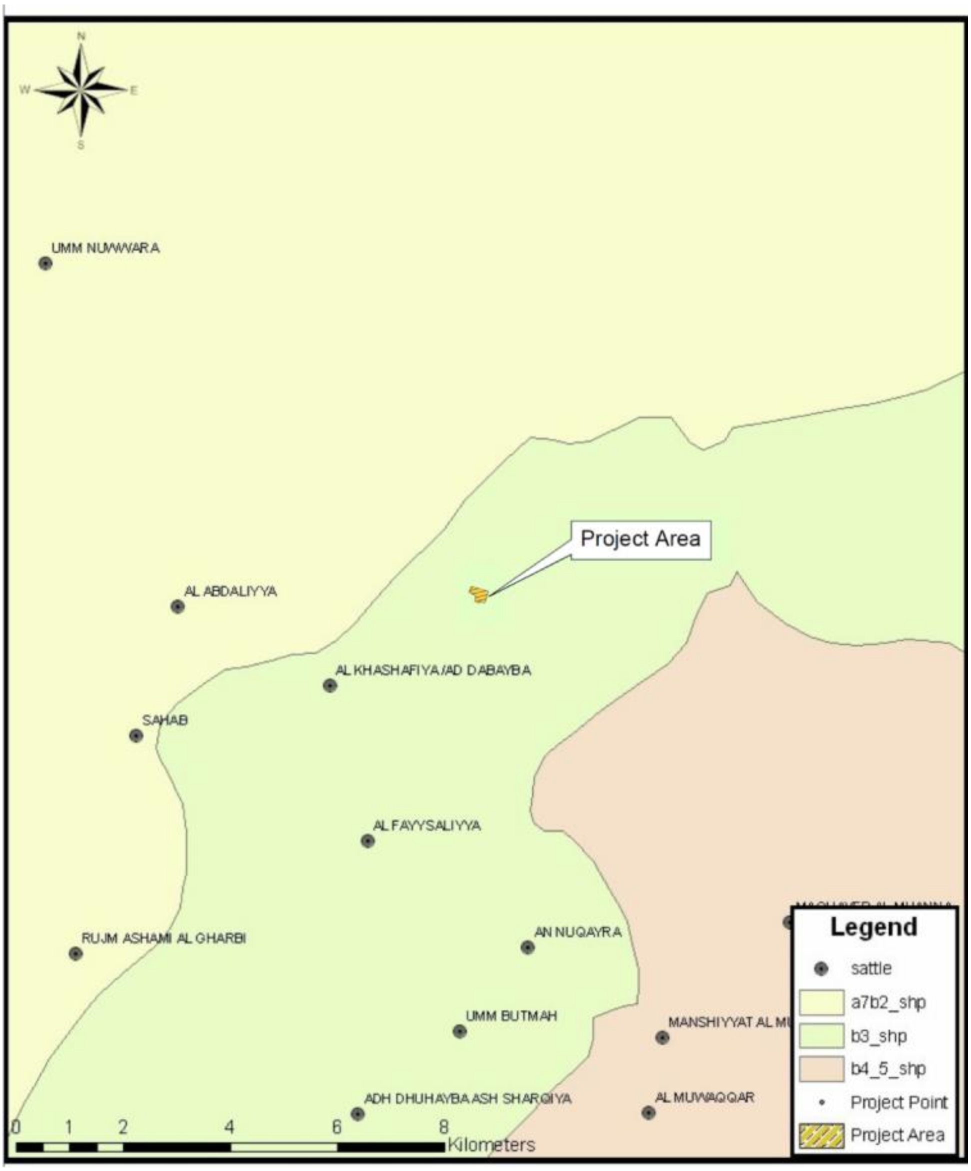

Fig.(14): Zoom on geological map of the Project Aea

Table 11: Lithological sucession for the central parts of Jordan

Era	Period		Epoch	Group	Formation	Symbol	General Lithology	Thickness(m)	Aquifer Potentiality
Cenozoic	Quaternary		Holocene	Azraq	Alluvium	AZ	Soil, Sand and Gravel		Good Aquifer
			Pleistocene	Volcanic	Basalt	V	basalt		Good Aquifer
	Tertiary		Pliocene Miocene Oligocene Eocene Paleocene	Volcanic	Sirhan	S1,S2			Good -Poor
					Basalt	V	Olivine basalt with augite, and tuff.		Good Aquifer
				Belqa	Shallala		These formations are not occur in the basin.	- - - - - - - -	
					Rijam	B5		-------------	Good Aquifer
Mesozoic	Cretaceous	Upper	Maestrichtian Campanian Santonian		Muwaqar	B4	marl and whitish yellow chalk	80-332m	Aquitard
					Al-Hasa	**B2b**	**phosphate rocks**	6-30m	Good Aquifer
					Amman	**B2a**	**chert rocks interbedding with limestone**	20-100m	
					Ghudran	**B1**	**chalk rocks**	20-50m	
		Middle	Toronian	Ajlun	**Wadi Sir**	**A7**	**bedded limestone and fossilized limestone**	62-120m	
					Shue'ib	A5/6	interbedded limestone with levels of marl rocks	60-72m	A1/6(Aquitard)
			Cenomanian		Hummar	A4	hard rock of limestone and dolomitic limestone	60-65m	
					Fuheis	A3	green marl, calcareous siltstone with thin bed of micritic limestone	55-90m	
					Nau'r	A1/2	limestone, dolomite and marl	86m	
		Lower	Albian	Kurnub	Bir Fa'as	K2	Dolometic sandstone interbedded with dolomitic shale and glauconite are alternating the sandstone	60-66m	Good Aquifer
					Jarash		Carbonate composed of fine sandstone interbedded with marl, clay and shale	60-84m	
			Aptian Neocomian		Ramel	K1	Basal Conglomerate composed of sandstone, coarse sandstone and level of carbonate	105m	

7.0 Groundwater Water Resources

Ground water aquifers in Jordan were divided into three main hydraulic complexes (MWI, 2009). These main aquifer complexes are, the Shallow Aquifer System (Upper Aquifer) comprising Quaternary and Tertiary Formations (Basalt, Rijam and Sirhan); the Upper Cretaceous (Middle Aquifer System) Amman Wadi Sir Hydraulic Complex; and the Deep Sandstone (Lower Aquifer System), Kurnub and Disi Hydraulic Complex. The main aquifer systems of the Azraq Basin are shown in Table (4) (WAJ, 2004). The Upper (Shallow) Aquifer and the Middle Aquifer Systems are separated by the Muwaqqar (Aquiclude) Formation (B3).

7.1 Groundwater Aquifers Systems

The basin is divided into two parts. These are an eastern part to north-east of Wadi Zarqa that flows to the west, and a western part extending to the west of Wadi Zarqa and that flows to the east. The average renewable groundwater quantity in the basin is approximately 88 MCM/Year, of which about 35 MCM/Year return to the surface as base flow along Zarqa River. The remaining 53 MCM/Year is pumped through wells distributed over the basin area. The direct recharge to the basin comes from precipitation, floodwater flows and infiltration resulting from irrigation activities. The contribution of domestic, industrial and irrigation activities in groundwater recharge is estimated to be about 40 MCM/Year. The ground water quality in the basin is affected by various factors of such as over pumping, inflows of wastewater and leaching of solid wastes. The basin consists of two main aquifers in the Power Project area. These are the deep Hummer formation (A4) and the shallow complex consisting of Wadi Sir Amman silicifid unit (B2/A7). These two aquifers are related to the Upper Cretaceous Hydraulic System.

7.2 Upper Cretaceous Aquifer

This Upper Cretaceous Hydraulic Aquifer consists of alternating sequences of: limestone; dolomite; marlstones; and, chert beds. The total thickness of the Hydraulic Aquifer in the central part reaches around 700 m. The lower portion is the Naur formation (A1/2) which consists of about 200 m of limestone and marls. It gives rise to relatively high permeability and in some areas forms a good potential aquifer. An aquitard aquifer (A3) of 80 m thickness consisting of marl and shale overlies the Naur formation and separates it from Hummar formation (A4). The Hummar formation consists of semi crystalline limestone and hence it has very high permeability and porosity. This formation is confined by the overlying aquitard of the Shueib formation (A5/6). The Shueib formation consists of marls and limestone and is overlain by the aquifer of Wadi Sir formation (A7) and Amman silicified formation (B2). The Wadi Sir Amman silicifid unit (B2/A7) consists of limestone, chert-limestone, sandy limestone and marly limestone. The aquifer complex is overlain in the eastern desert by thick marl layer (B3) forming a competent confining bed. The groundwater direction is directed from eastern highlands, partly to the western escarpment within the faults, but mainly to the east where it discharges along the various wadies.

7.3 Power Project Area Aquifer System

7.3.1 Hummar Aquifer System (A4)

The Hummar Aquifer system comprises a karstified dolomitic limestone, light to dark grey in colour, hard, crystalline, coarse grained and high fractured. The thickness of this aquifer system ranges between 40 to 45 m. This aquifer is overlain by an aquitared formation (A5/6) which separates the Hummar formation (A4) system from the Wadi Sir Amman silicifid unit (B2/A7) system. The specific capacity of the Hummar Aquifer is determined to be in the range of 1.1 to 8.8 m2/hr, with transmissibility ranging between 32 to 300 m2/day and a hydraulic conductivity range from 6.59 to 6.7 m/day (Water Authority Open Files). Studies undertaken estimate the total recharge of this aquifer (based on the flow- net analysis of groundwater) of about 5 MCM/Year, while the total abstraction of thisaquifer is about 7.4 MCM/Year (according to WAJ files). Therefore, it can be concluded that the water abstraction from the aquifer exceeds the recharge amount.

7.3.2 Wadi Sir-Amman Aquifer System (B2/A7)

The Wadi Sir-Amman (B2/A7) aquifer is considered as the most important aquifer in Amman-Zarqa Basin, consisting of: limestone; chert-limestone; sandy limestone; and, marly limestone. The aquifer complex is overlain in the eastern desert by a thick marl layer (B3) forming a competent confining bed. The groundwater recharge in this aquifer is from eastern highlands, partly to the western escarpment within the faults, but mainly to the east where discharge is along wadies.

The aquifer can be characterized as a karstified fractured rock aquifer. The karstification in the limestone and dolomites is unevenly distributed which leads to large heterogeneities in permeability and storability. Parts of the aquifer are highly cavernous. In these areas the movement of groundwater is quite rapid, thus restricting is filtering ability. The exploitation of the B2/A7 aquifer has been increased enormously over the past decade and as a result water levels are declining rapidly. In the past few years, annual water level decline rates reach more than 2 to 3 m/year, while the general depth to water level exceeds 140 m for this aquifer in this part of Amman-Zerqa basin.

Groundwater uses in the Power Project area are represented by the pumped wells encountered in the catchment area. Five wells have been drilled within 4 km of the site. Table 12 gives the co-ordinates of the drilled wells close to the site (Source of data: Water Authority files). Studies of these wells have provided information about the nature of the aquifer system in the Power Project area. The pumped water from these wells is presently used for municipal and agricultural purposes. All of these wells penetrated the Wadi Sir-Amman (B2/A7) Aquifer system, the depth of these wells range between 203 to 421 m, and the yield of these wells range between 16 to 66 m3/hr, while the static water levels range between 148.3 to158 m below the surface.

There are two wells (AL 3433, AL3503) penetrate the two aquifers in the Power Project area. The depth of these wells is about 359 to 421 m, and the yield is about 5 to 16 m3/hr. The static water level in the wells is about 158 to 218 m below the surface.

Table (12): Well inventory close to the power project area

Well ID	Well Name	Coordination		Altitude (m)	Aquifer	Static water level (m)	Yield	GWL (m)
		East	North					
AL1789	Madouneh 1	1146260	253930	810	B2/A7	148.3	810	661.70
AL1790	Maduneh 2	1146.22	258.16	820	B2/A7	201.0	820	619.00
AL1794	Ayed	1152.225	255.07	735	A7	74.0	740	661.00
AL1797	M.Hamlan No.3	1146180	251470	740	B2/A7	169.3	836	570.70
AL1801	Abdalla Irshid	1152.665	253.915	836	B2/A7	39.1		796.90
AL1803	Kareem Miqbil	1147.61	250.45	720	B2/A7	135.0		585.00
AL1804	Abd Rabbo Falah	1148.8	252.15	785	B2/A7	148.3		636.70
AL1807	M.S.Kurdi	1144200	252200	825	B2/A7	-	875	
AL3433	Al-Manakher 1	1143700	253170	835	B2/A7, A4	218.0	880	617.00
AL3503	Madouneh 1A	1146000	254100	812	B2/A7, A4	158.0	812	654.00

7.4 Groundwater Quality of the Upper Cretaceous Aquifer System

In general from the recharge area of the Wadi Sir Amman silicified unit (B2/A7) aquifer in the western highland to the discharge areas, there is an increase in salinity. Electrical Conductivity (EC) values vary considerably in the Amman-Zrqa basin from 480 to 8200 µs/cm. Also the Wadi Sir Amman silicified unit (B2/A7) aquifer in Amman- Zarqa basin shows an increase in the concentration of nitrate, which is typically higher than 50 mg/l.

For the Ajlun aquifers in general, the salinity of groundwater is mostly low, but increases towards the highlands. Several wells with salinity higher than 2000 µs/cm due to over pumping are found in the central part of Amman-Zarqa basin. There is also an increase in nitrate concentration with values greater than 50 mg/l observed in the western part of Amman-Zarqa basin (WAJ Files). This would appear to be due to the over usage of fertilizers in agriculture, and the use of the permeable cesspits to dispose of waste water, especially in Jerash and Ajloun areas.

7.5 Groundwater Flow direction

The groundwater contour map was constructed from the measurement of the static water well from the well inventory of the nearest wells to the proposed solar power plant. The groundwater level map was drawn as shown in Fig.(15). The groundwater flow direction in the Project Area is toward north and northeast direction. The groundwater level at the Project area is 650 m above sea level.

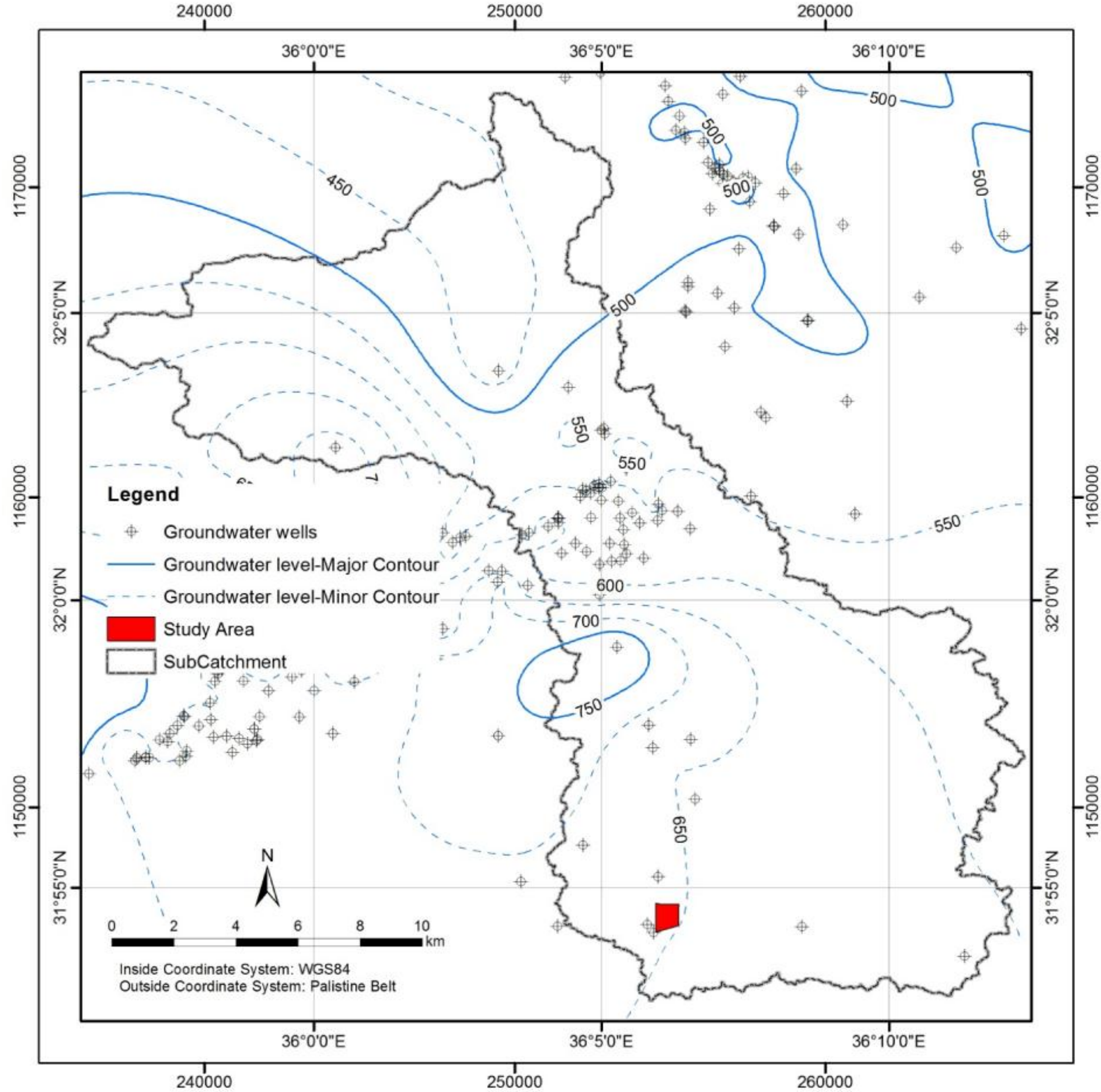

Figure (15): Groundwater flow direction in the Project Area

8.0 Conclusion

The Project area is located 14 southeast of Amman in Al Manakher area, the area is sparsely populated. The average rainfall in the Project Area is approximately 220 mm per year. The potential evapotranspiration is 2600 mm/Year. The runoff depth was estimated using the SCS method to be 90.6 mm and the volume of runoff in the project area is around 4500 cubic meter (m^3) and the volume from the whole catchment is estimated to b2 24.5 MCM. The peak discharge of the catchment area where the Project Area is located was estimated to be 112.9 m^3/s.

Groundwater uses in the Power Project area are represented by the pumped wells encountered in the catchment area. Five wells have been drilled within 4 km of the site. The pumped water from these wells is used for municipal and agricultural purposes. All of these wells penetrated the Wadi Sir-Amman (B2/A7) Aquifer system, the depth of these wells range between 203 to 421 m, and the yield of these wells range between 16 to 66 m3/hr, while the static water levels range from 150 m to more than 200 m in some wells. The groundwater flow direction in the Project Area is toward north and northeast direction where the groundwater level at the Project area is around 650 m above sea level.

References

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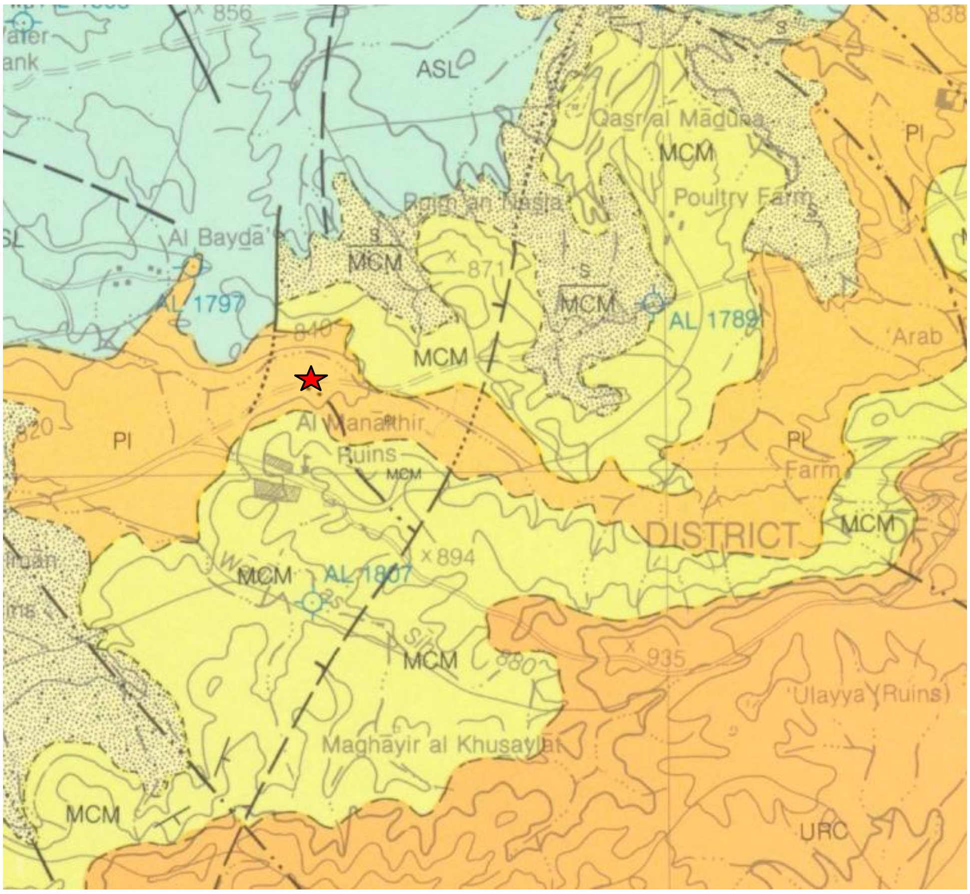
Chalikakis K, Nielsen MR, Legchenko A (2008) MRS applicability for a study of glacial sedimentary aquifers in Central Jutland, Denmark. J Appl Geophys 66:176–187

APPENDIX G

Geological Map
Legend of Symbol Used

415



530

Amman Silicifide Limestone Formation

Site

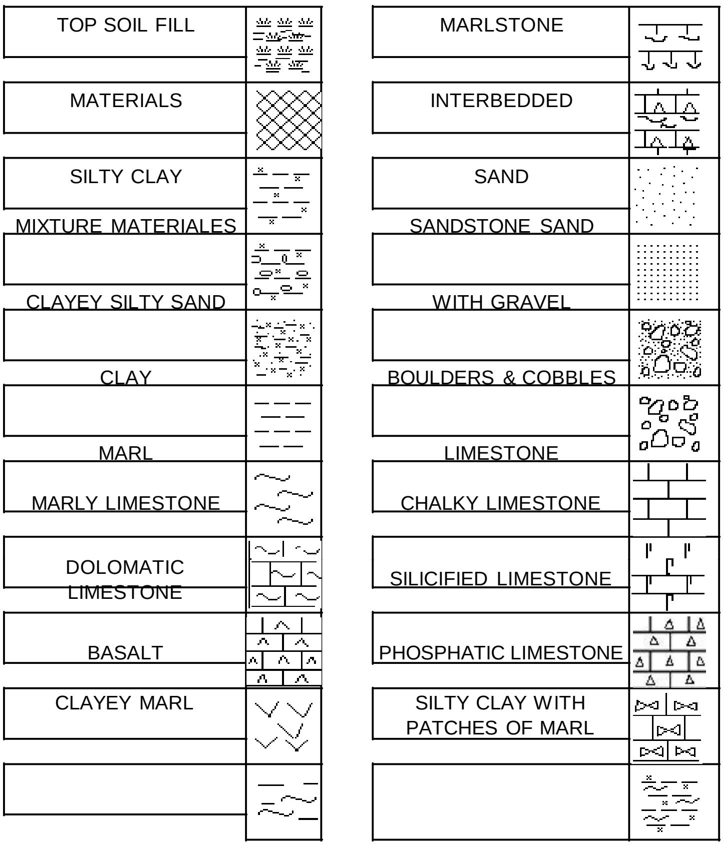
Pleistocene Sediments

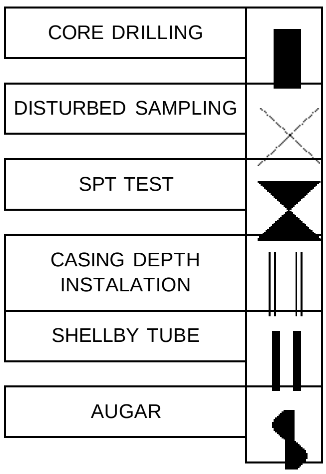
<u>Geological Legend</u>

Formation boundary	
Synclinal	
Anticlinal	
Fault	
Landslip	
Dip – measured	3^o
Approximate site location	

Geological map

LEGEND TO SYMBOLS USED





Appendix F

DOA FIELD RECORDS FOR IDENTIFIED SITES

APPENDIX F-1

DOA FIELD RECORDS FOR IDENTIFIED SITES

MEGA JORDAN THE NATIONAL HERITAGE DOCUMENTATION and MANAGEMENT SYSTEM

SITE Report
January 31, 2017

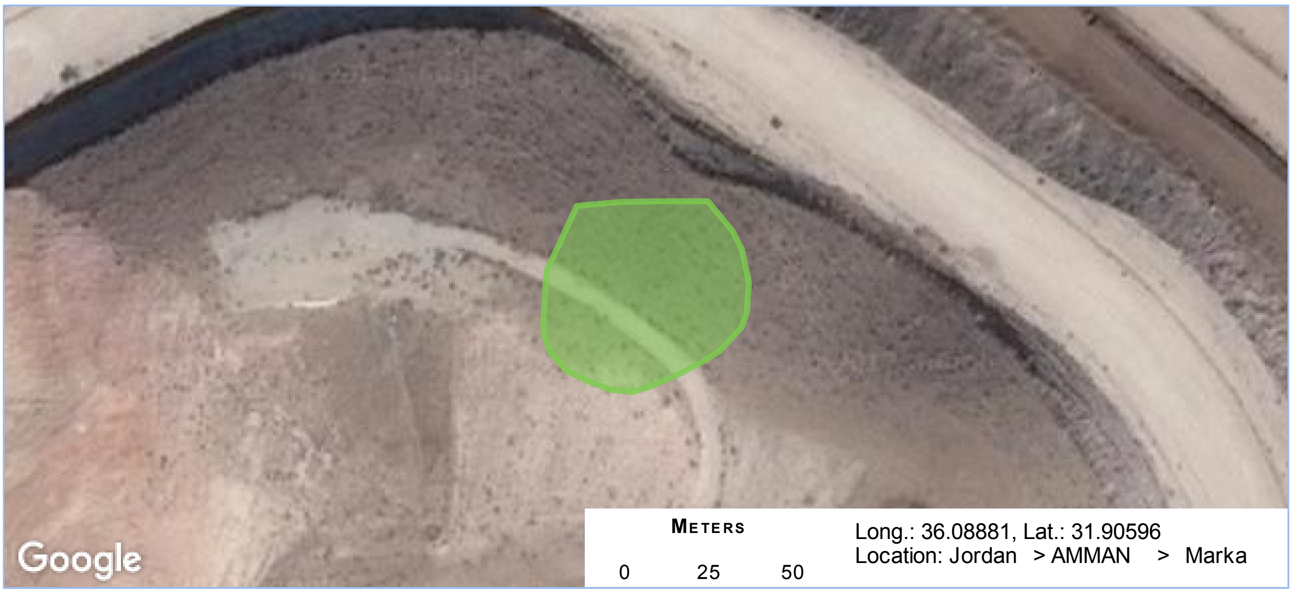
Primary Site name: en Naslah

Other Site Names: None

Governorate: AMMAN Sub-governorate: Marka

MEGA Number: 3103

Site Map:



Coordinates (Long Lat): 36.08897 31.9058, 36.0889 31.90577, 36.08882 31.90574, 36.08878 31.90573, 36.08872 31.90573, 36.08865 31.90576, 36.0886 31.90578, 36.08856 31.90582, 36.08854 31.90586, 36.08854 31.90589, 36.08855 31.906, 36.08863 31.90615, 36.08875 31.90616, 36.08886 31.90616, 36.08898 31.90616, 36.08904 31.9061, 36.08907 31.90606, 36.08909 31.90598, 36.08908 31.90591, 36.08907 31.90588, 36.08901 31.90582, 36.08897 31.9058

Total Area (m^2): 2038.1; Perimeter (m): 164.1
Buffer Zone (m): 0

Period(s) Recorded for Site:

None

DoA Office Responsible:

Department of Antiquities, Amman

Site Investigators:

Investigator(s): 2007-2008 Data, DOA; None
Investigation Date: None

Site Comments: [e.g., accuracy of coordinates; directions to Site]

Site Significance:

Scientific Value

Historical Value

Aesthetic Value

Social Value

Spiritual Value

Surveys:

Record History:

Last Modified By
Last Modified On
Record Created By ORIGINAL IMPORT

Record Created On July 1, 2010

Record Review Status:

Status: Approved
Reviewer: None
Review Date: None
Comments:

No site elements have been recognized at this site

No references were found for this site.

There are 0 images or pdfs associated with this Site.

Site images can be viewed and printed from MEGA.

This report summarizes the existing information in the system and should never be regarded as a final statement on the archaeological site being considered, nor should it be substituted for an on-site survey.

MEGA JORDAN THE NATIONAL HERITAGE DOCUMENTATION and MANAGEMENT SYSTEM

SITE Report
January 31, 2017

Primary Site name: Khirbet el Madhuna 2

Other Site Names: None

Governorate: AMMAN Sub-governorate: Marka

MEGA Number: 3102

Site Map:

Coordinates (Long Lat): 36.09612 31.91375, 36.0952 31.91447, 36.09551 31.91482, 36.09606 31.9151, 36.09639 31.91507, 36.09671 31.91488, 36.09675 31.91442, 36.09639 31.91391, 36.09612 31.91375

Total Area (m²): 13737.6; Perimeter (m): 443.9
Buffer Zone (m): 0

Period(s) Recorded for Site:

None

DoA Office Responsible:

Department of Antiquities, Amman

Site Investigators:

Investigator(s): 2007-2008 Data, DOA; None
Investigation Date: None

Site Comments: [e.g., accuracy of coordinates; directions to Site]

Site Significance:

Scientific Value

Historical Value

Aesthetic Value

Social Value

Spiritual Value

Surveys:

Record History:

Last Modified By
Last Modified On
Record Created By ORIGINAL IMPORT
Record Created On July 1, 2010

Record Review Status:

Status: Approved
Reviewer: None
Review Date: None
Comments:

No site elements have been recognized at this site

No references were found for this site.

There are 0 images or pdfs associated with this Site.

Site images can be viewed and printed from MEGA.

MEGA JORDAN THE NATIONAL HERITAGE DOCUMENTATION and MANAGEMENT SYSTEM

SITE Report
January 31, 2017

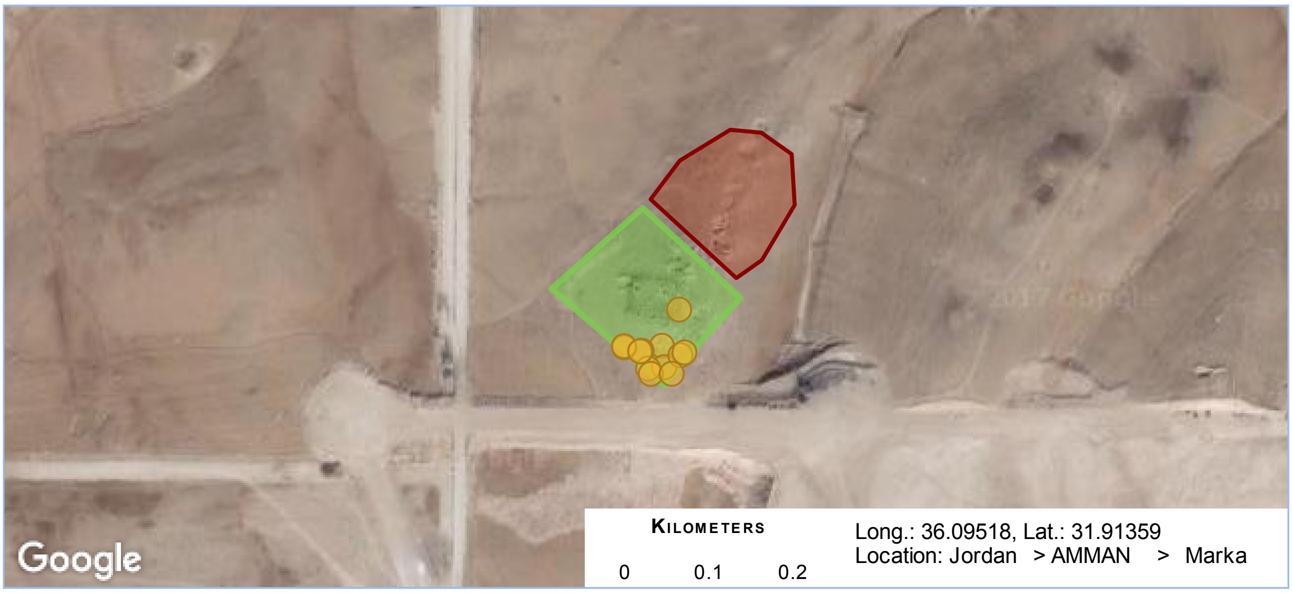
Primary Site name: MADUNA

Other Site Names: JADIS: 2514004, Khirbet el Madhuna 1

Governorate: AMMAN Sub-governorate: Marka

MEGA Number: 2743

Site Map:



Coordinates (Long Lat): 36.09414 31.91365, 36.09512 31.91439, 36.09617 31.91357, 36.09574 31.91317, 36.09534 31.91277, 36.09414 31.91365

Total Area (m²): 17014.3; Perimeter (m): 525.9
Buffer Zone (m): 0

Period(s) Recorded for Site:

9027 (Middle Bronze, Unspecified); 9031 (Iron Age I); 9032 (Iron Age IIa-b); 9033 (Iron Age IIc); 9046 (Roman, Unspecified); 9049 (Byzantine, Unspecified); 9050 (Islamic, Umayyad); 9060 (Modern (1915-1950)); 9999 (Unspecified/Unknown Period)

DoA Office Responsible:

Department of Antiquities, Amman

Site Investigators:

Investigator(s): 2007-2008 Data, DOA; None
Investigation Date: None

Site Comments: [e.g., accuracy of coordinates; directions to Site]

Site Significance:

Scientific Value

Historical Value

Aesthetic Value

Social Value

Spiritual Value

Surveys:

Record History:

Last Modified By
Last Modified On
Record Created By ORIGINAL IMPORT
Record Created On July 1, 2010

Record Review Status:
Status: Approved
Reviewer: None
Review Date: None
Comments:

The following 12 site element(s) have been recognized at this site:

MEGA Number	Element Type	Period(s) Recorded for Site Element:
15783	901 Sherd/Flint Surface Scatter (Unexcavated)	9060 Modern (1915-1950)
15784	901 Sherd/Flint Surface Scatter (Unexcavated)	9046 Roman, Unspecified
15785	515 Tower	9999 Unspecified/Unknown Period
15786	307 Stone Circle	9999 Unspecified/Unknown Period
15787	901 Sherd/Flint Surface Scatter (Unexcavated)	9033 Iron Age IIc
15788	901 Sherd/Flint Surface Scatter (Unexcavated)	9032 Iron Age IIa-b
15789	828 Stone Fences/Enclosures	9999 Unspecified/Unknown Period
15790	901 Sherd/Flint Surface Scatter (Unexcavated)	9049 Byzantine, Unspecified
15791	901 Sherd/Flint Surface Scatter (Unexcavated)	9027 Middle Bronze, Unspecified
15792	901 Sherd/Flint Surface Scatter (Unexcavated)	9050 Islamic, Umayyad
15793	899 Unspecified/Unknown General Site Element (Specify)	9999 Unspecified/Unknown Period
15794	901 Sherd/Flint Surface Scatter (Unexcavated)	9031 Iron Age I

No references were found for this site.

There are 0 images or pdfs associated with this Site.
Site images can be viewed and printed from MEGA.

MEGA JORDAN THE NATIONAL HERITAGE DOCUMENTATION and MANAGEMENT SYSTEM

SITE Report
January 31, 2017

Primary Site name: NASLE
Other Site Names: JADIS: 2514012

Governorate: AMMAN Sub-governorate: Marka

MEGA Number: 7364

Site Map:

Coordinates (Long Lat): 36.08854 31.90386, 36.08854 31.90398, 36.08869 31.90398, 36.08869 31.90386, 36.08854 31.90386

Total Area (m²): 198.8; Perimeter (m): 56.4
Buffer Zone (m): 0

Period(s) Recorded for Site:
9034 (Iron Age III (Persian)); 9999 (Unspecified/Unknown Period)

DoA Office Responsible:
Department of Antiquities, Amman

Site Investigators:
Investigator(s): JADIS IMPORT, DOA; None
Investigation Date: None

Site Comments: [e.g., accuracy of coordinates; directions to Site]

Site Significance:
Scientific Value
Historical Value
Aesthetic Value
Social Value
Spiritual Value

Surveys:

Record History:
Last Modified By
Last Modified On
Record Created By ORIGINAL IMPORT
Record Created On July 1, 2010

Record Review Status:

Status: Under Review
Reviewer: None
Review Date: None
Comments:

The following 2 site element(s) have been recognized at this site:

MEGA Number	Element Type	Period(s) Recorded for Site Element:
34580	901 Sherd/Flint Surface Scatter (Unexcavated)	9034 Iron Age III (Persian)
34581	810 Isolated Structure/House	9999 Unspecified/Unknown Period

No references were found for this site.

There are 0 images or pdfs associated with this Site.

Site images can be viewed and printed from MEGA.

MEGA JORDAN THE NATIONAL HERITAGE DOCUMENTATION and MANAGEMENT SYSTEM

Map Type: Satellite

Reports | Jordan > AMMAN > Marka > Qasr el Madhuna (Rujm el Ahmar)

Appendix G

STAKEHOLDER ENGAGEMENT PLAN

APPENDIX G-1

STAKEHOLDER ENGAGEMENT PLAN

REPORT Nº 008 - R02

AL MANAKHER SOLAR PHOTOVOLTAIC POWER PLANT

STAKEHOLDER ENGAGEMENT PLAN

CONFIDENTIAL

MAY, 2017

AL MANAKHER SOLAR PHOTOVOLTAIC POWER PLANT

STAKEHOLDER ENGAGEMENT PLAN

AES

Confidential

Project no: 52001890
Date: May, 2017

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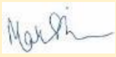
Signature				
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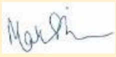
Signature				
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ABBREVIATIONS

Abbreviation	Definition
AES	AES Jordan
CLO	Community Liaison Officer
EPC	Engineering, Procurement, and Construction
ESIA	Environmental and Social Impact Assessment
EIA	Environmental Impact Assessment
EHS	Environmental, health and safety
IFC PS	IFC Performance Standards
IFC	International Finance Corporation
km	Kilometre
kV	Kilovolt
MW	Megawatt
m	Metre
MoE	Ministry of Environment
NEPCO	National Electric Power company
NEXI	Nippon Export and Investment Insurance
NGO's	Non-governmental organisations
OPIC	Overseas Private Investment Corporation
PAPs	Project-affected persons

ABBREVIATION	DEFINITION
RSS	Royal Scientific Society
SEP	Stakeholder engagement plan
ToR	Terms of Reference

FIGURES

APPENDICES

1 INTRODUCTION

1.1 BACKGROUND

AES Jordan (AES) and Mitsui & Co. Ltd have been awarded a contract by the Government of Jordan to build, own and operate a solar photovoltaic farm of up to 50 megawatt (MW), east of Amman at Al Manakher (herein referred to as the Project). The power generated by the project will be exported to the national grid via a substation and approximately 2km underground cable (to be developed by National Electric Power Company (NEPCO)) to an existing substation adjacent to IPP4, a dual fuel-fired power plant adjacent to Al Manakher village.

The Overseas Private Investment Corporation (OPIC) and Nippon Export and Investment Insurance (NEXI) lenders are considering to provide financing to the Project. As a result, the Project is required to meet the standards of both the Kingdom of Jordan in addition to the lender banks' requirements. OPIC and NEXI social and environmental guidelines (2014) refer to and require adherence to the International Finance Corporation (IFC) Performance Standards (current version 2012) and environmental, health and safety (EHS) industry sector guidelines.

An Environmental Impact Assessment (EIA) also known as an Environmental and Social Impact Assessment (ESIA) has been prepared in accordance with Jordanian requirements in addition to lender bank requirements.

An initial Scoping report and Terms of Reference (ToR) Report was developed by WSP | Parsons Brinckerhoff in 2015 although they were not admissible for submission to the Ministry of Environment (MoE) until the Project had cabinet approval, which occurred in December 2016. The Scoping and ToR were subsequently resubmitted in December 2016 for MoE review and comment. The Scoping and ToR were approved by the MoE in January 2017.

In order to ensure that stakeholders associated with the Project (local communities, government entities and other interested parties) are provided sufficient opportunities to raise their issues or concerns during the Project's lifecycle, effective and appropriate stakeholder communications are a key tool within the planning and development process. The following stakeholder engagement plan (SEP) provides the mechanism for these communications.

1.2 STAKEHOLDER ENGAGEMENT PLAN OBJECTIVES

The SEP has been developed with the following key objectives:

- Clarify previously undertaken consultations for the Project;
- Provide an appropriate mechanism to understand and manage stakeholder expectations in line with the Project's risks and opportunities;
- Building upon existing stakeholder mechanism(s) for IPP1 and IPP4 for future communications; and
- Provide a suitable grievance mechanism to allow stakeholders to express their concerns with project activities during lifetime of the plant.

It is noted that the proposed developers (AES) are key shareholders in the IPP1 and IPP4 power plants, which are located approximately 2km southwest of the Project site. Due to their proximity, these thermal power plants effectively manage community engagement as one entity in order to ensure what are often common issues are resolved together.

As a result of the common owners (AES), communities in the local area in particular are likely to consider the proposed Project as part of the overall project portfolio rather than as an individual project necessarily. Inputs to this SEP with respect to the Project have therefore considered the existing stakeholder engagement mechanism in place at the IPP1 and IPP4 power plant sites and have involved the existing community liaison officer at the same sites. With respect to the potential impacts associated with the proposed Project on surrounding local communities, these differ considerably from thermal power plants, with limited negative impacts associated with the proposed project particularly during the operational phase. An EIA has been undertaken in order to assess the environmental and social impacts associated with the development of the Project.

The general principles of effective stakeholder engagement as considered within the IFC International Finance Corporation (2007): '*Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets*' have also been considered within the development of this SEP, as shown within Figure 1-1.

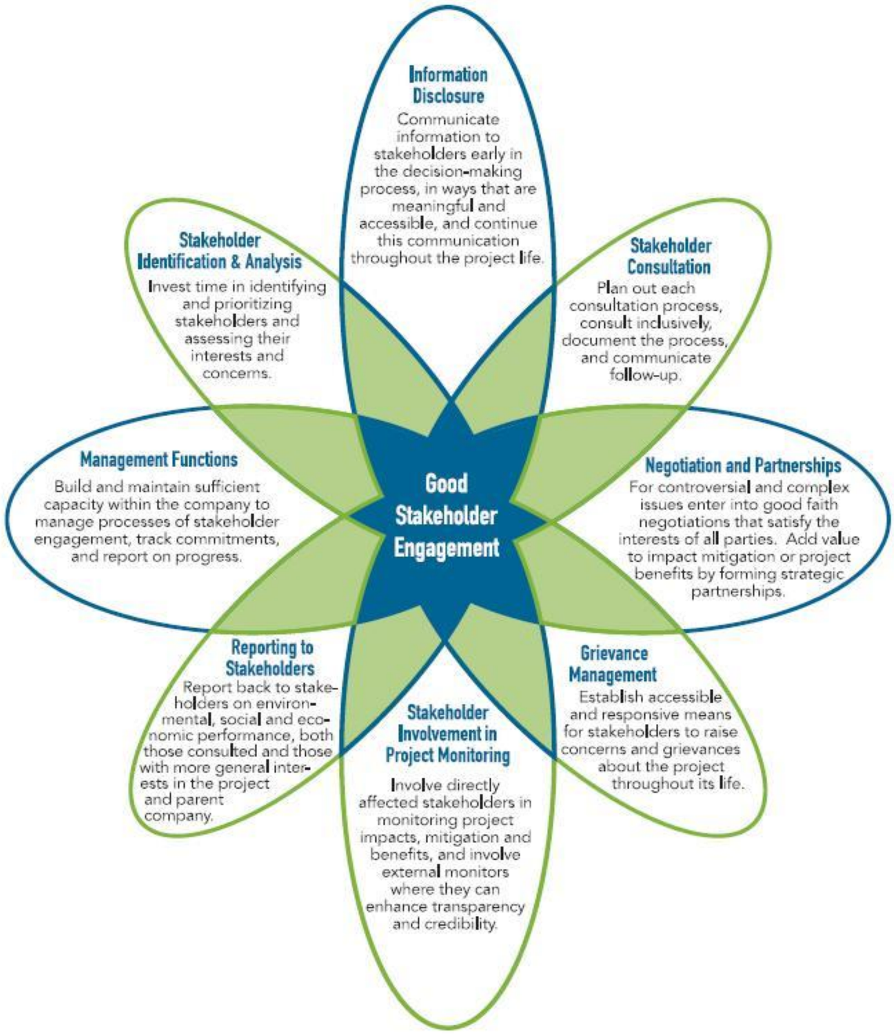

Figure 1-1 Good stakeholder engagement as per IFC Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets (2007)

1.3 PROJECT DESCRIPTION

The Project site is located within the Sahab District in the Amman Governorate. The site is approximately 2km northeast of the existing Levant Power Plants (IPP1 and IPP4), which was built and is operated by AES. The overall Project site plot is 498,000m^2 of government owned land. The land has been previously cleared by the Ministry of Finance and does not have any existing developments on or immediately adjacent. Directly to the south of the Project site is a main road which leads towards Amman in a westerly direction. Other notable receptors within the Project site include the IPP3 power plant located approximately 7.5km east, a municipal landfill, an army base and air strip located approximately 15km north east.

The land to be used for the Project will be leased to the Project Company by the Ministry of Finance (Department of Land and Survey) under a 20 year tenor. The Project location is indicated within Figure 1-2.

The Project will consist of solar photovoltaic modules of mono crystalline type (supplied by a yet to be confirmed Tier 1 supplier) with 497,000 panels. These will be accompanied by 11 dual inverter control stations (e.g. 22 inverters in total), running through the centre of the site in order to receive the direct current generated by the panels and convert to alternating current. There will also be two 132/33kV power transformers converting the electricity generated from the modules and a central control room. Each module will be approximately 2m x 1m in size.

The PV modules will be arranged on ground-mounted racks at an angle of 17^{o} from horizontal. This will result in a top of edge or the rows at an approximate average of 3m above grade. In some cases this could be 1-2m higher due to terrain irregularities. The site has already been cleared by the Ministry of Finance and no significant additional grading is planned for the project site with the exception of some final levelling and the creation of drainage swales and channels.

The proposed conceptual plant layout for the Project is shown in Figure 1-3.

The nearest residential properties are located in Al-Manakher village, approximately 3km to the southwest of the Project boundary, although two other main communities are also present within the general regional context, Al Khashafiyah and Al Baida within approximately 6km. The community locations are noted within Figure 1-4. Comments from these latter communities have been received by the community liaison officer at IPP4 with respect to the thermal power plants and, while limited direct impacts are expected on these communities by the solar plant, similar comments/requests are anticipated.

1.4 PROJECT CONTRACTOR

The Project EPC agreement involves three parties, the Project company AES , Wärtsilä Gulf FZE and Sgurr Energy India Private Limited. Sgurr is providing the engineering and technical expertise and Wärtsilä will be responsible for construction of the facility. Wärtsilä were the EPC contractor for the construction of the IPP4 project approximately 2km southwest of the Project site and it is anticipated that they will bring to the Project 'lessons learned' with respect to community liaising in particular.

1.5 STAKEHOLDER ENGAGEMENT PLAN STRUCTURE

This SEP is organised in the following sections:

- Regulatory requirements;
- Previous stakeholder engagement;
- Stakeholder identification and analysis;
- Stakeholder engagement activities;
- Timescales and responsibilities; and
- Grievance mechanism.

Figure 1-2 Site location

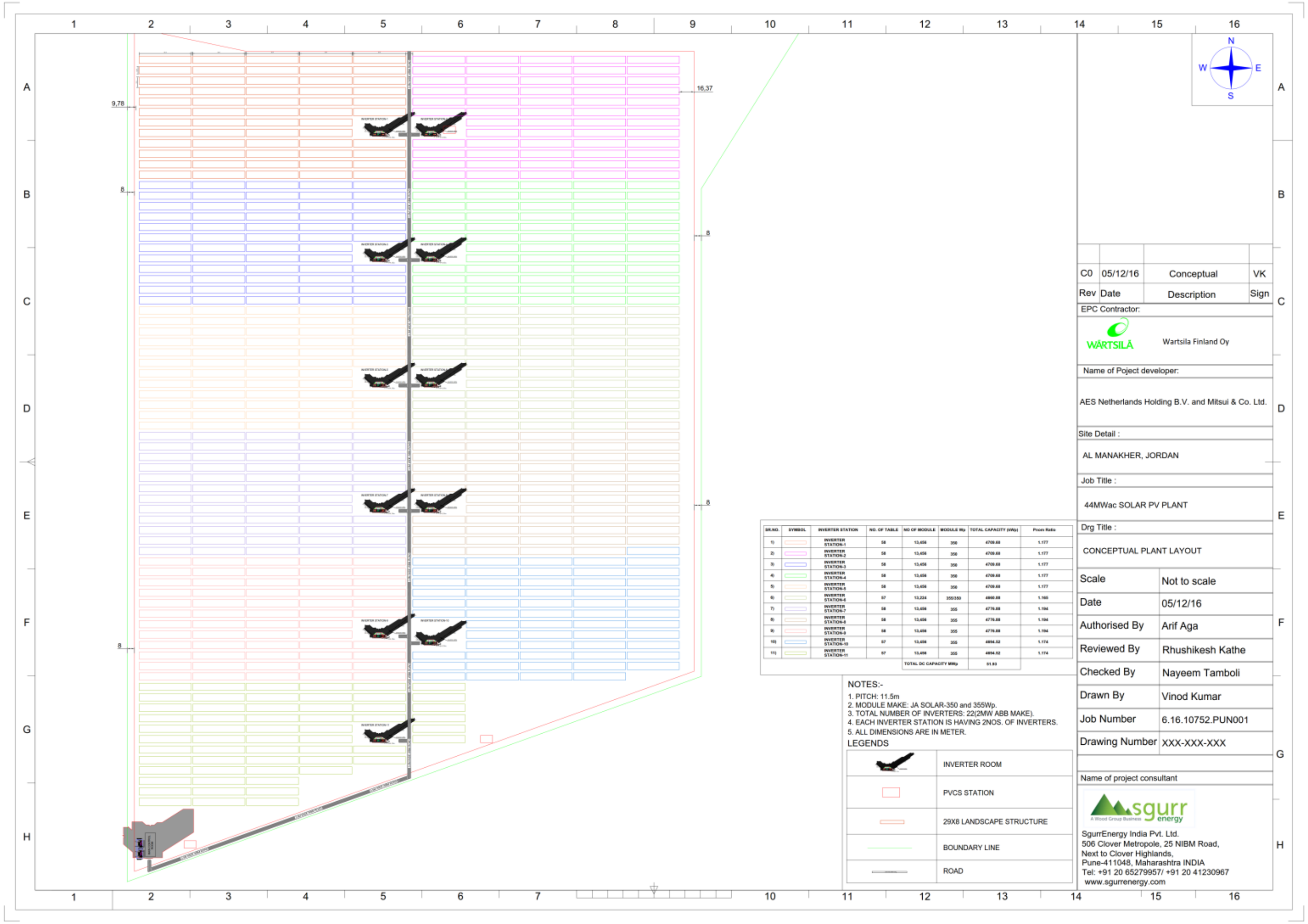

Figure 1-3 Conceptual plant layout

Figure 1-4 Nearest villages to project site

2 REGULATORY REQUIREMENTS

2.1 JORDANIAN REQUIREMENTS FOR PUBLIC CONSULTATION

Under Jordanian Law, (Jordanian EIA Regulations (No.37, 2005), a scoping session is required to be undertaken at the preliminary stage of the EIA process. The invited attendees are screened and confirmed by the Ministry of Environment with respect to their relevance. The Project owner or environment assessor working on behalf of the owner, is then required to include within the Scoping and ToR submission to MoE, a summary report of the meeting's discussions. This should include:

- The parties attending;
- The Significant Impacts identified; and
- Ensure the ToR for the EIA study account for these issues.

Where appropriate, the issues and concerns expressed at the scoping meeting should be considered within the subsequent EIA, project design and mitigation measures. Once these steps have been followed, no further public consultation is considered necessary within the Jordan guidelines. However, upon EIA submission the Ministry of Environment Technical Committee, chaired by the Secretary General, reviews and comments on the EIA and considers the issues raised within the scoping session to ascertain whether these have been appropriately addressed within the EIA and accompanying documentation.

The Technical Committee typically comprises representatives from a number of the following organisations:

- The Ministry of the Environment;
- The Ministry of Planning and International Cooperation;
- The Ministry of Municipal Affairs;
- The Ministry of Health;
- The Ministry of Agriculture;
- The Ministry of Industry and Trade;
- The Ministry of Energy and Mineral Resources;
- The Ministry of Water and Irrigation;
- The Ministry of Tourism and Antiquities;
- The Ministry of Public Works and Housing; and
- Any other concerned entity specified by the Minister.

Subject to the Committee's findings, further discussions with the developer and Committee may be necessary although typically no additional public consultations are considered necessary.

2.2 LENDER REQUIREMENTS FOR STAKEHOLDER ENGAGEMENT

As indicated within Section 1.1, the main lenders associated with the Project are OPIC and NEXI. The main standards which are referenced for the Project refer to the IFC Performance Standards

(IFC PS) (2012) and to the principles contained within. It is considered that adherence to the guidelines and principles outlined within the IFC PS ensures that the Project should be in general compliance with OPIC and NEXI social engagement requirements. Stakeholder engagement is primarily considered within PS 1 Assessment and Management of Environmental and Social Risks and Impacts, particularly paragraphs 25-36. The type and frequency of stakeholder engagement should reflect the nature of the project and risks/opportunities associated with the construction and operation of the facility.

With respect to IFC requirements, during the EIA process project-affected persons (PAPs) and groups and local non-governmental organisations (NGOs) should be consulted with about the project's environmental aspects and takes their views into account. These consultations should occur as early as possible.

This Project is considered at this stage to be a Category B project (as per Equator Principles' categorisation), however, this will need to be confirmed by the relevant Project lenders; if necessary the environmental and social documentation can be amended at a later date if the Project classification changes. For Category B projects stakeholders should be consulted at least once.

Effective communication should reflect the key principles of:

- Beginning early in the environmental assessment and continue on an ongoing basis;
- Being based upon disclosure of transparent information that is understandable to affected communities;
- Ensuring dialogue across different demographics with those directly affected by the Project;
- Enabling issues raised can impact upon the assessment, design or management of the facility; and
- That consultations and feedback are documented.

3 PREVIOUS STAKEHOLDER ENGAGEMENT

An official scoping consultation was organised by the MoE at the Holiday Inn Hotel, Amman on 5 November 2015 in accordance with MoE EIA Regulations.

A list of relevant and potentially relevant stakeholders was prepared by the AES and the MoE. Thirty five (35) stakeholders were invited to the session with 22 subsequently attending. Stakeholders who attended ranged from Government Ministries to representatives from Al Manakher Village, who are the nearest local community.

During the scoping session, AES, with support from the Royal Scientific Society (RSS), provided a presentation outlining an overview of the Project, the proposed Project activities, facilities and processes. The attendees were invited to discuss their issues and concerns associated with the Project, with the comments and attendees recorded and included within the Scoping & ToR report. A list of the attendees (in Arabic) and points raised are included within **Appendix A**. The points raised have subsequently been considered in the final EIA where appropriate.

The scoping session held in November 2015, provided an early forum for interested parties to discuss their concerns or issues with the Project with a broad cross-section of parties selected, addressing the national consultation requirements. While the plant sizing is slightly smaller than the original maximum size considered in 2015 (up to 80MW was originally envisaged though the planned size is closer to 50MW) the Project site and general concept remain the same. As a result, it is considered that the findings of the stakeholders' discussion held in 2015 remain relevant. This also corresponds to MoE's acceptance of the Scoping & ToR in January 2017 (and Cabinet approval in principle for the Project in December 2016). However, during the course of the review of stakeholder engagement considered within the Scoping & ToR it was determined that heavy rains during the time of the first consultation resulted in some of the originally invited parties from the local communities not attending.

In order to ensure that key stakeholders were provided with an opportunity to express their concerns and issues with the proposed Project, additional workshops were arranged with local communities from Al Manakher, Al Beida and Al Kashafiyeh on 1, 2 and 11 February 2017 respectively, with attendance and presentations provided by the local consultant RSS and the AES community liaison officer for the IPP1 and IPP4 power plants. Key findings from these sessions are summarised within **Appendix B** and have been assessed within the EIA.

The key objectives of these engagement activities have been to:

- Engage key potential and key stakeholders by introducing the Project and EIA process;
- Identify additional potential and key stakeholders;
- Facilitate capacity enhancement through explanation of the technology and potential impacts and benefits;
- Provide forum for stakeholders to express concerns and opportunities to be addressed by the feasibility study and EIA process;
- Provide stakeholders with points of contact to address further concerns and liaise with over ongoing engagement activities.

In addition to the original consolation and the consolation undertaken as part of the EIA, A site visit was undertaken on March 14, 2017, this site visit was initiated by OPIC in order to undertaken a ground truthing exercise as well as to consult various stakeholders first hand. WSP

| Parsons Brinckerhoff environmental consultants also attended this meeting, along with the AES Project Manager.

The meetings were held over one day and consulted with:

- **Staff members of Al Manakher Primary School** - This school is located centrally within the village of Al Manakher which boarders the AES operated IPP1 and IPP4 power plants. Approximately 275 pupils, aged 5-12 years old attend the school which has been open in the community since 1973. The staff members who were involved in the consultation were female and included the head teacher (Mrs. Majedah Raggad);
- **Village leaders of Al Manakher Village ( )** – a meeting was held at the Majlis of the two leaders (Mutllaq Sallameh Bnian & Odallah Bnian) of the Al Manakher Village. Four other senior members of the village also attended.
- **Head of the Khashafya Community Centre (Abed Faleh Dabobi)** – the community centre is located in the Khashafyavillage which is located 5.5km west of the Project site. The community centre has received funding from AES's previous community and stakeholder funding programmes. The centre is used to host various events in the village such as birthday celebrations, weddings and funerals; and
- **The Governor of Sahab District (Dr Mohammad Abu Romman)** – the Governor has only recently taken up his post in office over the last 4 months. Sahab is district number 23 out of 27 and is located south east of the capital Amman.

All meetings held were positive and all of the members who were consulted were in support of the proposed Project. Each of the stakeholders who were consulted with all indicated that Project company – AES have provided support to them, namely in a financial manner.

Table 3-1 provides a summary of the key feedback received from the stakeholder consultations undertaken during the Project's assessment.

Table 3-1 Previous Stakeholder engagement

STAKEHOLDER FORUM	DATE	STAKEHOLDER	KEY PROJECT ISSUES AND PERCEPTIONS
Scoping Session (Holiday Inn, Amman)	November 2015	See Appendix A Included Ministries and communities	See Appendix A
EIA workshops (Local community centres)	1 February 2017	Al Manakher community	▪ Believe the Project will lead to an increase employment opportunities in the area; ▪ Believed that the Project would contribute positively in the area prosperity, both during the construction and the operation phases; ▪ Interviewees believed that the Project would not affect the land price; and ▪ Believed that communities surrounding the Project site will see

STAKEHOLDER FORUM	DATE	STAKEHOLDER	KEY PROJECT ISSUES AND PERCEPTIONS
			an increase in the living standard.
	2 February 2017	Al Baida community	▪ Believed the Project may reduce their land price; ▪ Do not consider there are good opportunities for employment; ▪ Consider the use of the tall overhead transmission lines as an eyesore and do not want them; ▪ Believe power projects reduce the land values; and ▪ Suffer from additional vehicle movements from the facilities.
	11 February 2017	Kashafiya community	▪ The interviewees believe that the Project would reduce their land price; ▪ Hope that the proposed Project would increase the employment opportunities during both the construction and operation phases; ▪ Fair compensation for landowners located close to existing transmission towers; ▪ Fair compensation for landowner if their land value lowers because of the proposed Project; and ▪ To give priority for local contracts in the construction phase.
Additional stakeholder workshops	14 March 2017	Al Manakher School	▪ Supportive of the power project and AES in general as AES has contributed positively to the school's development through provision of facilities and equipment
		Sahab Governor	▪ Supportive of the Project and particularly highlighted that local (Al Manakaher and Sahab district) employment should be prioritised through discussion with mukhtars and local labour offices.
		Khashafyacommunity	▪ Supportive of the power project and

STAKEHOLDER FORUM	DATE	STAKEHOLDER	KEY PROJECT ISSUES AND PERCEPTIONS
		centre	AES in general as AES has contributed positively to the community centre's development through provision of centre renovation.

4 STAKEHOLDER IDENTIFICATION AND ANALYSIS

During the development, construction and operation of the proposed Project there are a number of stakeholders who are considered to have a direct or indirect interest in the Project.

It is not practical, and usually not necessary, to engage with all stakeholder groups with the same level of intensity all of the time. This SEP has aimed to be strategic and clear as to whom the Project should engage with and why. This has been achieved through a process of prioritising the relevance of the stakeholders and, depending on who they are and what interests they might have, determining the most appropriate ways to engage with them.

It is important to keep in mind that the situation is dynamic and that stakeholders and their interests might change over time, in terms of level of relevance to the project and the need to actively engage at various stages. As such, the SEP should be considered as a 'live' document and updated regularly to account for example from stakeholder feedback or legal changes.

The relevance of each stakeholder to the proposed Project has been considered in terms of whether they are:

- *"Impact-based*" - stakeholders directly affected stakeholders through adverse and beneficial Project impacts such as physically or economically impacted groups or individuals.

  In common with best practice, the intensity of engagement should reflect the level of impact, with special efforts where necessary to reach out to disempowered, socially excluded and/or vulnerable groups who may not have a good understanding of their rights or entitlements and may not be familiar with engagement activities. Note, with respect to the proposed Project, no such disempowered parties have been identified during the course of consultations although care will need to be given to ensure stakeholders continue to feel engaged with; and
- "*Interest-based*" - stakeholders who may have an interest to influence the Project for their own objectives and be able to influence the Project or public perception, e.g. NGOs. Itis important to ensure that potential critics of the project and those who can positively influence the Project design are appropriately engaged at the correct moments in order to facilitate their effective input and to manage potential negative perceptions.

With respect to the stakeholders who have been identified as 'impact-based' these tend to also be 'interest-based' too. For example, local communities may be impacted by construction activities and effects such as noise, traffic or dust, although at the same time they are also likely to have an interest in ensuring they benefit from community initiatives and employment opportunities.

The full list of relevant Stakeholder groups, organisations and their relevance as identified for the project to date is provided in Table 4-1.

Table 4-1 Stakeholder identification

Stakeholder		Relevance to project
Local project-affected communities	Al Manakher	Impact-based
	Al Baida	Interest-based
	Kashafiya	Interest-based
Regional government	Governor of Sahab District	Impact-based
National government departments	Ministry of Interior	Interest-based
	Ministry of Energy and Mineral Resources	Interest-based
	Rangers	Interest-based
	Energy and Minerals Regulatory Commission	Interest-based
	MoE	Interest-based
	Ministry of Education- Al Manakher School	Interest-based
	Ministry of Water and Irrigation	Interest-based
	Ministry of Municipal Affairs	Interest-based
	Ministry of Industry, Trade and Supply	Interest-based
Local industry	IPP4 and IPP1 Power Plants - AES	Impact-based
Financial institutions	European Bank for Reconstruction and Development (investor in IPP1 and IPP4 Power Plants)	Interest-based

Stakeholder		Relevance to project
	OPIC	Interest-based

5 STAKEHOLDER ENGAGEMENT ACTIVITIES

The stakeholder engagement for the Project during the development, construction and operational phases enables the following:

- Disclosing appropriate information about the Project and the assessment process;
- Disclosure of Project information helps stakeholders understand the risks, impacts and opportunities. Similarly, consultation activities are more informed and constructive if stakeholders have accurate and timely information about the project and its impacts. The information and issues that will require public disclosure so that stakeholders can fully understand the project include:
  - What the Project is and why it is needed?
  - Where the Project will be located?
  - What the Project will look like?
  - What effects there will be on the local environment?
  - What effects there could be on residents, businesses and livelihoods?
  - What the effects could be on human health?
- Providing relevant stakeholders with the opportunity to voice their opinions, preferences and grievances. This enables participation and involvement in the planning and design process.

The various engagement and disclosure activities for the proposed Project are indicated below.

5.1 WORKSHOPS AND FOCUS GROUPS

Regular workshops will be a constructive way in which to involve key stakeholders throughout the duration of the EIA review and approval process, construction and operation periods so that issues and any grievances can be raised and addressed as they emerge.

It is envisaged that private meetings with individual stakeholders will also be organised where necessary, as the need arises to inform the EIA process and to discuss specific Project elements or concerns.

Following the development of the IPP4 power plant it is understood that government-registered community councils with nominated spokespersons have been set up with respect to Al Manakher village. It is not clear at this stage whether similar councils exist for the other communities in the area (Al Baida and Khashifiya). It is anticipated and recommended that any such engagement for the Project is undertaken within the existing framework for IPP1 and IPP4 power plants. Where necessary, similar formalised community organisation arrangements may be necessary for other communities, although given the minimal negative impacts during operation of the Project, this may be more applicable to community investment initiatives with respect to a more formal approach with respect to the nomination of potential projects.

5.2 MEDIA COMMUNICATIONS AND DISCLOSURE OF WRITTEN INFORMATION

The Project Owner, AES, currently has an appointed Community Liaison Officer (CLO) who is responsible for day-to-day community engagement with respect to the existing IPP1 and IPP4 power plants. Given the proximity of the proposed Project to these sites and the likely perception of the communities to agglomerate all three plants given the common owner (AES), it is anticipated that this CLO will also act on behalf of the Project too. The CLO's contact details will be made available on sign boards and within hard copies of documents which will be made available at locations in the communities (including Arabic translation of the executive summary of the EIA). The CLO undertakes the following tasks:

- Act as main point of contact for the local community e.g. local community leaders/mukhtars and the elected and appointed local authorities;
- Disclosure of Project employment opportunities and key Project news and impact information, such as the commencement/completion of construction activities;
- Community consultation and disclosure events at key stages in the project, for example at the beginning of construction;
- Organise local community meetings to provide a regular opportunity to discuss any issues or concerns; and
- Receive and record written and oral comments.

The SEP will need to be reviewed throughout the course of the Project's development. Once the Project is operational, this should happen at least annually by the CLO in order to assess whether:

- The type of consultation and disclosure activities continue to be appropriate for the different stakeholders;
- The frequency of consultation activities is sufficient;
- Grievances have been adequately dealt with; and
- The stakeholder list remains appropriate and whether engagement should cease or be extended to any additional stakeholders.

5.3 PROJECT WEBSITE

An AES website has been established which contains details on the IPP1 and IPP4 power plants.

This is located at www.aesjordan.com.jo.

It is anticipated that information on the solar project will be uploaded as and when it becomes available. Once uploaded, interested local parties will be informed of the documentation availability, with contact details provided on the website (phone and email address of the community liaison officer).

6 TIMESCALES AND RESPONSIBILITIES

6.1 OVERVIEW

For effective consultation and disclosure, consideration of the appropriate timescales are necessary. This Section of the SEP assigns timescales and responsibilities to the activities identified in the previous section.

6.2 IMPLEMENTATION

The activities described in Section 5.1 are presented in Table 6-1 below with suggestions regarding when they should be implemented and the various people who would have responsibility.

Table 6-1: Stakeholder Engagement Implementation Timescales and Responsibilities

ACTIVITY	TIMING	RESPONSIBILITY
EIA Phase Engagement		
Draft EIA Disclosure on AES website (www.aesjordan.com.jo)	■ Upon submission of EIA to MoE.	■ AES (Project Company)
Draft EIA NTS (Arabic and English) made available in Manakher, Al Badia and Khashifiyeh local communities (schools, masjids or equivalent) in hardcopy	■ Within 3 weeks of EIA submission to MoE.	■ AES (Project Company)
Private meetings and workshops	■ As necessary over the duration of the ESIA process in parallel with ongoing IPP1/IPP4 consultations.	■ CLO
■ **Construction Phase Engagement**		
Ongoing Community liaison and grievance logging	■ Grievance logging to occur once received, with the CLO following up with the concerned party; ■ Community liaison to occur on a regular basis with the CLOs contact details being made available to communities to use when needed; ■ CLO to interact with the relevant communities at a minimum of twice a month; ■ Visiting local communities for informal consultation, generally once a week at minimum; and ■ Monthly grievance reporting.	■ AES CLO at IPP1 and IPP4 Power Plants ■ Project manager (when required)
Community consultation events	■ Prior to the start of construction; and ■ Prior to the completion of construction.	■ CLO and HSE Manager on site
Updating SEP	■ Prior to the start of construction; and	■ CLO and HSE Manager on site

ACTIVITY	TIMING	RESPONSIBILITY
	■ Prior to the completion of construction.	
■ **Operation and Decommissioning Phase Engagement**		
Open days including consideration of local school visits or community visits if feasible from security/H&S perspective	■ At least annually	■ CLO and Project Manager
Grievance logging, resolution and reporting	■ Ongoing logging and resolution; and ■ Annual reporting (or in line with IPP1 and IPP4 reporting if more frequent).	■ CLO and Project Manager
Decommissioning consultation event with affected staff and communities	■ With staff prior to retrenchment proceedings; and ■ With communities prior to ceasing operations.	■ CLO and Project Manager
Updating SEP	■ Annually or in line with IPP1 and IPP4 changes if relevant.	■ CLO

7 GRIEVANCE MECHANISM

7.1 OVERVIEW

The objective of a grievance procedure is to ensure that all comments and complaints from any Project stakeholder are considered and addressed in an appropriate and timely manner. There should be no costs associated with lodging a grievance.

As a general policy, it is anticipated that AES will work proactively towards preventing grievances through the implementation of impact mitigation measures (as identified by the EIA) and community liaison. As highlighted within the EIA and earlier sections within this SEP, activities undertaken by the AES for the proposed Project will need to be undertaken in coordination with activities undertaken for the IPP1 and IPP4 power plants. This includes corporate social responsibility and community investment initiatives.

These activities are designed to anticipate and address potential issues before they become grievances. This will be the responsibility of the construction (and subsequent operational) Site Manager and the CLO.

The sections below consider types of grievances, confidentiality and anonymity, and the project's grievance resolution process.

All comments and complaints will be responded to either verbally or in writing, in accordance with the preferred method of communication specified by the complainant. Comments will be reviewed and taken into account in the project preparation; however they may not receive an individual response unless requested.

All grievances will be registered and acknowledged within 5 days and responded to within 20 working days. AES will keep a grievance log and report on grievance management, as part of annual Project progress reports, which will be available on the company website.

7.2 CONFIDENTIALITY AND ANONYMITY

The Project will aim to protect a person's confidentiality when requested and will guarantee anonymity in annual reporting. Individuals will be asked for permission to disclose their identity. Investigations will be undertaken in a manner that is respectful of the aggrieved party and the principle of confidentiality. The aggrieved party will need to recognise that there may be situations when disclosure of identity is required and the Project will identify these situations to see whether the aggrieved party wishes to continue with the investigation and resolution activities.

7.3 GRIEVANCE REPORTING AND RESOLUTION

A formal logging system will be developed and the CLO will be responsible for logging all grievances. A template complaints sheet is provided within **Appendix C** for those wanting to make a complaint or comment. This should be finalised by AES and be made available to the relevant stakeholders. Provision will be made to do this directly to the MoE or contractor; through the CLO or through a community representative (e.g. through the village elders). The procedure for lodging grievance and their resolution will be included in appropriate project communication materials such as the non-technical summaries. In the first instance, grievances will be directed to the CLO who will classify grievances according to Table 7-1.

Table 7-1: Grievance Classification Criteria

Grievance Classification	Risk Level	Validity	Response
Low	None or low	Unsubstantiated	CLO will conduct investigation, document findings and provide a response
Medium	Possible risk and likely a one-off incident	Possible substantiation	CLO and an appropriate investigation team will conduct investigation. The Site Manager or OHS Manager may decide to stop work during the investigation to allow the corrective preventive actions to be determined. The CLO will provide a response.
High	Probable risk and has potential to reoccur	Probable substantiation	CLO will get the contractor to organise a Major Investigation Team including the MoE for prompt investigation and resolution. Work will be stopped in the affected area. The CLO will provide a response.

8 MONITORING AND REPORTING

This SEP identifies various activities that will require monitoring and reporting during the construction and operational phases of the Project, these include:

- CLO activities: minutes of consultation meetings will be produced and all original written consultation correspondence will be retained as evidence of the process and outcomes;
- Grievance logging and tracking: each raised grievance will be logged by the CLO, given an identification number and followed through by recording details and timing for their resolution and closing out;
- Annual reporting: a Project-specific annual report (potentially included within IPP1/IPP4 reports) summarising project performance, CLO activities including grievances and updates to the SEP will be produced;
- Reporting schedules are presented in Section 0; and
- Public domain documents will be distributed widely to stakeholders including regulatory agencies, lenders associated with the Project local authorities and local communities.

As part of the EIA, an Environmental and Social Management and Monitoring Plan will detail specific monitoring and reporting requirements for environmental and social project performance.

9 CONTACT DETAILS

Comments and concerns regarding the project can be submitted in writing in the following ways:

- Email: mohammad.alqudah@aes.com;
- By telephone: *Office:* +962 *6 4293200*; and
- By post or hand delivered to (see example grievance form attached **– Appendix C**).

Individuals who submit their comments or grievances have the right to request that their name be kept confidential, although it is recognised that this may mean that the company is unable to provide direct feedback on how the grievance is to be addressed.

A separate grievance mechanism will be made available for workers, including employees of both the Project Company and its contractors, with further details contained within AES' Human Resources Policy.

Alternatively if a female member of staff is required, contact details as follows:

- Ms. Muna Al-Khatib;
- Telephone: +962 79 8554405;
- E-mail: muna.khatib@aes.com;and
- Postal Address: Al Madhonna St – Al Manakher Village P.O. Box 3099 Amman 11181.

Appendix A

SCOPING CONSULTATION SESSION 2015- ATTENDEES AND COMMENTS

AES, Al-Manakher Solar PV Plant, Jordan

Scoping Session Amman

Nov 5, 2015

No.	Name	Organization / Company	Telephone Number	E-mail
1.	وصفي احمد العدوان	وزارة الداخلية	٠٧٩٩٣٩٧٩٦	
2.	م. علي الخوالدة	وزارة الطاقة	٠٧٧٢٤٧١٠٨٧	ali@memr.gov.jo
3.	م. حسام دريكات	الإدارة الملكية لحماية البيئة	٠٧٩٥٨[illegible]	Hussamwerikat@yahoo.com
4.				
5.	م. ايمن القرعان	هيئة تنظيم قطاع الطاقة والمعادن	٠٧٩٥٧٥٩٧٥٠	Quraan.ayman@Yahoo.com
6.	م. عمار مسمار	وزارة البيئة / مديرية حماية الطبيعة	٠٧٩٦١١٦٥٨٧٦	ammar.mesmmar@moenv.gov.jo
7.	عطالله سلامة الكعابي	local		
8.	رئيس منطقة الدجه			
9.	نرمين حماد	البنك الأوروبي لإعادة الإعمار والتنمية	٠٧٧٧٢٣٢٠٠٠	hammadn@ebrd.com
10.	ماجدة محمد الرقاد	[illegible]	٠٧٧٧٦٨٠٠٨٣	majedaraggad@yahoo.com
11.	عماد موسى [illegible]	وزارة الصحة	٠٧٨٨٥٨٨٨٤١	Emads_mp78@yahoo.com
12.	ايمن جابر	وزارة المياه والري	0795830380	ayman_Jaber@mwi.gov.jo
13.	د. [illegible] الحرازنة	وزارة البلديات	0777272008	
14.	م. [illegible] الطعاني	وزارة الصناعة والتجارة	٠٧٩٩٠٤٨٠٤١	
15.	أمين طهبوب	وزارة الصحة	٠٧٩٥٠١٤٦٦١٠	tahboub_ameen@yahoo
16.	د. محمد [illegible]	[illegible]	[illegible]	[illegible]@yhoo.co
17.				

AES, Al-Manakher Solar PV Plant, Jordan

Scoping Session Amman

Nov 5, 2015

No.	Name	Organization / Company	Telephone Number	E-mail
18.	Amjad Almomani	AES		
19.				
20.	Muna Musa	EMRS	0799723572	
21.				
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35.				

#	الملاحظة	Note	Organization – الجهة
.1	المحافظة على المراعي	conservation of Pastures	Ministry of Environment – وزارة البيئة
.2	عدم الإضرار بالمنظر الطبيعي	Landscape and Visual impacts	Ministry of Environment – وزارة البيئة
.3	المحافظة على التنوع الحيوي	Bio-diversity conservation	Ministry of Environment – وزارة البيئة
.4	نظرا للظروف التي تطرأ على الأردن نتيجة الأحداث المجاورة تحتاج المدارس في وزارة التربية إلى الدعم للوفاء بإلتزاماتها ومنها مدرسة المناخر وهي مدرسة من (الروضة – السابع) مختلطة لعدم وجود مدرسة ذكور في المنطقة. الطلبة بعد السابع يسيرون على الأقدام 5 كم.	Due to the current situation in the region that affects Jordan, public schools are in need for support to fulfill their commitments, including Al-Manakher School (Kindergarten – 7th Grade) for Both Girls and Boys because there is No Boys school in the village. Additionally students are forced to walk 5 km to precede their education after the 7th grade.	Al-Manakher – مدرسة المناخر الأساسية Primary School
.5	ضرورة وجود مدرسة ذكور	There is a necessity to establish a boys school in the village	Al-Manakher – مدرسة المناخر الأساسية Primary School
.6	بناء 5 غرف صفية لتصبح مدرسة المناخر ثانوية	Building of five Classrooms for the existing school in order to become a high school	Al-Manakher – مدرسة المناخر الأساسية Primary School
.7	المدرسة بحاجة ملاعب/ساحات/مظلة/لوازم مدرسية	The school is in need for Playgrounds/open areas/school supplies	Al-Manakher – مدرسة المناخر الأساسية Primary School
.8	دعم سكن كريم	Supporting Sakan Kareem (a Housing support Program for least opportune areas)	Al-Manakher – مدرسة المناخر الأساسية Primary School
.9	أنقاض الحفر وتأثيرها على الصحة العامة	Impact of construction activities on Public health.	Ministry of Environment – وزارة البيئة
.10	دراسة موضوع الآثار (في حال وجودها)	Impact on archaeological sites (if there is any)	Ministry of Environment – وزارة البيئة
.11	تأثر المشروع من الفيضانات والأمطار الشديدة والإجراءات التخفيفية لحماية المشروع	The effects of floods and heavy rainfall on the project, and the mitigation measures to minimize these effects	Ministry of Environment – وزارة البيئة
.12	أثر الوهج الذي قد ينتج عن الخلايا الكهروضوئية وتأثيره خاصة على الطريق الرئيسي	Impact of solar glare on the Main Roads	Ministry of Environment – وزارة البيئة Energy and – هيئة تنظيم قطاع الطاقة والمعادن Minerals Regulatory Commission
.13	التخلص من الخلايا الكهروضوئية التي تعرضت للكسر	Disposal of broken photovoltaic cells	Ministry of Environment – وزارة البيئة
.14	التخلص من الخلايا الكهروضوئية بعد إنتهاءعمر المشروع	Disposal of photovoltaic cells at the decommissioning phase	Ministry of Environment – وزارة البيئة Ministry of Water and – وزارة المياه والري Irrigation
.15	عدم التأثير على الأودية إن وجدت	Impact on wadies, if there is any.	Ministry of Water and – وزارة المياه والري Irrigation

Organization – الجهة	Note	الملاحظة	#
وزارة المياه والري – Ministry of Water and Irrigation	Constructing a detours for water flow basins	إنشاء تحويلات لمجاري المياه	.16
وزارة المياه والري – Ministry of Water and Irrigation	Calculating the flood flow that might occurred, and the effects of these floods on soil erosion, and the basis of the photovoltaic cells, to what extent the soil erosion can happen under these basis	حساب كمية الفيضانات التي يمكن أن تحدث وأثرها على تجريف التربة وقواعد اللوحات الشمسية إلى أي مدى يمكن أن تنجرف التربة تحت القواعد	.17
وزارة المياه والري – Ministry of Water and Irrigation وزارة الصحة – Ministry of Health	Management of solid waste resulting from construction activities.	الإنتباه إلى مخلفات العمال والإنشاء والتخلص منها بعد الإنشاء	.18
وزارة المياه والري – Ministry of Water and Irrigation	Traffic and infrastructure impact	تأثير حركة الشاحنات	.19
وزارة المياه والري – Ministry of Water and Irrigation وزارة الصحة – Ministry of Health	Impact of solid wastes, waste water and Oils	أثر المخلفات الصلبة والسائلة والزيوت	.20
وزارة المياه والري – Ministry of Water and Irrigation وزارة الداخلية – Ministry of Interior	Solid waste management	جمع مخلفات العمل والتخلص منها بطريقة آمنة	.21
وزارة الصحة – Ministry of Health	Road Accidents	حوادث الطرق	.22
وزارة الصحة – Ministry of Health	Generated dust from vehicle Activities	الأغبرة الناتجة من حركة السيارات	.23
وزارة الصحة – Ministry of Health هيئة تنظيم قطاع الطاقة والمعادن – Energy and Minerals Regulatory Commission	Generated dust from Construction and drilling activities	الأغبرة الناتجة من عمليات البناء والحفر	.24
وزارة الصحة – Ministry of Health هيئة تنظيم قطاع الطاقة والمعادن – Energy and Minerals Regulatory Commission	Noise impact on the nearest populated area and the nearest development areas (Projects), schools and worship houses	الضجيج ومستوياته ومدى تأثيره على أقرب التجمعات السكانية والمناطق التنموية القريبة (المشاريع)، المدارس والمساجد	.25
وزارة الصحة – Ministry of Health وزارة الداخلية – Ministry of Interior	The emergency measures in case of accidental breaking of cells components (Hazardous wastes)	في حال حدوث كسر لبعض المواد الداخلة في الصناعة مثل الخلايا كيفية التعامل معها	.26
وزارة الصحة – Ministry of Health	Medical examination for employees.	الفحوصات المهنية المراد إجراءها للعاملين (أولية ودورية)	.27
وزارة الصحة – Ministry of Health	Employees training and Awareness raising	التدريب والتوعية للعاملين	.28
وزارة الصحة – Ministry of Health	Guidance Signs for employees	اللوحات الإرشادية للعاملين	.29
وزارة الصحة – Ministry of Health	Personal protection equipment availability	الأدوات الوقائية وملابس العمل	.30

Organization – الجهة	Note	الملاحظة	#
Ministry of Health – وزارة الصحة	Environmental Measures intended to be made ($PM_{2.5}$, PM_{10}, TSP)	القياسات البيئية المراد إجراءها ($PM_{2.5}$, PM_{10}, TSP)	.31
Ministry of Health – وزارة الصحة	Handling and Disposal of E-wastes	التعامل مع النفايات الإلكترونية والتخلص منها	.32
Energy and Minerals Regulatory Commission – هيئة تنظيم قطاع الطاقة والمعادن	The project should comply with the existing regulations and standard regarding the harmful impact coming out from the construction activities.	ضرورة اللإلتزام بالمعايير البيئية للأضرار الناتجية عن عمليات الإنشاء	.33
هيئة تنظيم قطاع الطاقة والمعادن – Energy and Minerals Regulatory Commission	Study the possibility of reusing cleaning wastewater from the photovoltaic cells, in order to be used by the project's management for green areas (irrigation) or for household use except drinking .	دراسة إمكانية تجميع مياه التنظيف على الألواح الشمسية لإستخدامها من قبل إدارة المشروع لدى المساحات الخضراء إن وجدت أو للإستخدام المنزلي عدا الشرب	.34
هيئة تنظيم قطاع الطاقة والمعادن – Energy and Minerals Regulatory Commission	Landscaping and rehabilitation of the project site to avoid forming of ponds inside the project area which might be dangerous for local community	إعادة طبوغرافية الأرض إلى الوضع الصحيح لتجنب تجميع المياه داخل المشروع وتشكل برك مائية قد تكون خطيرة على المجتمع المحلي	.35
Ministry of Interior – وزارة الداخلية	Stakeholder Engagement	إستمرار اللقاءات مع المجتمع المحلي	.36
Ministry of Interior – وزارة الداخلية Rangers - الإدارة الملكية لحماية البيئة	Give priority for local community in terms of employment	إعطاء الأولوية لأبناء المجتمع المحلي في فرص العمل	.37
Ministry of Interior – وزارة الداخلية	Support the local community	التركيز على محور المسؤولية الإجتماعية	.38
Rangers - الإدارة الملكية لحماية البيئة	Giving the local community special rates in terms of electricity fees	تخفيض فاتورة الكهرباء لسكان المجتمع المحلي	.39

Appendix B

CONSULTATION FINDINGS- FEBRUARY 2017

RSS notes from the February 2017 - Public consultations

To make real estimation of the value of the negative impact of the project during the construction and operation phase two public consultation meetings were conducted. The consultation process was started by introducing a description of the project activities, and by inquiring if the participants know about the project, The meeting aimed at identifying the residents' concerns about the project activities in relation to the major environmental and social aspects, The first meeting was held at Al-Mankher village on February first 2017 by RSS team and AES Jordan team. Annex (1) shows the list of participants.

The interviewees believe that the project will increase employment opportunities in the area just for guards and workers, 85% of the interviewees believe that the project will contribute in the area prosperity; the interviewees believe that the project will not affect the land price and they believe that existing of such a project will raise the people living standard also they believe that the project will bring other projects to the area, in over all the interviewees were supporting existence of the project, additionally, the interviewees raised many requirements as follow:

- Painting the mosque
- Having a bus for the school students
- Fixing the resident solar panels
- They recommended forming an environmental committee from the local community to submit people complaint officially.
- To have secondary school.
- Regarding the existing scholarship for public university students they suggest to give the scholarship for private university students in case of Lack of accepted students in the public university.

The second meeting was held at Al-Beida village on February second 2017 by RSS team and AES Jordan team. Annex (1) shows the list of participants.

 

The residents of the area have their own lands around the project site, The interviewees believe that the project will reduce their land price and it will not increase employment opportunities, they mentioned that the village suffer from the existing projects all around the area and from the high pressures towers and from the AES vehicles. The interviewees were against the project and they mentioned that they have a bad experience with AES since they didn’t support their village.

The villager raised the following concerns:

- If the presence of this project will stop the custom project.
- Lowering their land price.
- Existing of new high pressures towers.

The villager requirements were as follow:

- Building a health care center for serving the village.
- Building Training center for serving the village.
- Training for the local communities.
- Supporting the village Fund.
- Lighting the area.

The third meeting was held at Al Khshafiyeh village on 11/2/ 2017 by RSS team and AES Jordan team, annex (1) shows the list of participants.

One of the interviewees has his own land around the project site, the interviewees believe that the project will reduce their land price and they hope that the project will increase the employment opportunities. The interviewees were support the project and they have some requirements such as:

- Providing schools with solar energy.
- Training of the local community.
- Fair compensation for land owners where the high pressures towers pass.
- Fair compensation for land owner if their land price is lower because of the existing of the project.
- They required forming an environmental committee from the local community to control and evaluate the project during the operation and to submit people complaint officially.
- They required that the project owner should appoint a second accredited consultant to monitor the cumulative impact in the area from all existing projects.
- Supporting universities and schools.
- Providing scholarships for universities' students.
- To give priority for the local contract in the construction phase.
- The representor of East Amman Society for Environmental Protection (EASEP) engineer Farhan Al daboby mentioned that they need to attend the process of monitoring plan.

List of Attendees

طبيعة العمل	رقم الهاتف	الاسم	الرقم
	0796691619	شكري موسى محمد الشملتي	1
	0795695124	سيد العبد ابو ثريا	2
	0795010071	ذياب محمود	3
	0796764206	عيد سلمان الحنيطي	4
	0777258714	جمعان عساف المساعيد	5
	0799995325	انور رمضان	6
	0792813833	عماد موسى الشملتي	7
	0795332067	حسين مطر	8
	0777493839	يوسف الحميدين	9
	0796868758	حكم محمد العبوس	10
	0795100055	علي نهار العبوس	11
	07916889549	عمر محمد كريم	12
	0796693123	عبدالله مرزوق الطلاس	13
	0777072446	عوده يوسف هنداوي	14
	0795027950	فاعور عواد الدعجة	15
	0788662742	قاسم موسى الحميدين	16

الرقم	الاسم	رقم الهاتف	طبيعة العمل
1	عطا الله سليمان مناحي		
2	انور عبد الكريم سلامة	0777340991	
3	مطلق سلامة نويران		
4	عودة الله محمد سيلمان	0772602120	
5	هاني مطلق سلامة	0772851607	
6	ناصر احمد سيلمان	0772172661	
7	منصور محمد سيلمان	077611541	
8	نضال ضيف الله محمد	07967703898	
9	نهار منور		
10	خالد حمدان سيلمان الدعجة		
11	مطلق سلامة مناحي		
12	رياض احمد	0772576027	
13	محمد سليمان الدعجة		
14	أحمد سليمان		

الرقم	الاسم	رقم الهاتف	طبيعة العمل
1	خالد مسلم الدبوبي	0795121166	تاجر
2	م.فرحان عيسى الدبوبي	0796731284	رئيس جمعية شرق عمان لحماية البيئة
3	منصور حميدان الدبوبي	0797988395	متقاعد
4	زيدان حمد الدبوبي	0779505489	متقاعد
5	محمد سالم الدبابيه	0796211819	متقاعد
6	محمد حسين الدبابية	0796643047	متقاعد
7	محمد عبد ربه الدبابيه	0790357994	امين سر جمعية شرق عمان لحماية البيئة
8	احمد محمد الدبابيه	0772665716	طالب
9	رسلان محمد الدهون	0777055808	عاطل عن العمل
10	راشد امين الدبابيه	0796719158	عاطل عن العمل
11	حمزة غازي الدبوبي	0772101080	عاطل عن العمل
12	احمد امين الدبوبي	0796719158	عاطل عن العمل
13	نسيم رائد الدبوبي	0798556353	عاطل عن العمل
14	مصعب فواز الدبوبي	0770257121	عاطل عن العمل
15	عبدالكريم فواز الدبوبي	0770257121	عاطل عن العمل
16	ناصر علي الدبابيه	0796295083	عاطل عن العمل
17	ثامر محمد الدبابيه	0797778890	موظف
18	عبد فالح الدبوبي	0796007981	رئيس جمعية خشافيه الدبابيه

Appendix C

GRIEVANCE/COMPLAINTS TEMPLATE

Comments and Complaints Sample Form

FORM FOR COMMENTS, COMPLAINTS AND REPORTS OF INDIVIDUALS

Reference No:	
Full Name	
Contact Information and Preferred method of communication Please mark how you wish to be contacted (mail, telephone, e-mail).	**By Post: Please provide mailing address:** ____ ____ ____ **By Telephone:** ________________________________ **By E-mail** ________________________________ **I would like to communicate with a female community liaison officer**
Description of Incident or Grievance:	What happened? Where did it happen? Who did it happen to? What is the result of the problem? Source and duration of the problem?
Date of Incident/Grievance	
	One time incident/grievance (date ________________) **Happened more than once (how many times? _____)** **On-going (currently experiencing problem)**
What would you like to see happen to resolve the problem?	

Signature: ______________________________

Date: ______________________________

Please return this form to: Mr. Mohamed Qudah, HSE and Community Liaison Officer, AES Levant B.V. Jordan PSC, Amman East Power Plant office

Address: Amman East Power Plant
Al Madhonna St – Al Manakher Village
P.O. Box 3099
Amman 11181
Telephone: *Office:* +962 6 4293200
E-mail: mohammad.alqudah@aes.com

Contact for Women: Ms. Muna Al-Khatib

Address: *Amman East Power Plant (as above)*
Telephone: Office: +962 6 4293200
E-mail: muna.khatib@aes.com