

# **Dandara Solar Power, S.A.E.**

## **ESIA for Dandra PV Power Plant and BESS in Nagaa Hammadi *Qena governorate***

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## List of Acronyms

Abbreviation	Definition
ESIA	Environmental and Social Impact Assessment
PV	Photovoltaic
BESS	Battery Energy Storage System
EIA	Environmental Impact Assessment
AFDB	African Development Bank Group's
OS	Operational Safeguards
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
CDP	Cassa depositi e prestati S.p.A.
IFC	International Finance Corporation
EHS	Environmental, Health and Safety
HSSE	Health, Safety, Security, and Environment
ESMP	Environmental and Social Management Plan
ER	Executive Regulations
EU	European Union
SR	Solar Radiation
KBA	Key Biodiversity Areas
PA	Protected Area
EAAA	Ecologically Appropriate Area of Analysis
AC	Alternating Current
EEAA	Egyptian Environmental Affairs Agency
PPA	Power Purchase Agreement
CBAM	Carbon Border Adjustment Mechanism
OHTL	Overhead Transmission Line
DC	Direct Current
MV	Medium Voltage
NMC	Nickel Manganese Cobalt Oxide
LFP	Lithium Iron Phosphate
BMS	Battery Management System
SCADA	Supervisory Control and Data Acquisition
IEC	International Electrotechnical Commission
OPGW	Optical Ground Wire
EETC	Egyptian Electricity Transmission Company
ONAF	Oil Natural Air Forced
ROW	Right-Of-Way
DFI	Development Financial Institution
HV	High Voltage
GIIP	Good International Industry Practice
PS	Performance Requirements
PVC	Polyvinyl Chloride
ESMS	Environmental and Social Management System
ILO	International Labour Organization

Abbreviation	Definition
GHG	Greenhouse Gas
IAQM	Institute of Air Quality Management
NNE- SSW	North-Northeast to South-Southwest
ERM	Environmental Resources Management
CAA	Competent Administrative Authority
NREA	The New and Renewable Energy Authority
WHO	World Health Organization
PM	Particulate Matter
CITES	Convention on International Trade in Endangered Species
MOTA	The Ministry of Tourism and Antiquities
NCCS	National Climate Change Strategy
NDC	Nationally Determined Contribution
UNFCCC	The United Nations Framework Convention on Climate Change
INDC	Intended Nationally Determined Contribution
BAU	Business-As-Usual
AEWA	Agreement on the Conservation of African-Eurasian Migratory Waterbirds
UNCBD	United Nations Convention on Biological Diversity
CMS	The Conservation of Migratory Species
UNFCC	The United Nations Framework Convention on Climate Change
UNESCO	The United Nations Educational, Scientific and Cultural Organization
ISS	Integrated Safeguards System
ESS	Environmental and Social Standards
ESR	EBRD Environmental and Social Requirement
GBVH	Gender-Based Violence And Harassment
DNSH	Do Not Significant Harm
BAT	Best Available Techniques
NPI	Net Positive Impact
CRVA	Climate Risk and Vulnerability Assessment
RAP	Resettlement Action Plan
LRP	Livelihood Restoration Plan
FPIC	Free, Prior and Informed Consent
HSMS	Health and Safety Management System
UN	United Nations
FI	Financial Intermediaries
ECS	Emerging Contaminants
ESG	Environmental, Social, and Governance
SDA	Sustainable Development Assessment
OHS	Standards of Occupational Health and Safety
GIS	Geographic Information Systems
IUCN	The International Union for the Conservation of Nature
IBAT	The Integrated Biodiversity Assessment Tool
GBIF	Global Biodiversity Information Facility
MSBT	Migratory Soaring Birds Tool
GPS	Global Positioning System

Abbreviation	Definition
CAPMAS	The Central Agency for Public Mobilisation and Statistics
ESRI	Environmental Systems Research Institute, Inc.
QMS	Quality Management System
ISO	International Organization for Standardization
TSP	Total Suspended Particulates
MSL	Mean Sea Level
SRTM	Shuttle Radar Topography Mission
CSS	Climate Safeguards System
WD	Western Desert
MLP	The Middle Limestone Plateau
LC	Least Concern
NT	Near Threatened
EN	Endangered
VU	VU: Vulnerable
AVISTEP	The Avian Sensitivity Tool for Energy Planning
NCE	Nature Conservation Egypt
MOU	Memorandum of Understanding
CR	Critically Endangered
IBA	Important Bird Area
IPA	Important Plant Areas
PBF/CH	Priority Biodiversity Features and Critical Habitat Criteria and Associated Thresholds
QG	The Qena Governorate
SIS	The State Information Service
TOT	Total Population Size
ICU	Intensive Care Units
EAM	The Egyptian Archeological Map
CULTNAT	The Center for Documentation of Cultural and Natural Heritage
ICH	Intangible Cultural Heritage
HS	Hazardous Substances
ARCS	Automatic Robotic Cleaning Systems
PV	Photovoltaic
LTO	Lithium-Ion Titanate
NCM	Lithium Nickel Manganese Cobalt
VRFB	Vanadium Chemistry Based
AMBRI	The Environmental Sector by Providing a Novel Long-Duration Energy Storage Solution
CSR	A Corporate Social Responsibility
HC	Hydrocarbons
GBV	Gender-Based Violence
EPC	Engineering, Procurement, and Construction
PPE	Personal Protective Equipment
LCA	Life Cycle Assessment
SF6	Sulfur hexafluoride
SGHAT	The Solar Glare Hazard Analysis Tool

Abbreviation	Definition
HEC-RAS	(by USACE) in determining the floodplain boundaries of the main streams that affect the study area
DEFRA	Department for Environment, Food & Rural Affairs
SEAH	Sexual Exploitation and Abuse and Harassment
HSE	Health, Safety, and Environment
HSEE	Health, Safety, Environment, and Energy
LCO	The Labor Compliance Officer
HR	Human Resources
DEIB	Diversity, Equity, Inclusion and Belonging
CESMP	The Construction Environmental and Social Management Plan
HW	Hazardous Waste
WMRA	Waste Management Regulatory Authority
SEP	Stakeholder Engagement and Management Plan
CLO	Community Liaison Officer
YEO	The Youth Employment Office
EGP	The Egyptian Pound
NGO	Non-Governmental Organization



# شركة دندرة للطاقة الشمسية

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## 1- نظرة عامة على المشروع

### 1-1 الخلفية

تعتمد شركة سكاتك إنشاء محطة طاقة شمسية بقدرة 1000 ميغاوات (تيار متردد) مدمجة مع نظام تخزين طاقة بالبطاريات بسعة 200 ميغاوات. ساعة، يتم تنفيذها على مرحلتين من خلال شركتها التابعة دندرة للطاقة الشمسية ش.م.م. ستبلغ قدرة المرحلة الأولى 500 ميغاوات (تيار متردد) مدمجة مع نظام تخزين طاقة بسعة 100 ميغاوات. ساعة، بينما ستكون المرحلة الثانية مماثلة تمامًا للمرحلة الأولى. تركز هذه الدراسة على المرحلة الأولى فقط.

يقع المشروع في محافظة قنا إلى الشرق من المنطقة الصناعية بنجع حمادي وبالقرب من مجمع شركة مصر للألومنيوم (وقد خصصت الحكومة المصرية الموقع لهيئة الطاقة الجديدة والمتجددة ضمن برنامج مشروعات الطاقة المتجددة. يتم تنفيذ المشروع بالتعاون مع مؤسسات تمويل دولية، من بينها البنك الأوروبي لإعادة الإعمار والتنمية وبنك التنمية الإفريقي، والبنك الأوروبي للاستثمار، وشركة كاسا ديوزيتي إي بريستيتي مما يعكس ثقة الشركاء الدوليين في مناخ الاستثمار المستدام في مصر وقدرتها على تنفيذ مشروعات ذات أثر بيئي واقتصادي طويل الأمد.

وقد كلفت شركة إنفايرونكس من خلال شركة دندرة بإعداد دراسة تقييم الأثر البيئي والاجتماعي وفقاً للقوانين الوطنية المصرية، وكذلك المعايير البيئية الدولية..

### 2-1 الأهداف العامة

يمثل مشروع محطة دندرة للطاقة الشمسية خطوة استراتيجية في جهود مصر نحو التحول إلى اقتصاد منخفض الكربون وتعزيز استخدام الطاقة المتجددة في القطاع الصناعي، بما يتماشى مع رؤية مصر 2030 وأهداف التنمية المستدامة.

ويسهم المشروع في تحسين موثوقية إنتاج الطاقة الشمسية من خلال دمج نظام تخزين البطاريات، مما يعزز قدرة مصر على تحقيق أهدافها المعلنة للطاقة المتجددة. ويمثل المشروع أحد النماذج الرائدة لدمج نظم التخزين مع مشروعات الطاقة المتجددة، الأمر الذي يساعد على مواجهة التحديات الناتجة عن الطبيعة المتقطعة لمصادر الطاقة المتجددة. كما يدعم جهود الدولة لزيادة نسبة الطاقة المتجددة ضمن مزيج الطاقة الكلي.

### 3-1 أهداف الدراسة

يهدف إعداد دراسة تقييم الأثر البيئي والاجتماعي إلى ضمان أن يكون المشروع المقترح مستداماً بيئياً ومقبولاً مجتمعياً، وأن يتم التعرف مبكراً على الآثار البيئية والاجتماعية المحتملة واتخاذ التدابير اللازمة لمعالجتها قبل تنفيذ المشروع.

وتهدف الدراسة إلى تحديد الآثار البيئية والاجتماعية المحتملة أثناء مرحلتي الإنشاء والتشغيل؛ ووضع تدابير التخفيف المناسبة للحد من الآثار السلبية المحتملة؛ وضمان الامتثال لمتطلبات القوانين البيئية والاجتماعية المحلية والمعايير الدولية. كما تهدف الدراسة إلى تلبية المتطلبات القانونية المنصوص عليها في قانون البيئة رقم 4 لسنة 1994 وتعديلاته 2009/9 و2015/105 واللوائح التنفيذية المحدثة.

بالإضافة إلى ذلك، تهدف الدراسة إلى تلبية المتطلبات البيئية والاجتماعية لمؤسسات التمويل الدولية، بما في ذلك البنك الأوروبي لإعادة الإعمار والتنمية، بنك التنمية الإفريقي، بنك الاستثمار الأوروبي، شركة كاسا ديبوزيتي إي بريستيتي (CDP) وغيرها من بنوك التنمية المتعددة الأطراف.

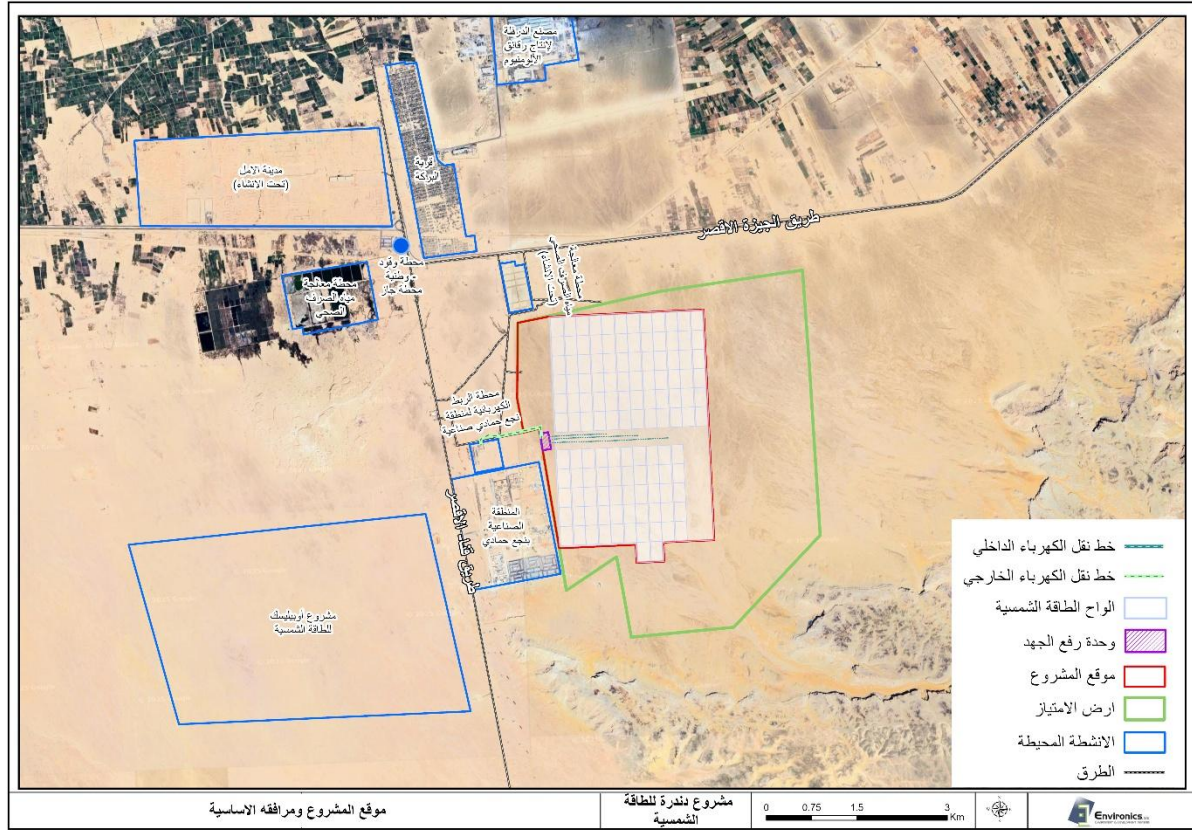
#### 1-4 موقع المشروع

تبلغ مساحة حق الانتفاع المخصصة للمرحلتين الأولى والثانية حوالي 2335 هكتار ( $\approx 23,350,000$  م<sup>2</sup>)، منها حوالي 1130 هكتار ( $\approx 11,300,000$  م<sup>2</sup>) مخصصة للمرحلة الأولى لإنشاء محطة طاقة شمسية بقدرة 500 ميغاوات (تيار متردد).

يقع الموقع في منطقة صحراوية شرق المنطقة الصناعية بنجع حمادي داخل محافظة قنا، ويقع جنوب شرق مجمع مصر للألومنيوم، وملاصقاً لمحطة محولات المنطقة الصناعية بنجع حمادي.

يبعد طريق الجيزة-الأقصر حوالي 1,2 كم شمال موقع المشروع. ويمكن الوصول إلى الموقع عبر طريق غير ممهد يمتد لمسافة 2,5 كم غرباً من طريق الجيزة-الأقصر أو عبر طريق غير ممهد يمتد لمسافة مماثلة غرباً من الطريق الصحراوي قنا-الأقصر.

أقرب تجمع سكاني هو قرية البركة ويقع على مسافة حوالي 4 كم شمال غرب حدود المشروع، كما توجد بعض الأراضي الزراعية المستصلحة المتناثرة في المنطقة المحيطة. يوضح شكل 1 الأنشطة والاستخدامات المحيطة بالموقع.



شكل 1: موقع المشروع والأنشطة المحيطة

## 2- وصف المشروع

### 1-2 المخطط العام للمشروع

ستقوم محطة الطاقة الشمسية باستخدام ألواح شمسية عالية الكفاءة من السيليكون أحادي البلورة، بالإضافة إلى أنظمة تتبع أحادية المحور (Horizontal Single-Axis Tracker – 1P) لتعزيز الاستفادة من الطاقة. كما سيتم دمج نظام لتخزين الطاقة بالبطاريات باستخدام بطاريات الليثيوم أيون لتخزين الطاقة المُولدة وإدارتها.

سيتم ربط المشروع بالشبكة القومية من خلال خط نقل كهرباء هوائي يتم إنشاؤه بواسطة شركة دندرة للطاقة الشمسية، بحيث يربط محطة محولات المشروع بمحطة محولات المنطقة الصناعية بنجع حمادي القائمة. وسيتم بعد ذلك نقل الطاقة المنتجة إلى شركة مصر للألومنيوم عبر شبكة الكهرباء القائمة.



## 2-2 مكونات المشروع

### 2-2-1 المكون الأول: الحقل الشمسي

#### • الألواح الشمسية (PV Modules)

تتكون المحطة من حوالي 903960 لوحًا شمسيًا ثنائي الوجه عالي الكفاءة من نوع السيليكون أحادي البلورة، بقدرة اسمية 630 واط لكل لوح، لتوفر قدرة إجمالية بالتيار المستمر حوالي 569,49 ميغاوات. يتم توصيل الألواح على التوالي لتوليد التيار المستمر، مع مراعاة عوامل التصميم الأساسية مثل اتجاه الألواح والمسافات بين الصفوف وزاوية الميل.

#### • الهياكل الحاملة (Mounting Structures)

سيتم تركيب الألواح الشمسية على أنظمة تتبع أحادية المحور بارتفاع أقصى يبلغ حوالي 2,8 متر وبمدى حركة يتراوح بين 55°- إلى 55°+.

سيتم ترتيب صفوف الألواح بما يتلاءم مع الطبيعة الطبوغرافية للموقع لتقليل تأثيرات الظل وتحسين التعرض الشمسي. يعرض جدول 1: وصف مكونات المشروع (500 ميغاوات متدد) - مرحلة أولى.

جدول 1: وصف المكونات (500 ميغاوات AC)

البند	الوصف	الوحدة	الكمية
1	ألواح شمسية 630 واط	عدد	930960
2	هياكل التتبع	طاوولات	10,044
3	عدد الألواح لكل طاولة	لوح	90
4	(Inverters) محولات عاكس	عدد	496
5	عدد محطات المحولات الفرعية/محولات المتوسط	عدد	62
6	التكنولوجيا	ثنائية الوجه (Bifacial)	—
7	BESS حاويات بطاريات	عدد	20

#### • أنظمة مغيرات التيار Inverters

##### ○ العواكس

سيتم استخدام 496 عاكسًا لتحويل التيار المستمر إلى تيار متردد، بإجمالي قدرة 545,6 ميغاوات كما سيتم توفير حوالي 164,34 ميغاوات من القدرة غير الفعالة (Reactive Power) من خلال مغيرات التيار ونظام تخزين الطاقة بالبطاريات.

##### ○ المفاتيح الكهربائية (Switchgear)

تشمل معدات الجهد المتوسط (33 ك.ف) المستخدمة لحماية وإدارة الدوائر قبل رفع الجهد إلى 220 ك.ف، وهي ضرورية لضمان التشغيل الآمن والفعال للشبكة داخل محطة المحولات.

## 2-2-2 المكون الثاني: نظام تخزين الطاقة بالبطاريات (BESS)

يتكوّن نظام تخزين الطاقة بالبطاريات الصلبة (Solid-State Battery) من مجموعة من الخلايا الكهربائية المجمعة في وحدات تُعرف باسم الوحدات النمطية (Modules). يعتمد النظام المستخدم في المشروع على بطاريات أيون الليثيوم (Lithium-Ion BESS)، والتي تستخدم عادةً أحد نوعين من المواد في الكاثود هما: أكسيد النيكل والمنغنيز والكوبالت (NMC) أو فوسفات الحديد والليثيوم (LFP).

يشمل نظام بطاريات تخزين الطاقة من عدة وحدات أو بطاريات تُوضع داخل حاويات شحن أو هياكل مناسبة، ويتم توريدها إلى موقع المشروع مجمعة مسبقاً وجاهزة للتركيب، عادةً ما تُرفع هذه الحاويات قليلاً عن سطح الأرض وتُرتب في صفوف.

تتضمن البنية التحتية الخاصة بها والمعدات الإضافية أنظمة التحكم في درجة الحرارة (مثل التبريد أو التدفئة)، والتي تُثبت عادةً بين حاويات البطاريات لضمان أداء مثالي للبطاريات.

تجدر الإشارة إلى أن البطاريات الصلبة المستخدمة في المشروع تعتمد على أنظمة أيون الليثيوم الصلبة.

## المكونات الرئيسية لنظام تخزين الطاقة بالبطاريات

### 1. وحدات البطاريات

- تُعد هذه الوحدات العنصر الأساسي لنظام تخزين الطاقة بالبطاريات، وسيتم استخدام بطاريات أيونات الليثيوم بقدرة تصميمية تبلغ 100 ميجاوات ساعة وقدرة قابلة للتوزيع تبلغ 50 ميجاوات تيار متردد ، مع مراعاة أن كفاءة البطاريات قد تتناقص تدريجياً على مدى عمر المشروع.
- يتم توصيل الوحدات على التوالي والتوازي لتحقيق السعة الكهربائية المطلوبة للنظام.
- توضع الوحدات داخل حاويات معزولة مقاومة للعوامل الجوية للحماية من الظروف الخارجية.
- تم تصميم النظام ليعمل بدورة شحن وتفريغ واحدة كاملة في اليوم، بحيث يمكن للنظام، عند بلوغ حالة الشحن الكاملة (100%)، توفير خدمات مساندة للشبكة (Ancillary Services) وتحويل الأحمال، وذلك بالاتفاق بين الأطراف المعنية، وعند الوصول لحالة التفريغ الكاملة (0%)، يتم تعليق جميع الخدمات المساندة لبقية اليوم حفاظاً على كفاءة التشغيل والعمر الافتراضي للبطاريات.
- يمكن للنظام تخزين الطاقة الكهربائية وإعادة إطلاقها في أوقات محددة وفقاً للاتفاق مع مشتري الطاقة، وذلك بناءً على النسبة المخصصة من السعة الإجمالية لخدمات الشبكة، والتي تُعد ضرورية للحفاظ على استقرار الشبكة الكهربائية .

### 2. نظام إدارة البطاريات

- يعد نظام إدارة البطاريات مكوناً أساسياً في منظومة تخزين الطاقة . ويشمل بعض المهام الرئيسية التي يؤديها نظام إدارة البطارية ما يلي:
- مراقبة الجهد والتيار: لضمان تشغيل البطاريات ضمن الحدود التشغيلية الآمنة .
  - موازنة الشحن : لضمان توزيع الشحن بالتساوي بين جميع خلايا البطارية، مما يساعد على تحسين الأداء وإطالة عمر البطارية.

- مراقبة درجة الحرارة: يقوم النظام بمتابعة درجة حرارة البطارية وتفعيل أنظمة التبريد أو التدفئة عند الحاجة وذلك للحفاظ على درجات الحرارة المثالية.
- نظام الحماية: يحمي البطاريات من الظروف الغير الطبيعية مثل الشحن الزائد والإفراط في التفريغ وحدوث قصر كهربائي Short circuits .
- الفحص والصيانة: من خلال إصدار تقارير دورية عن حالة البطاريات وتحديد الأعطال المحتملة قبل حدوث مشاكل تشغيلية جسيمة تؤثر على أداء النظام .

### 3. نظام التبريد والتهوية

تولد البطاريات حرارة أثناء عمليات الشحن والتفريغ، ولذلك تُعد أنظمة التبريد عنصراً أساسياً للحفاظ على درجة الحرارة ضمن الحدود الآمنة، بما يمنع ارتفاعها المفرط الذي قد يؤدي إلى تدهور أداء البطاريات أو نشوب حرائق.

### 4. أنظمة التحكم والمراقبة

توفير بيانات لحظية دقيقة عن أداء نظام تخزين الطاقة وخصائص التشغيل.

تشمل هذه الأنظمة مجموعة من المكونات مثل: أنظمة الإشراف والتحكم وجمع البيانات (SCADA)، وأجهزة الاستشعار (Sensors)، وواجهات الاتصال (Communication Interfaces)

### 5. الأنظمة المساندة

تشمل أنظمة الإضاءة الداخلية والخارجية، ومصادر الطاقة الاحتياطية في حالات الطوارئ، وأنظمة مكافحة الحرائق.

تسهم هذه الأنظمة في تعزيز السلامة التشغيلية واستمرارية الأداء في مختلف ظروف التشغيل.

### 2-2-3 المكون الثالث: خط النقل الهوائي الداخلي متوسط الجهد (MV OHTL)

داخل حدود موقع المشروع، سيتم إنشاء ممر لخط نقل هوائي داخلي بجهد متوسط 33 كيلوفولت، لتجميع ونقل الطاقة الكهربائية المولدة من الألواح الشمسية إلى وحدة رفع الجهد داخل الموقع.

يمثل هذا الممر العمود الفقري لشبكة تجميع الطاقة الداخلية للمحطة، حيث يربط مغيرات التيار بوحدة رفع الجهد 220/33 كيلوفولت داخل موقع المشروع.

يمتد الخط الهوائي الداخلي بجهد 33 ك.ف عبر حوالي 12 برجاً لمسافة 2,7 كم، من الغرب إلى الشرق عبر الجزء المركزي من موقع المشروع. تُدعم الخطوط بأبراج فولاذية بارتفاع متوسط يبلغ 28 متراً، وقد يصل إلى 34 متراً حسب طبوغرافيا الموقع ومتطلبات التصميم الفني.

## 2-2-4 المكون الرابع: الربط على الشبكة القومية

يتضمن هذا المكون إنشاء وحدة رفع الجهد داخل حدود موقع المشروع، بهدف ضمان كفاءة نقل الطاقة المولدة وتعزيز مرونة التشغيل واستقرار الشبكة القومية.

تهدف الوحدة إلى رفع الجهد الكهربائي من مستوى الجهد المتوسط (33 كيلوفولت) إلى الجهد العالي (220 كيلوفولت)، بما يتيح نقل الطاقة بكفاءة وربطها بالشبكة القومية.

تتضمن وحدة رفع الجهد الكهربائي جهازين تشغيليين لرفع الجهد الكهربائي تبلغ قدرة كل منهما 300 ميغافولت أمبير، ليصل إجمالي القدرة المركبة إلى 600 ميغافولت أمبير. يهدف هذا التصميم المزدوج للأجهزة التشغيلية إلى تحقيق مرونة تشغيلية عالية وضمان الاحتياطية المزدوجة (Redundancy) وموثوقية تفريغ الطاقة الكهربائية نحو الشبكة.

تُصنف الأجهزة التشغيلية من النوع (ONAF (Oil Natural Air Forced)، حيث تستخدم الزيت كعازل ومبرد مع نظام تبريد بالهواء القسري مدفوع بواسطة مراوح تبريد خارجية متعددة للحفاظ على درجات حرارة التشغيل المثالية، بما يعزز كفاءة الأداء وإطالة العمر الافتراضي للأجهزة.

## 2-2-5 المكون الخامس: خط النقل الهوائي الخارجي

يتضمن المشروع إنشاء خط نقل هوائي جديد بجهد 220 كيلوفولت، يهدف إلى نقل الطاقة الكهربائية المولدة من محطة الطاقة الشمسية وربطها بالشبكة القومية للكهرباء.

سيقوم الخط الهوائي بربط وحدة رفع الجهد الكهربائي بقدرة 33 كيلوفولت / 220 كيلوفولت الواقعة داخل موقع المشروع بمحطة الربط الكهربائية لمنطقة نجع حمادي الصناعية بجهد 220 كيلوفولت، والتي تبعد حوالي واحد كيلومتر إلى الغرب من موقع وحدة الرفع الجديدة.

يمتد خط النقل الهوائي الجديد عبر مسار محدود داخل أراضي صحراوية مملوكة للدولة، مما يساهم أيضاً في الحد من الآثار البصرية واستخدامات الأراضي والآثار البيئية.

## 2-3 الجدول الزمني للتنفيذ

من المخطط أن يبدأ تنفيذ مشروع محطة دندرة للطاقة الشمسية دندرة خلال الربع الثاني من عام 2026، وذلك بعد الحصول على جميع التصاريح والموافقات التنظيمية المطلوبة من الجهات المختصة.

تُقدّر فترة التنفيذ الإجمالية بحوالي 15 شهراً، تمتد من مارس 2026 حتى يونيو 2027، وتشمل جميع أعمال التجهيزات الميدانية، والأعمال المدنية، والكهربائية، والميكانيكية.

## 2-4 مراحل تنفيذ المشروع

### (أ) مرحلة الإنشاء

تشمل الأنشطة الأساسية داخل موقع مشروع محطة الطاقة الشمسية دندرة الأعمال المدنية، وإنشاء المباني، وتوريد وتركيب المعدات والمرافق الخدمية، وأعمال الاختبار والتشغيل التجريبي للمعدات. وتتضمن الأنشطة الرئيسية خلال مرحلة الإنشاء ما يلي:

- **تجهيز الموقع:** يشمل أعمال الرفع المساحي، وتسوية الأرض، وإزالة العوائق، بالإضافة إلى أعمال الخرسانة، وتركيب المرافق والخدمات، وتجهيز ساحات التخزين (Laydown Areas) لمواد ومعدات المشروع.
- **أعمال تركيب الألواح والطرق الداخلية:** تتضمن تركيب الدعامات الخاصة بالألواح الشمسية، وإنشاء طريق وصول من الحصى بطول حوالى 1.5 كم يربط الموقع بالطريق الرئيسي، إلى جانب إنشاء طرق داخلية من الحصى لمرور المعدات الثقيلة ولعمليات التشغيل والصيانة.
- **نظام تصريف مياه الأمطار والسيول:** يشمل تنفيذ قناة مفتوحة بشكل شبه منحرف أو سائر ترابي مُدَكَّك على طول السياج الشرقي للموقع للحماية من السيول، بحيث يتوافق مسار النظام مع المجاري الطبيعية ويستوعب سيولاً محتملة تحدث مرة كل مائة عام، مع تطبيق وسائل للتحكم في التآكل وتبديد طاقة المياه.
- **الأسوار والبوابات:** سيتم إحاطة الموقع بالكامل بسياج محيط وبوابات رئيسية وطوارئ، مع توفير أسوار منفصلة لمحطة المحولات ذات الجهد العالي ومبنى التشغيل والصيانة لرفع مستوى الأمان والسلامة.

### سكن العمل

خلال مرحلة الإنشاء، سيتم توفير أماكن إقامة سكن العمال من خلال مزيج من منشآت الإقامة داخل موقع المشروع وخارجه، وذلك وفقاً لطبيعة مهام العمال ومحل إقامتهم الدائم.

سيتم إنشاء معسكر رئيسي مخصص داخل موقع المشروع مخصص للعمال الأساسية، بينما سيتولى المقاولون من الباطن توفير مساكن إضافية للعمال غير المقيمين محلياً في شقق سكنية مؤجرة بالقرى أو المراكز القريبة، إذا دعت الحاجة لذلك. ومع ذلك، يُشترط على جميع المقاولين الاستعانة بالعمال المحلية.

سيتم تصميم، وإنشاء، وإدارة جميع مرافق الإقامة بما يتوافق مع أفضل الممارسات الدولية، وبما يتماشى مع متطلبات الأداء رقم 2 للبنك الأوروبي لإعادة الإعمار والتنمية، والمعيار رقم 2 لمؤسسة التمويل الدولية، بالإضافة إلى إرشادات مؤسسة التمويل الدولية والبنك الأوروبي لإعادة الإعمار والتنمية الخاصة بإقامة العمال: العمليات والمعايير الصادر في 2009. وسيتم أيضاً الامتثال لقانون العمل المصري رقم 2025/14، والقرارات المرتبطة بالصحة والسلامة المهنية، وموافقات الدفاع المدني للسلامة من الحرائق.

### المنشآت المؤقتة (خلال مرحلة الإنشاء)

- خلال مرحلة الإنشاء، سيتم تأسيس مجموعة من المرافق المؤقتة داخل موقع المشروع لخدمة العاملين والمقاولين وممثلي الجهة مالكة المشروع، بما في ذلك مناطق التخزين المؤقت (Laydown Areas) وستشمل هذه المنشآت ما يلي:
- مكاتب إدارية مزودة بأنظمة تكييف الهواء.
  - قاعة لتناول الطعام / استراحة مخصصة لتناول الوجبات.
  - مرافق صحية مخصصة للعاملين.
- وعند الانتهاء من أعمال الإنشاء، سيتم تفكيك معظم هذه المنشآت والمرافق المؤقتة وإزالتها من الموقع .

### ب) مرحلة التشغيل

- وبعد الانتهاء من مرحلة الإنشاء، سيتم توليد وتخزين الطاقة النظيفة. وتشمل الأنشطة الرئيسية خلال مرحلة التشغيل ما يلي:
- إنتاج الطاقة: تقوم الألواح الشمسية بتحويل أشعة الشمس إلى كهرباء يتم تغذيتها مباشرة إلى الشبكة الكهربائية.
  - تخزين وإدارة الطاقة: يقوم نظام تخزين الطاقة بالبطاريات (BESS) بتخزين فائض الطاقة خلال النهار وإطلاقها في المساء للمساهمة في استقرار إمدادات الكهرباء.
  - مراقبة وصيانة الأنظمة: تشمل عمليات التفتيش الدورية، والتنظيف، وصيانة الألواح والعواكس والبطاريات لضمان أعلى كفاءة تشغيلية.
  - السلامة والامتثال: مراقبة مستمرة لمعايير السلامة والبيئة، بما في ذلك التحكم في درجات الحرارة، ومنع الحرائق، وتطبيق إجراءات سلامة العاملين.

### ج) مرحلة الإغلاق

- وفي نهاية العمر التشغيلي للمشروع، سيتم تفكيك الموقع وإعادة تأهيله بشكل آمن. وتشمل الأنشطة ما يلي:
- إزالة المعدات: سيتم تفكيك الألواح الشمسية والبطاريات والهياكل الداعمة وجميع المعدات المرتبطة بها بطريقة آمنة ومراقبة.
  - إعادة التدوير وإدارة المخلفات: سيتم إعادة تدوير المكونات القابلة لإعادة الاستخدام، بينما سيتم التخلص من المواد الخطرة وفقاً للوائح البيئية المعمول بها والمعايير الدولية.
  - إعادة تأهيل الموقع: سيتم إعادة الأرض إلى حالتها الأصلية أو إعادة توظيفها في استخدامات مستدامة أخرى، بحسب متطلبات الجهات المختصة وخطط استخدام الأراضي.

## 2-5 الجوانب البيئية والاجتماعية للمشروع

وبناءً على مكونات المشروع الموضحة في الفصل الثاني، يُلَخَّص جدول 2 أهم الجوانب البيئية والاجتماعية للمشروع خلال مرحلتي الإنشاء والتشغيل:

جدول 2: الجوانب البيئية والاجتماعية اثناء مرحلتي الانشاء والتشغيل

المصادر		الجوانب البيئية والاجتماعية	
مرحلة التشغيل	مرحلة الإنشاء	تقييد الوصول إلى الأراضي	استغلال الأراضي
البنية التحتية الدائمة (الحقول الشمسية المسيجة، وحدة رفع الجهد، نظام تخزين الطاقة).	إنشاء البنية التحتية للمشروع (مناطق التخزين، المرافق المؤقتة، الأمن بالموقع).	تغيير استخدام الأراضي	الطلب على وسائل النقل
سيتم تغيير خصائص الموقع المقام عليه المشروع بالكامل	<ul style="list-style-type: none"> <li>• تجهيز الموقع والتسوية والتمهيد</li> <li>• الحفر للأساسات</li> <li>• منطقة وضع الكابلات</li> <li>• انشاء وحدة رفع الجهد</li> <li>• إنشاء مرافق مؤقتة (على سبيل المثال، معسكر العمال)</li> </ul>	الاستحواذ على الأراضي	
لا ينطبق على المشروع المقترح	<ul style="list-style-type: none"> <li>• لا ينطبق حيث ان مسار خط النقل الكهربائي في أرض صحراوية مملوكة للدولة</li> <li>• أرض المشروع نفسها مملوكة للدولة (أرض صحراوية).</li> </ul>		
متطلبات نقل محدودة تشمل عمال التشغيل وقطع الغيار ومعدات الصيانة.	<ul style="list-style-type: none"> <li>• نقل مكونات المشروع</li> <li>• نقل الآلات والمعدات</li> <li>• نقل المياه والوقود والمواد الأخرى اللازمة لأنشطة البناء</li> <li>• نقل العمال من وإلى موقع المشروع ومعسكر الإقامة</li> </ul>		تدفق العمالة
عدد محدود من العاملين الدائمين.	<ul style="list-style-type: none"> <li>• توافد عمال مدربة وغير مدربة لأعمال الحفر والتركيب والإنشاء (أنشطة إعداد الموقع، التركيبات التقنية، الخ...)</li> </ul>		رفاهية العمال
<ul style="list-style-type: none"> <li>• في موقع العمل</li> <li>• في سكن العمال (حالة الاحتياج لذلك)</li> </ul>	<ul style="list-style-type: none"> <li>• في موقع العمل</li> <li>• في معسكر سكن العمال</li> </ul>		احتياجات المياه
<ul style="list-style-type: none"> <li>• ق عدد عمالة محدود في التشغيل والصيانة والصرف الصحي والمرافق الأخرى.تنظيف اللوحات الشمسية</li> </ul>	<ul style="list-style-type: none"> <li>• أنشطة الموقع (تجهيز الخرسانة)</li> <li>• مياه الشرب</li> <li>• العمال (سكن العمال، الإعاشة، والمرافق الأخرى)</li> <li>• اخماد الغبار والأتربة</li> </ul>		الضوضاء والاهتزازات
<ul style="list-style-type: none"> <li>• أنشطة محدودة من التشغيل والصيانة (مغيرات التيار والمحولات ومراوح التبريد وأجهزة التتبع)</li> <li>• معدات نقل وصيانة العمال المحدودة</li> </ul>	<ul style="list-style-type: none"> <li>• إعداد الموقع (التسوية، التمهيد،...)</li> <li>• نقل الآلات (الخلاطات، معدات الإنشاء العمال )</li> <li>• المركبات المستخدمة لتوصيل مواد البناء والمكونات والعمال إلى الموقع</li> <li>• تركيب المكونات (خاصة آلات الدك)</li> </ul>		انبعاثات الغبار/الجسيمات/الغازات
<ul style="list-style-type: none"> <li>• انبعاثات طفيفة - تقتصر على مركبات نقل العاملين مركبات الصيانة.</li> </ul>	<ul style="list-style-type: none"> <li>• إعداد الموقع (تسوية الموقع، والحفر تسوية التربة السطحية)</li> <li>• حركة المركبات عبر الطرق الترابية/غير الممهدة، والتربة السطحية، والتعامل مع الحفر</li> <li>• زيادة تدفقات المرور (انبعاثات المركبات)</li> <li>• الانبعاثات من مولدات الطاقة التي تعمل بالديزل في الموقع</li> </ul>		تولد مياه الصرف الصحي
محدودة وتقتصر على استخدامات المرافق الصحية.	الصرف الصحي الناتج من عدد كبير من العمال		

المصادر		الجوانب البيئية والاجتماعية
مرحلة التشغيل	مرحلة الإنشاء	
<p><b>غير الخطرة (كميات محدودة)</b></p> <ul style="list-style-type: none"> <li>• نواتج تغليف مواد التشغيل والصيانة (على سبيل المثال، قطع الغيار)</li> <li>• المخلفات البلدية الصلبة الناتجة عن العمال (مثل مخلفات الطعام والزجاجات والعلب البلاستيكية والورق والزجاج)</li> <li>• الورق والكرتون واللوازم المكتبية الأخرى</li> </ul> <p><b>الخطرة</b></p> <ul style="list-style-type: none"> <li>• مواد ماصة، زيت مستهلك من زيوت التشحيم للآلات</li> <li>• حاويات فارغة من المواد الخطرة</li> <li>• مذيبيات التنظيف المستهلكة</li> <li>• بطاريات الليثيوم منتهية الصلاحية</li> </ul>	<p><b>غير الخطرة</b></p> <ul style="list-style-type: none"> <li>• مواد التغليف والمخلفات الإنشاء</li> <li>• نواتج التقطيع الغير خطرة</li> <li>• المخلفات البلدية الصلبة الناتجة عن العمال (مثل مخلفات الطعام والزجاجات والعلب البلاستيكية والورق والزجاج)</li> </ul> <p><b>الخطرة</b></p> <ul style="list-style-type: none"> <li>• حاويات فارغة من المواد الخطرة</li> <li>• نفايات الدهانات والطلاءات والمواد اللاصقة ومذيبات التنظيف</li> <li>• زيوت التشحيم المستعملة والسوائل الهيدروليكية</li> </ul>	تولد المخلفات (الخطرة والغير خطرة)
الألواح الشمسية تُعد عناصر دخيلة على المشهد الصحراوي الطبيعي، مما قد يؤدي إلى تباين بصري مع البيئة المحيطة.	المعدات والآلات بما في ذلك الحفارات والشاحنات والرافعات الأمامية	الجوانب البصرية
انعكاس أشعة الشمس على أسطح الألواح والهياكل المعدنية.	لا ينطبق	الوهج (الانعكاسات الضوئية)
<p>ناتج عن تشغيل كلا من</p> <ul style="list-style-type: none"> <li>• وحدة رفع الجهد</li> <li>• القواطع الكهربائية</li> <li>• خطوط النقل الهوائي</li> </ul>	لا ينطبق	الموجات الكهرومغناطيسية
<ul style="list-style-type: none"> <li>• تمتاز محطات الطاقة الشمسية الكهروضوئية بمظهر أملس ومتجانس يشبه في انعكاسه سطح الماء، حيث تعكس الألواح ضوء الشمس بطريقة تشبه البحيرات أو البرك المائية، مما قد يجذب الطيور أحياناً.</li> <li>• أما في حالة الألواح المزودة بنظام تتبع شمسي (Tracking System)، فإن هذا التأثير يحدث فقط خلال فترة قصيرة من اليوم تبعاً لاتجاه وزاوية الألواح أثناء الحركة</li> </ul>	لا ينطبق	تأثير "بحيرة الضوء" (Lake Effect)



## 2-6 نطاق التأثير

الجوانب البيئية والاجتماعية المحددة ضمن منطقة التأثير المباشرة للمشروع موضحة في الجداول أدناه

جدول 3: الجوانب البيئية والاجتماعية لنطاق التأثير أثناء مرحلة الإنشاء

الجوانب البيئية والاجتماعية		منطقة التأثير
		مرحلة الانشاء
الاستحواذ على الأرض	تقييد الوصول إلى الأراضي	المساحة المخصصة للمشروع
	تحويل الأرض	المساحة المخصصة للمشروع
	الاستحواذ على الأرض (لخط النقل الكهربائي الهوائي)	ضمن أراضي حكومية صحراوية تشمل مسار خط النقل والمنطقة المحيطة بالمحطة.
حركة النقل		عبر شبكة الطرق الوطنية والإقليمية التي تربط موانئ البحر الأحمر بمحافظات الصعيد، وتشمل: - من موانئ البحر الأحمر (عين السخنة / الأدبية): يمكن نقل البضائع غربًا عبر الطرق الساحلية للبحر الأحمر باتجاه ميناء سفاجا ثم التوجه داخليًا نحو الموقع. - ممر سفاجا - قنا: يوفر طريق سفاجا-قنا مسارًا مباشرًا عبر الصحراء الشرقية، وصولًا إلى جسر قنا على النيل، مما يتيح الوصول إلى صعيد مصر . - طريق الصحراء الشرقية - جسر الأقصر: يمكن أيضًا استخدام الطريق السريع للصحراء الشرقية للوصول إلى جسر الأقصر، الذي يوفر نقطة عبور أخرى للنيل جنوب قنا. - الربط بطريق الجيزة-الأقصر: يرتبط كل من جسر قنا وجسر الأقصر بطريق الجيزة-الأقصر (الصحراء الغربية)، والذي يمثل الشريان الرئيسي شمال-جنوب على الضفة الغربية لنهر النيل. - الوصول إلى موقع المشروع: من طريق الجيزة-الأقصر، يمكن الوصول إلى موقع المشروع عبر طريق الوصول إلى المنطقة الصناعية، الواقع شرق الموقع، والذي يؤدي مباشرة إلى الموقع المخصص للمشروع. - طريق السخنة - سفاجا - قنا كطريق رئيسي لنقل المعدات. - طريق الصحراء الشرقية - جسر الأقصر كمسار بديل. - طريق الجيزة - الأقصر (غرب النيل) كمحور رئيسي شمال-جنوب. - الطريق الصناعي المؤدي إلى منطقة المشروع كمدخل مباشر للموقع
تدفق العمالة		أقرب المجتمعات قرية البركة تبعد حوالي 4 كم من موقع المشروع
الطلب على المياه		سيتم نقل المياه بالشاحنات من أقرب محطة مياه
الضوضاء والاهتزازات		محصورة ضمن نطاق الموقع ومناطق العمل الإنشائي.
الانبعاثات الغازية، الاتربة، الجسيمات		يُعتبر نطاق افتراضي عام بمسافة 350 مترًا لدراسة تأثير الغبار (IAQM, 2012).
تأثير التنوع البيولوجي		الموائل صحراوية على طول مساحة الموقع ومسارات خطوط النقل الهوائية .
صحة وسلامة المجتمع		قرية بركة والمجتمعات الواقعة على طول طرق النقل والإمداد.

جدول 4: الجوانب البيئية والاجتماعية لنطاق التأثير أثناء مرحلة التشغيل

الجوانب البيئية والاجتماعية		منطقة التأثير
		مرحلة التشغيل
الاستحواذ على الأرض	تقييد الوصول إلى الأراضي	المساحة المخصصة للمشروع
	تحويل الأرض	المساحة المخصصة للمشروع
	الاستحواذ على الأرض	غير منطبق - لا حاجة لأي أراضٍ إضافية خلال مرحلة التشغيل والصيانة
الطلب على النقل		احتياجات محدودة جدًا، مقتصرة على استخدام الطرق نفسها التي استُخدمت خلال مرحلة الإنشاء لنقل العمال وقطع الغيار ومعدات الصيانة.
تدفق العمالة		غير منطبق - لا يُتوقع توافد عمالة جديدة للموقع خلال مرحلة التشغيل.
احتياجات المياه		احتياجات محدودة جدًا لتغطية الاستخدامات الصحية والإدارية داخل مباني التشغيل، ويتم تأمينها إما من خلال سيارات نقل المياه أو توصيل مباشر من الشبكة العامة للمياه.
الضوضاء والاهتزازات		محدودة النطاق داخل حدود المشروع فقط، وتنتج بشكل رئيسي عن مغيرات التيار (Inverters) والمحولات وحركة المركبات العرضية داخل الموقع.
الانبعاثات الغازية، الاتربة، الجسيمات		لا تنطبق - لا يُتوقع أي انبعاثات جوية ذات أهمية خلال التشغيل العادي للمحطة.
الجوانب البصرية		في حدود موقع المشروع
الانعكاسات الضوئية Glare		من المتوقع أن تكون التأثيرات البصرية الناتجة عن الانعكاسات الشمسية محدودة جدًا، حيث: <ul style="list-style-type: none"> <li>- مطار الأقصر الدولي يبعد حوالي 50 كم عن الموقع ويقع على محور شمال شمال شرق</li> <li>- جنوب جنوب غرب (NNE-SSW)، وبالتالي لا يُتوقع وجود أي خطر ناتج عن الانعكاسات على الملاحة الجوية.</li> <li>- احتمالية الانعكاس باتجاه طريق الجيزة-الأقصر تُعد محدودة للغاية، نظرًا لأن الطريق يبعد حوالي 2,5 كم شمال الموقع، كما أن وجود منشآت المشروع مثل وحدة رفع الجهد ونظام تخزين الطاقة ومباني التشغيل والصيانة على الحدود الغربية والجنوبية الغربية يحجب معظم الانعكاسات المحتملة.</li> <li>وبناءً على ما سبق، فإن تأثير الوهج البصري (Glare) على المستقبلات الخارجية مثل المطارات، والطرق، والمجمعات المجاورة يُعتبر مهملاً وغير ذي أهمية.</li> </ul>
الموجات الكهرومغناطيسية		- ضمن نطاق المشروع المباشر (Project Footprint)، بالإضافة إلى ممر خط النقل الكهربائي (OHTL Corridor) بحرم مسار 25 مترًا على كل جانب من محور الخط .

استنادًا إلى الجدولين السابقين، تشمل **منطقة التأثير (Aol)** خلال مرحلة الإنشاء موقع المشروع والمناطق المحيطة به مباشرة. أما خلال مرحلة التشغيل، فبالرغم من أن معايير مؤسسة التمويل الدولية لا تحدد نطاقًا دقيقًا لنطاق التأثير لمشروعات الطاقة الشمسية الكهروضوئية، فقد أشارت دراسات سابقة إلى أفضل الممارسات الدولية التي توصي باعتبار منطقة عازلة (Buffer Zone) تمتد لمسافة 1 كيلومتر من حدود موقع المشروع كمنطقة تأثير محتملة (وفقًا لـ ERM، 2018؛ Masdar، 2022). وبناءً عليه، فإن نطاق التأثير البيئي والاجتماعي للمشروع سيعتبر ممتدًا لمسافة 1 كيلومتر حول حدود الموقع في جميع الاتجاهات.

### 3- الإطار القانوني والتشريعي والإداري

#### 3-1 التشريعات الوطنية

وفقاً لقانون البيئة المصري رقم 4 لسنة 1994 وتعديلاته بالقانونين 9 لسنة 2009 و 105 لسنة 2015، يجب إعداد دراسة تقييم الأثر البيئي للمشروعات الجديدة. وتُعد هيئة الطاقة الجديدة والمتجددة هي الجهة الإدارية المختصة بهذا المشروع، والمسؤولة عن عملية تقديم ومراجعة الدراسة بالتنسيق مع جهاز شؤون البيئة.

يقوم جهاز شؤون البيئة بتصنيف المشروعات إلى أربع فئات (أ، ب، ب ذات نطاق محدد، ج) وفقاً لحجم تأثيرها البيئي المحتمل. وقد تم تصنيف محطة دندرة للطاقة الشمسية ونظام تخزين الطاقة بالبطاريات ضمن فئة ب ذات نطاق محدد (Scoped B)، مما يعني أنه لا يشترط إعداد دراسة تقييم أثر بيئي واجتماعي شاملة (Full ESIA)، كما أن إجراء المشاورات العامة ليس إلزامياً.

ويعرض الجدول التالي أهم التشريعات والجهات التنظيمية المرتبطة بكل عنصر بيئي واجتماعي تم تقييمه ضمن هذه الدراسة. وفي الفصول اللاحقة، يتم الإشارة إلى المتطلبات القانونية ذات الصلة بكل عنصر.

جدول 5: القوانين واللوائح الوطنية ذات الصلة بالمشروع

المجال	التشريعات والقوانين ذات الصلة
إدارة المخلفات غير الخطرة والخطرة	قانون 4 لسنة 1994 وتعديلاته بالقانون 9/2009 ولائحته التنفيذية 1095/2011 المعدلة بالقرار 710/2012 قانون 202/2020 بشأن إدارة المخلفات ولائحته التنفيذية 722/2022 و 1113/2024
حماية التنوع البيولوجي	المادة 28 من قانون البيئة 4/1994 الملحق 4 من اللائحة التنفيذية 1095/2011 قانون 102/1983 بشأن المحميات الطبيعية قانون 53/1966 بشأن الزراعة وتعديله بالقرار 1227/1988
التراث الثقافي والآثار	قانون حماية الآثار 117/1983 وتعديلاته: 3/2010، 61/2010، 91/2018، 20/2020
جودة الهواء والضوضاء	المادة 36 من قانون البيئة 4/1994 والمادة 37 من اللائحة التنفيذية 1095/2011 المادة 35 من قانون البيئة والملحق (5) من اللائحة 710/2012 المادة 42 من قانون 9/2009 والمادة 44 من اللائحة 1095/2011 الملحق 7 من اللائحة التنفيذية المعدلة بالقرار 710/2012 اللائحة التنفيذية 81/2023 المعدلة بالقرار 164/2025
السجلات البيئية وسجلات المواد الخطرة	المادة 22 من قانون 9/2009 المادة 17 من قرار 1741/2005 والملحق 3 المادة 56 من قانون 202/2020 الملحق 3 من اللائحة التنفيذية لقانون البيئة 4/1994 المادة 50 والملحق 7 من اللائحة التنفيذية لقانون 202/2020 (654/2021)

المجال	التشريعات والقوانين ذات الصلة
انبعاثات مواقع العمل	قرار وزير القوى العاملة 2003/134 (لجان السلامة والصحة المهنية) قرار وزير القوى العاملة 2003/211 (معايير الحماية من المخاطر الفيزيائية والكيميائية والبيولوجية والميكانيكية)
ضوضاء مواقع العمل	الملحق 7 من اللائحة التنفيذية 2012/710 لقانون البيئة، المعدل بالقرار 2024/2466
الصحة والسلامة المهنية	قانون العمل والسلامة المهنية 2025/14 قرار وزير القوى العاملة 2003/211
عمالة الأطفال	المادة 64 من قانون الطفل 1996/12 المواد 62-65 من قانون العمل 2024/14 القرار 2021/215 بشأن تشغيل وتدريب الأطفال
الأشخاص ذوو الإعاقة	قانون 2018/10 وتعديله بالقانون 2021/156 المادة 37 من قانون العمل 2025/14
تكافؤ الفرص وعدم التمييز	المادة 9 من الدستور المصري المادة 5 من قانون العمل 2025/14 قانون 2018/10 بشأن حقوق الأشخاص ذوي الإعاقة
الحماية من التحرش	المادة 254 من قانون العمل 2025/14 قانون 2021/141 لمكافحة التحرش
آلية الشكاوى (التظلمات)	المادة 85 من الدستور المصري المادة 103 من قانون البيئة 1994/4
الاستثمار المجتمعي	قانون الاستثمار المصري 2017/72

### 3-2 المبادرات الوطنية الاستراتيجية

#### 3-2-1 استراتيجية مصر الوطنية لتغير المناخ (NCCS 2050)

أطلقت في مايو 2022، وتُعد خارطة طريق للعمل المناخي في مصر من خلال خمسة محاور رئيسية: التخفيف من الانبعاثات، التكيف، الحوكمة، التمويل، والبحث العلمي.

- يساهم مشروع محطة الطاقة الشمسية ومنظومة تخزين الطاقة (BESS) في تحقيق الأهداف الوطنية التالية:
- أهداف الطاقة المتجددة: دعم هدف مصر بالوصول إلى 42% من الطاقة المتجددة بحلول عام 2035.
- تعزيز القدرة على التكيف المناخي: من خلال مراعاة الظروف الجوية القاسية المحتملة في محافظة قنا.
- خفض انبعاثات غازات الاحتباس الحراري: عبر استبدال الطاقة المعتمدة على الوقود الأحفوري بمصادر الطاقة المتجددة.
- التنمية المستدامة: بما يتماشى مع رؤية مصر 2030 لتحقيق نمو اقتصادي منخفض الانبعاثات.

#### 3-2-2 المساهمات المحددة وطنياً (NDC)

وقَّعت مصر على اتفاق باريس عام 2016 وصدّقت عليه عام 2017، وحددت التزاماتها المتعلقة بخفض الانبعاثات والتكيف مع آثار تغير المناخ. تتضمن النسخة المحدثة من الـ NDC لعام 2023 ما يلي:

- خفض الانبعاثات على المستوى القطاعي: في قطاعات الطاقة، النفط والغاز، النقل، الصناعة، إدارة المخلفات، والسياحة.
- قطاع النفط والغاز: خفض الانبعاثات من 2,575 جيغا جرام مكافئ CO<sub>2</sub> في سيناريو الأعمال المعتادة (BAU) إلى 0.89 جيغا جرام مكافئ CO<sub>2</sub> بحلول 2030، من خلال استخدام الوقود الأنظف ومصادر الطاقة البديلة.

### 3-2-3 الاستراتيجية الوطنية لتمكين المرأة المصرية 2030

أطلقت عام 2017 بهدف تعزيز تمكين المرأة عبر أربعة محاور رئيسية:

- التمكين السياسي: زيادة مشاركة المرأة في مواقع القيادة وصنع القرار.
- التمكين الاقتصادي: توسيع فرص العمل ودعم ريادة الأعمال للمرأة.
- التمكين الاجتماعي: تعزيز الوصول إلى التعليم، الرعاية الصحية، والخدمات الاجتماعية.
- الحماية والاستجابة: منع ومعالجة جميع أشكال العنف ضد المرأة.

### 3-3 الاتفاقيات والمعاهدات الدولية

#### 3-3-1 اتفاقيات التنوع البيولوجي (Biodiversity Conventions)

صدقت مصر على عدد من الاتفاقيات الدولية المعنية بحماية التنوع البيولوجي، وتشمل:

- اتفاقية حماية طيور المياه المهاجرة وموائلها الرطبة (AEWA)، 1995 لحماية الطيور المائية المهاجرة وموائلها الطبيعية.
- اتفاقية الأمم المتحدة للتنوع البيولوجي (UNCBD)، 1992 لتعزيز الإدارة المستدامة للتنوع البيولوجي.
- اتفاقية حفظ الأنواع المهاجرة (CMS)، 1979 لضمان الحفاظ على الأنواع المهاجرة.
- اتفاقية التجارة الدولية بالأنواع المهددة بالانقراض (CITES)، 1973 لتنظيم التجارة الدولية في الأنواع المهددة.
- الاتفاقية الإفريقية لحفظ الطبيعة (1968) لتعزيز الاستخدام المستدام للموارد الطبيعية.

#### 3-3-2 اتفاقيات تغير المناخ (Climate Change Conventions)

اتخذت مصر خطوات مهمة لمعالجة آثار تغير المناخ من خلال التصديق على:

- اتفاقية الأمم المتحدة الإطارية لتغير المناخ (UNFCCC)، 1992 التي وضعت الإطار الدولي للتعامل مع تغير المناخ.
- بروتوكول كيوتو (1997) الذي يحدد أهدافاً ملزمة لخفض الانبعاثات.
- اتفاق باريس (2016) بهدف الحد من ارتفاع درجة حرارة الأرض إلى أقل من 2 درجة مئوية.

#### 3-3-3 اتفاقيات التراث الثقافي (Cultural Heritage Conventions)

تلتزم مصر بحماية تراثها الثقافي من خلال:

- اتفاقية اليونسكو لصون التراث الثقافي غير المادي (2003) لحماية التقاليد، والممارسات، والمعارف الثقافية.
- اتفاقية التراث العالمي (1972) التي تهدف لتحديد وحماية مواقع التراث الثقافي والطبيعي.

### 3-4 اتفاقيات بيئة العمل (ILO - Work Environment Conventions)

تلتزم مصر بمعايير العمل الدولية الصادرة عن منظمة العمل الدولية (ILO) ، بما في ذلك:

- اتفاقية حرية التنظيم وحماية حق التنظيم لعام 1948 (رقم 87)
- اتفاقية حق التنظيم والمفاوضة الجماعية لعام 1949 (رقم 98)
- اتفاقية العمل الجبري لعام 1930 (رقم 29) وبروتوكولها لعام 2014
- اتفاقية إلغاء العمل الجبري لعام 1957 (رقم 105)
- اتفاقية الحد الأدنى لسن العمل لعام 1973 (رقم 138)
- اتفاقية حظر أسوأ أشكال عمل الأطفال لعام 1999 (رقم 182)
- اتفاقية المساواة في الأجر لعام 1951 (رقم 100)
- اتفاقية مكافحة التمييز في الاستخدام والمهنة لعام 1958 (رقم 111)
- اتفاقية السلامة والصحة المهنية لعام 1981 (رقم 155)
- اتفاقية الإطار الترويجي للسلامة والصحة المهنية لعام 2006 (رقم 187)

### 3-4 المعايير والإرشادات التوجيهية الدولية

تلتزم دراسة التقييم البيئي والاجتماعي (ESIA) الخاصة بمشروع محطة دندرة للطاقة الشمسية ونظام تخزين الطاقة بالبطاريات (BESS) في نجع حمادي بكل من قانون البيئة المصري رقم 4 لسنة 1994 وتعديلاته، بالإضافة إلى متطلبات جهات التمويل الدولية، وخاصة البنك الإفريقي للتنمية (AfDB) والبنك الأوروبي لإعادة الإعمار والتنمية (EBRD).

وفيما يلي ملخص لمتطلبات المعايير الدولية ذات الصلة بالمشروع:

#### الإجراءات الوقائية للبنك الإفريقي للتنمية (AfDB)

- الإجراءات الوقائي 1: إدارة المخاطر البيئية والاجتماعية طوال دورة حياة المشروع.
- الإجراءات الوقائي 2: ضمان ممارسات العمل العادلة وتوفير بيئة عمل آمنة وصحية.
- الإجراءات الوقائي 3: التحكم في التلوث وتعزيز كفاءة استخدام الموارد.
- الإجراءات الوقائي 4: حماية صحة وسلامة وأمن المجتمع.
- الإجراءات الوقائي 5: الاستحواذ على الأراضي وإعادة التوطين (غير منطبق على المشروع).
- الإجراءات الوقائي 6: حماية التنوع البيولوجي والاستخدام المستدام للموارد الطبيعية.
- الإجراءات الوقائي 7: حماية الفئات الضعيفة من الآثار المحتملة.
- الإجراءات الوقائي 8: حماية التراث الثقافي (لا توجد تأثيرات متوقعة).
- الإجراءات الوقائي 9 و 10: أحكام خاصة بالوسطاء الماليين (غير منطبقة)، مع التأكيد على مشاركة أصحاب المصلحة.

**متطلبات الأداء للبنك الأوروبي لإعادة الإعمار والتنمية (EBRD)**

- متطلب الأداء 1: التقييم المتكامل للأثر البيئي والاجتماعي وإشراك أصحاب المصلحة.
- متطلب الأداء 2: ضمان شروط العمل اللاتقة ومعايير الصحة والسلامة المهنية ومتابعة أداء الموردين.
- متطلب الأداء 3: منع التلوث وكفاءة استخدام الموارد.
- متطلب الأداء 4: إدارة مخاطر الصحة والسلامة والأمن، بما في ذلك تقييم مخاطر العنف القائم على النوع الاجتماعي.
- متطلب الأداء 5: الاستحواذ على الأراضي وإعادة التوطين (غير منطبق على المشروع).
- متطلب الأداء 6: تقييم التنوع البيولوجي والإدارة المستدامة للموارد الطبيعية.
- متطلب الأداء 7: الشعوب الأصلية (غير منطبق).
- متطلب الأداء 8: حماية التراث الثقافي (لا توجد مواقع مسجلة).
- متطلب الأداء 10: مشاركة أصحاب المصلحة والإفصاح الشفاف.

**معايير البنك الأوروبي للاستثمار (EIB)**

- المعيار 1: التأثيرات والمخاطر البيئية والاجتماعية.
- المعيار 2: مشاركة أصحاب المصلحة.
- المعيار 3: كفاءة استخدام الموارد ومنع التلوث.
- المعيار 4: حماية التنوع البيولوجي والأنظمة البيئية.
- المعيار 5: التغير المناخي.
- المعيار 6: الاستحواذ على الأراضي.
- المعيار 7: الفئات الضعيفة والشعوب الأصلية والنوع الاجتماعي.
- المعيار 8: حقوق العمال.
- المعيار 9: الصحة والسلامة والأمن.
- المعيار 10: التراث الثقافي.
- المعيار 11: التمويل عبر الوسطاء الماليين.

**إطار الاستدامة لكاسا دييوزيتي إي بريستيتي 2020 - (CDP)**

- يضع إطار الاستدامة نظاماً شاملاً للحوكمة البيئية والاجتماعية، يهدف إلى:
- منع الآثار البيئية والاجتماعية السلبية،
  - احترام حقوق الإنسان،
  - تعزيز الإسهام في أهداف التنمية المستدامة،
  - ضمان التوافق مع المبادئ الدولية للاستدامة.

**معايير الأداء لمؤسسة التمويل الدولية (IFC)**

- المعيار 1: تقييم الأثر الاجتماعي والبيئي ونظام الإدارة.
- المعيار 2: العمل وظروف العمالة.
- المعيار 3: منع التلوث.

- المعيار 4: صحة وسلامة وأمن المجتمع.
- المعيار 5: الاستحواذ على الأراضي وإعادة التوطين.
- المعيار 6: حماية التنوع البيولوجي والإدارة المستدامة للموارد الطبيعية.
- المعيار 7: الشعوب الأصلية.
- المعيار 8: التراث الثقافي.

#### إرشادات البيئة والصحة والسلامة للبنك الدولي (EHS Guidelines)

تلتزم جهات التمويل بتطبيق الإرشادات العامة للبيئة والصحة والسلامة، بالإضافة إلى الإرشادات القطاعية الخاصة بالمشروعات الصناعية والطاقة المعقدة.

### 4- تحليل البدائل

تم استبعاد بديل "عدم تنفيذ المشروع"، إذ إن الأرض المقترحة كانت ستستخدم على أي حال لمشروعات طاقة متجددة أخرى. وقد تم النظر في البدائل التالية:

#### 4-1 بدائل موقع المشروع

يقع المشروع المقترح على أرض صحراوية خالية جنوب نجع حمادي، وقد خصصتها الحكومة المصرية لهيئة الطاقة الجديدة والمتجددة (NREA) لإقامة مشروعات الطاقة المتجددة، ولا يتعارض استخدامها مع أي أنشطة قائمة أو مخططة. لذلك، لم تُدرس بدائل أخرى للموقع، مما يجعل الموقع المختار مناسباً لتنفيذ المشروع.

#### 4-2 بدائل أنواع الألواح الشمسية

تم تقييم عدة تقنيات للألواح الشمسية، مثل الألواح أحادية البلورة (Monocrystalline) والألواح الرقيقة (Thin Film) وتم اختيار الألواح الشمسية أحادية البلورة عالية الكفاءة نظراً لتوازنها الأمثل بين الأداء والتكلفة والجوانب البيئية.

#### 4-3 بدائل أنظمة التتبع

تمت دراسة عدة أنظمة تتبع لتعظيم إنتاجية الطاقة الشمسية، وتم اختيار نظام التتبع الأحادي المحور (Single-Axis Tracker)، لكونه أقل تكلفة وأسهل في الصيانة مقارنة بالأنظمة الأخرى نتيجة احتوائه على أجزاء متحركة أقل.



#### 4-4 بدائل طرق تنظيف الألواح

شملت البدائل المُقيمة: التنظيف اليدوي، والتنظيف الميكانيكي، والأنظمة الآلية. وتم اختيار نظام التنظيف الآلي الجاف باستخدام الروبوتات باعتباره أكثر كفاءة وأقل استهلاكًا للمياه.

#### 4-5 بدائل تقنيات نظام تخزين الطاقة بالبطاريات (BESS)

تمت دراسة عدة تقنيات، مثل البطاريات من نوع أيون الليثيوم والبطاريات ذات التدفق (Flow Batteries) وتم اختيار تقنيتي: الليثيوم-نيكل-منغنيز-كوبالت (NMC) و ليثيوم-حديد-فوسفات (LFP) وذلك نظرًا لكثافة طاقتهما العالية، وكفاءتهما، وسجل استخدامهما الناجح في التطبيقات الكبيرة على مستوى الشبكات.

#### 4-6 بدائل مصادر المياه

تم تقييم بدائل مختلفة مثل استخراج المياه الجوفية ونقل المياه عبر الصحاري من أقرب محطة مياه. وفي النهاية، تم اختيار نقل المياه بالصحاري كمصدر أساسي، مع إمكانية استخدام خط أنابيب ليكون خيارًا إضافيًا عند الحاجة.

### 5- البيئة الأساسية للمشروع

#### 5-1 موقع المشروع

يقع المشروع داخل نطاق منطقة نجع حمادي بمحافظة قنا. ويوضح الشكل أدناه إحداثيات حدود مساحة حق الانتفاع والمنطقة المخصصة للمشروع، بالإضافة إلى مواقع أقرب الطرق المناطق السكنية المجاورة (شكل 2).



## 5-2 المناخ والأرصاد الجوية

تتسم محافظة قنا بتباين كبير في درجات الحرارة، حيث تشهد صيفاً شديد الحرارة، وشتاءً بارداً، مع فروق حرارية واضحة بين الليل والنهار. كما تتميز المنطقة بطقس جاف، وأمطار قليلة جداً، ومستويات مرتفعة من الإشعاع الشمسي خصوصاً في فصل الصيف.

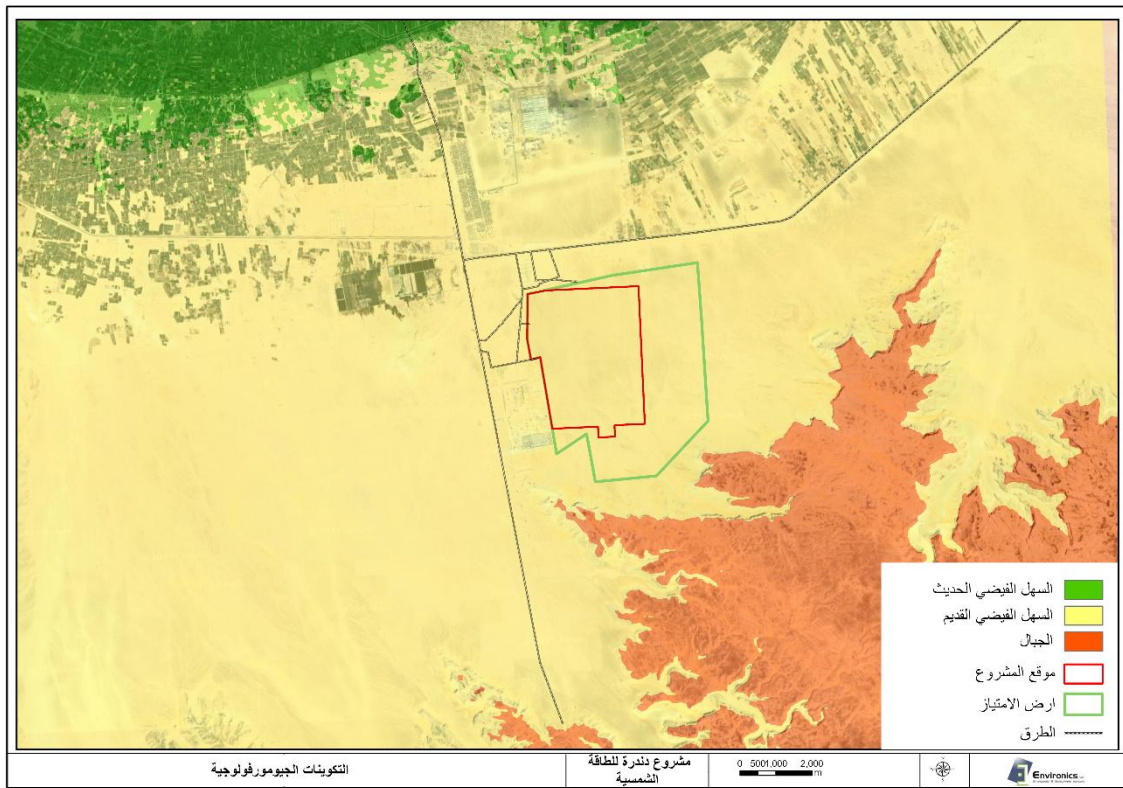
- **درجات الحرارة:** يبلغ متوسط الحرارة السنوي نحو 23.9 درجة مئوية، مع أعلى متوسط شهري يصل إلى 37.9 درجة مئوية في يوليو، وأدنى متوسط شهري يصل إلى 5.3 درجة مئوية في يناير.
- **إشعاع الشمس:** يتراوح الإشعاع السنوي بين 2,191-2,264 كيلوواط/م<sup>2</sup>، ويبلغ ذروته في يوليو بمعدل 27 ميغا جول/م<sup>2</sup>/اليوم، ويصل إلى أدنى مستوى له في ديسمبر عند 12 ميغا جول/م<sup>2</sup>/اليوم.
- **طول النهار:** يتراوح بين 11 ساعة في ديسمبر و14.2 ساعة في يونيو.
- **سرعة واتجاه الرياح:** يبلغ متوسط سرعة الرياح 12 كم/ساعة، مع أعلى قيمة تصل إلى 13.7 كم/ساعة في أبريل. تهب الرياح غالباً من القطاعين الشمالي والشمالي الغربي.
- **الأمطار:** كمية الأمطار شبه معدومة، حيث تبلغ أعلى قيمة سنوية حوالي 0.4 مم في مايو.
- **الرطوبة النسبية:** تتراوح بين 30% في مايو و54.2% في ديسمبر، بمتوسط سنوي 41%.
- **العواصف الرملية والترابية:** يتعرض موقع المشروع، كغيره من مناطق صعيد مصر، إلى الغبار والعواصف الرملية والضباب الخفيف، وفق سجل رصد لمدة 22 عاماً:
- **حالات الضباب (Haze):** سُجلت لمدة 2,864 ساعة (1.5% من إجمالي الوقت)، وبلغت ذروتها في فبراير، وترتبط غالباً بسرعات رياح منخفضة.
- **العواصف الترابية (Dust Storms):** سُجلت لمدة 544 ساعة (0.29% من إجمالي الوقت)، خاصةً في مارس، مع سرعات رياح متوسطة (2-5 م/ث).
- **الرمال المتحركة (Rising Sand):** سُجلت لمدة 446 ساعة (0.23% من الوقت)، وترتبط بسرعات رياح عالية (>5 م/ث)، وتبلغ ذروتها في مارس.
- **العواصف الرملية الشديدة (Sandstorms):** نادرة، سُجلت لمدة 34 ساعة فقط (0.02% من الوقت)، معظمها في مارس، نتيجة رياح غربية قوية.
- **جودة الهواء:** تشير بيانات محطة الأرصاد في قنا (ديسمبر 2023) إلى ارتفاع تركيزات الجسيمات العالقة PM<sub>10</sub> بمقدار 166 ميكروجرام/م<sup>3</sup>، متجاوزة الحد المسموح به (70 ميكروجرام/م<sup>3</sup>)، ويرجع ذلك بالأساس لطبيعة البيئة الصحراوية المحيطة.

أما الغازات الأخرى مثل ثاني أكسيد الكبريت SO<sub>2</sub>، وثنائي أكسيد النيتروجين NO<sub>2</sub>، والأمونيا NH<sub>3</sub> فكانت ضمن الحدود المسموح بها. كما أظهرت البيانات السنوية لعام 2022 ارتفاعاً مشابهاً في تركيزات PM<sub>10</sub> لتصل إلى 149 ميكروجرام/م<sup>3</sup>، متجاوزة الحدود الوطنية ومعايير WHO، بينما بقيت الغازات الأخرى ضمن الحدود المقبولة.

### 5-3 الخصائص الجيومورفولوجية والطبوغرافية

يقع موقع المشروع ضمن السهول الرسوبية القديمة، بين تضاريس وعرة وهضبة من الحجر الجيري في الجنوب، والسهول الرسوبية الحديثة الممتدة عبر وادي النيل من جهة الشمال. وتشكل السهول الرسوبية القديمة مصاطب بمستويات ارتفاع مختلفة أعلى من السهول الأحدث.

وبحسب الخريطة القومية لتصنيف التربة في مصر، فإن تربة الموقع ناتجة أساسًا عن صخور الحجر الجيري. ويُصنف نوع التربة في موقع المشروع بأنه تربة رملية طميية (Sandy Loam)، وهي عادةً تربة ضحلة أو تحتوي على نسبة عالية من الأحجار.

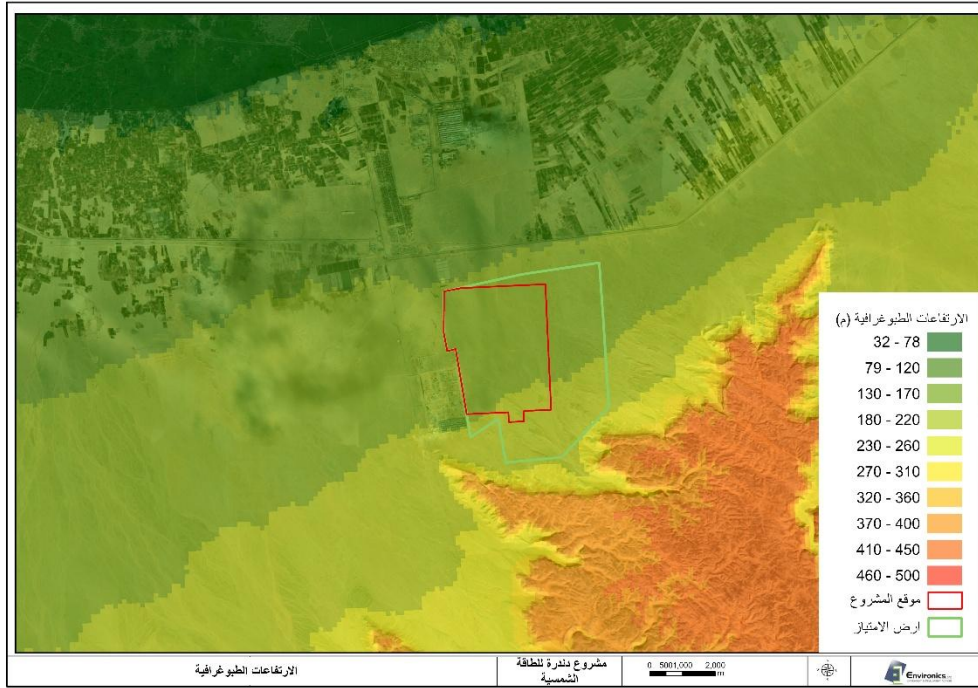


شكل 3: الخصائص الجيومورفولوجية لمنطقة المشروع والمناطق المحيطة بها

#### الطبوغرافيا

تزداد الارتفاعات داخل موقع المشروع والمناطق المحيطة به كلما اتجهنا جنوبًا، حيث تصل إلى حوالي 450-500 متر فوق مستوى سطح البحر. أما داخل موقع المشروع ومنطقة حق الانتفاع، فتتراوح الارتفاعات عادةً بين 130 و170 مترًا فوق مستوى سطح البحر، باستثناء الجزء الجنوبي للموقع، الذي يصل فيه الارتفاع إلى ذروة تبلغ حوالي 220 مترًا فوق مستوى سطح البحر.





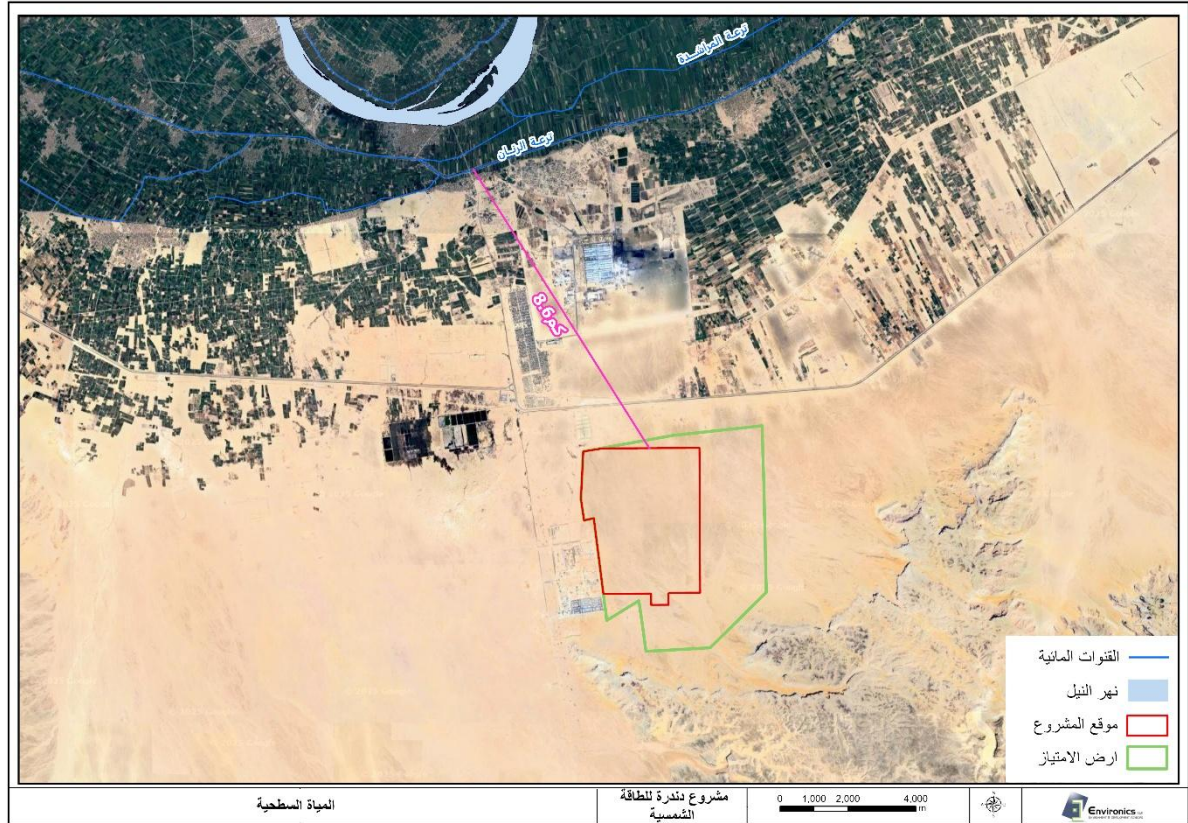
شكل 4: الخصائص الطبوغرافية بمنطقة المشروع والمناطق المحيطة بها

#### 4-5 الهيدرولوجيا والهيدروجيولوجيا

يقع موقع المشروع في الهضاب الصحراوية التابعة لمركز نجع حمادي، لذلك يخلو موقع المشروع تمامًا من أي مسطحات مائية سطحية أو قنوات مائية داخله. وتوجد ثلاثة مسطحات مائية بالقرب من الموقع، تقع جميعها إلى الشمال منه، وهي:

- ترعة الرنان: أقربهم إلى الموقع، وتبعد 8.5 كم.
- ترعة المراشدة: تبعد حوالي 9 كم
- نهر النيل

شكل 5 يبين المسطحات والقنوات المائية القريبة من موقع المشروع

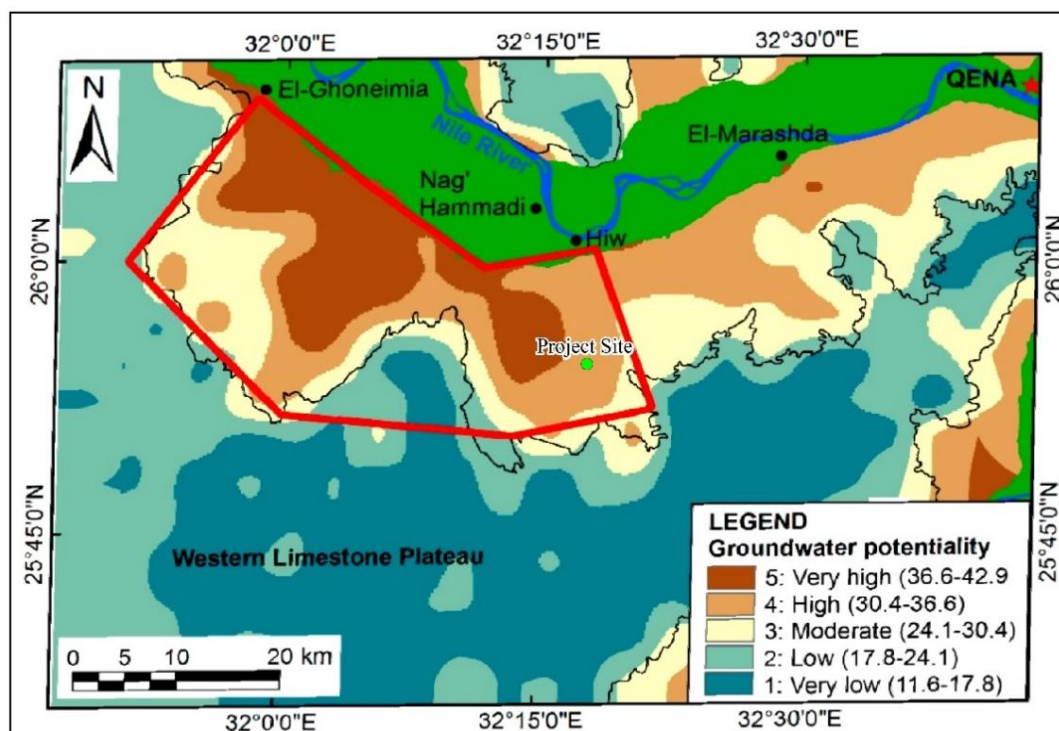


شكل 5: المسطحات المائية القريبة من موقع المشروع

### المياه الجوفية

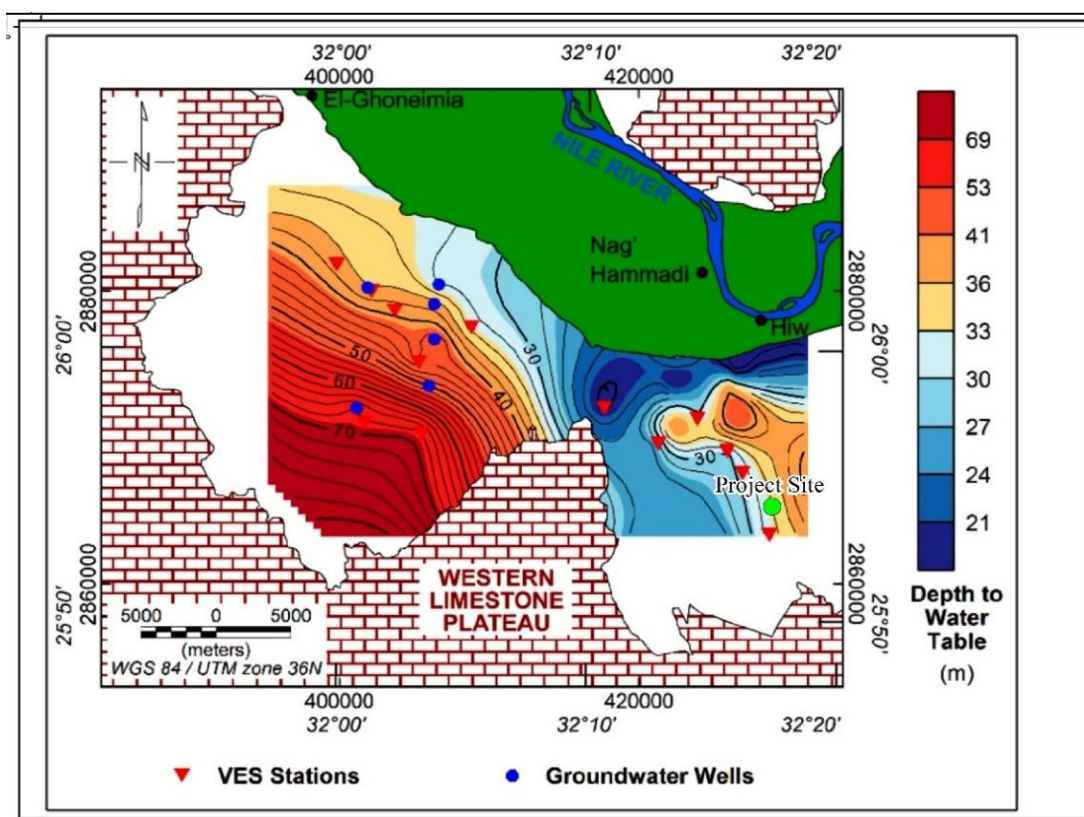
يقع الموقع فوق الخزان الجوفي الرباعي (Quaternary Aquifer)، وهو المصدر الرئيسي للمياه الجوفية في وادي النيل. ويتكون هذا الخزان من طبقات من الرمل والحصى والطيني، وتوجد المياه الجوفية فيه في صورة غير محصورة (Unconfined). حيث يتراوح سمك الخزان بين 200 متر في وسط الأراضي الزراعية الخصبة، و 80 مترًا عند الأطراف الصحراوية، ويتم إعادة تغذيته بشكل مستمر من فائض مياه الري، بالإضافة إلى الأمطار النادرة. كما يتصف السهل الرسوبي القديم بأنه ذو قدرة متوسطة إلى عالية على إعادة التغذية. يقع موقع المشروع في منطقة ذات قدرة متوسطة للتغذية الجوفية وتظهر المياه الجوفية على أعماق تتراوح بين 36 و 41 مترًا.

شكل 7 يبين خريطة أعماق المياه الجوفية بالنسبة لموقع المشروع



شكل 6: خريطة إمكانية تغذية المياه الجوفية تُظهر موقع المشروع

المصدر: Gaber et al (2020)



شكل 7: خريطة عمق المياه بالنسبة لموقع المشروع

المصدر: Gaber et al (2020)



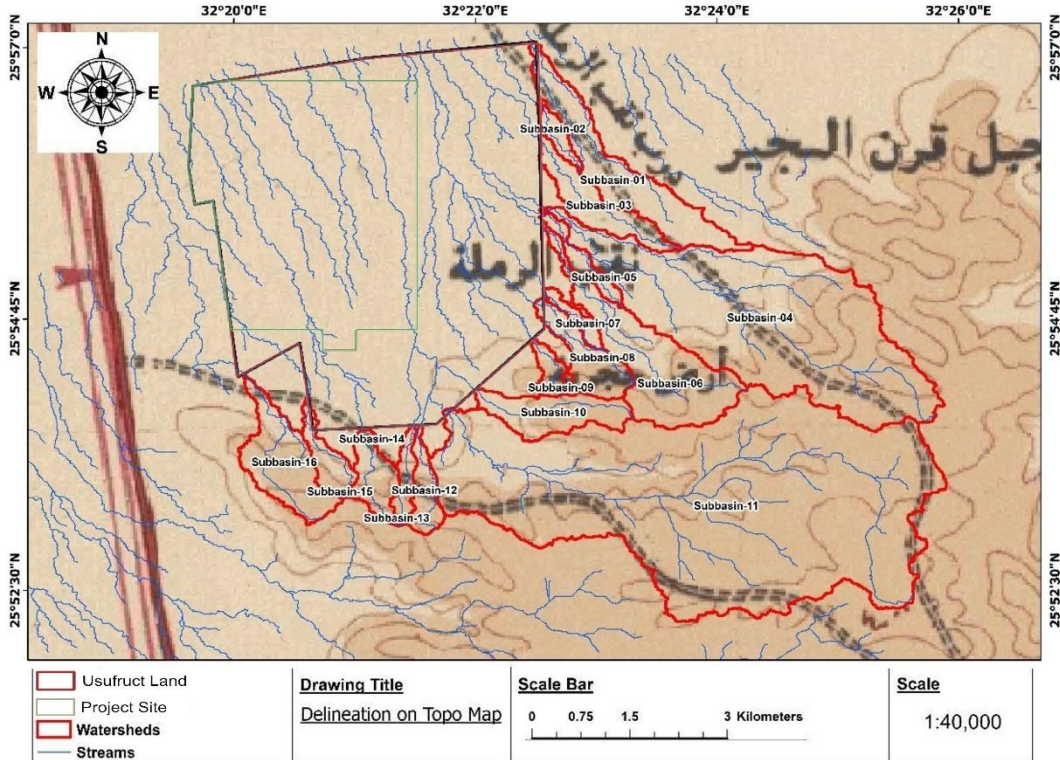
### مخاطر السيول

على الرغم من انخفاض معدلات الأمطار السنوية، تُعد محافظة قنا من أكثر المناطق عُرضة للسيول داخل وادي النيل، خاصة خلال فصل الشتاء (أكتوبر - فبراير). وتعود السجلات التاريخية للسيول في المنطقة إلى عام 1938.

وفيما يلي عرض موجز لخيارات الحماية من أخطار السيول:

- سيتم حماية موقع المشروع من السيول عبر قناة مفتوحة بشكل شبه منحرف تمتد من مصبات الوادي جنوب موقع المشروع وتتجه من الجنوب إلى الشمال بمحاذاة الحد الشرقي لسور موقع المشروع. وسيتم تصميمها لاستيعاب حدث سيلبي يُعاد حدوثه كل 100 عام. وستحافظ القناة المفتوحة إلى حد كبير على المسار الطبيعي للجريان دون تغيير نقطة الصرف. كما سيتم تصميم المخرج بحيث لا يحدث أي تغيير في السرعة الطبيعية عند نقطة الصرف.
- بدلاً من ذلك، سيتم حماية موقع المشروع من خلال سد ترابي مضغوط (مزود بحماية ضد التعرية على جانب الجريان)، يمتد من الجنوب إلى الشمال بمحاذاة الحد الشرقي لسور موقع المشروع. وسيتم تطبيق إجراءات تبديد الطاقة عند مخرج الموقع لضمان عدم حدوث أي زيادة في سرعة الجريان الطبيعي في المناطق الواقعة أسفل المجرى.

شكل 8 يبين الأودية الطبيعية في منطقة المشروع



شكل 8: الأودية الطبيعية في منطقة المشروع

### 5-5 البيئة البيولوجية

يقع موقع المشروع ضمن هضبة الحجر الجيري الوسطى (Middle Limestone Plateau - MLP) بالصحراء الغربية، وهي منطقة شاسعة شديدة الجفاف تمثل ثلثي مساحة مصر. تمتد الهضبة بين خطي عرض 25° و 29° شمالاً، وتضم عدة واحات تعتمد على المياه الجوفية.



ويتميز الجزء الجنوبي الشرقي من الهضبة، حيث يقع موقع المشروع، بأنه أرض رملية جافة ذات غطاء نباتي محدود جدًا.

شكل 9 يبين الأقاليم الفسيولوجية للصحراء الغربية وموقع المشروع.



شكل 9: المناطق الفيزيوجرافية بالصحراء الغربية وموقع المشروع

#### 5-5-1 البيانات المحيطة بموقع المشروع

يمكن تقسيم الطبوغرافيا البيئية للأنظمة البيئية القريبة من موقع المشروع (أي المواقع الواقعة على مسافة 15 كيلومترًا أو أقل من موقع المشروع) إلى أربعة أنواع رئيسية من المواطن البيئية:

- **الأراضي الزراعية بوادي النيل:** تقع على بعد حوالي 8.5 كم شمال موقع المشروع، ويفصلها عنه طريق أسوان - الجيزة. وهي في الأساس موائل شبه مُعدلة بالكامل، وتوفر مواطن لعدد كبير من الأعشاب والنباتات الرعوية في الحقول وعلى ضفاف القنوات والمصارف.
- **الأراضي الزراعية المستصلحة:** أقرب المناطق الصحراوية الزراعية المستصلحة تقع على بعد 1 كم شمال المشروع. كما توجد أراضي مستصلحة إضافية شمال وشمال غرب موقع المشروع.
- **الموائل الحضرية:** منتشرة داخل أراضي وادي النيل الزراعية والأراضي المستصلحة، مثل ضفاف القنوات والمصارف، جوانب الطرق، السكك الحديدية، والأراضي الخالية. وهي موطن لنباتات وأشجار دخيلة يتم إدخالها لأغراض الزينة، بالإضافة إلى أنواع حيوانية انتهازية مرتبطة بالأنشطة البشرية (مثل الكلاب الضالة، الفئران، والطيور).
- **هضبة الحجر الجيري الوسطى:** هضبة رملية جافة شديدة القحولة مع هطول مطري شبه منعدم، وخارج المنخفضات والواحات لا يوجد سوى موائل الأرض الجرداء. وهي خالية تمامًا من الغطاء النباتي باستثناء بعض الأنواع النباتية الصحراوية المتكيفة، المنتشرة كشجيرات متباعدة ومعزولة عبر الهضبة.

يقع موقع المشروع ضمن الجزء الجنوبي الشرقي من هضبة الحجر الجيري الوسطى.



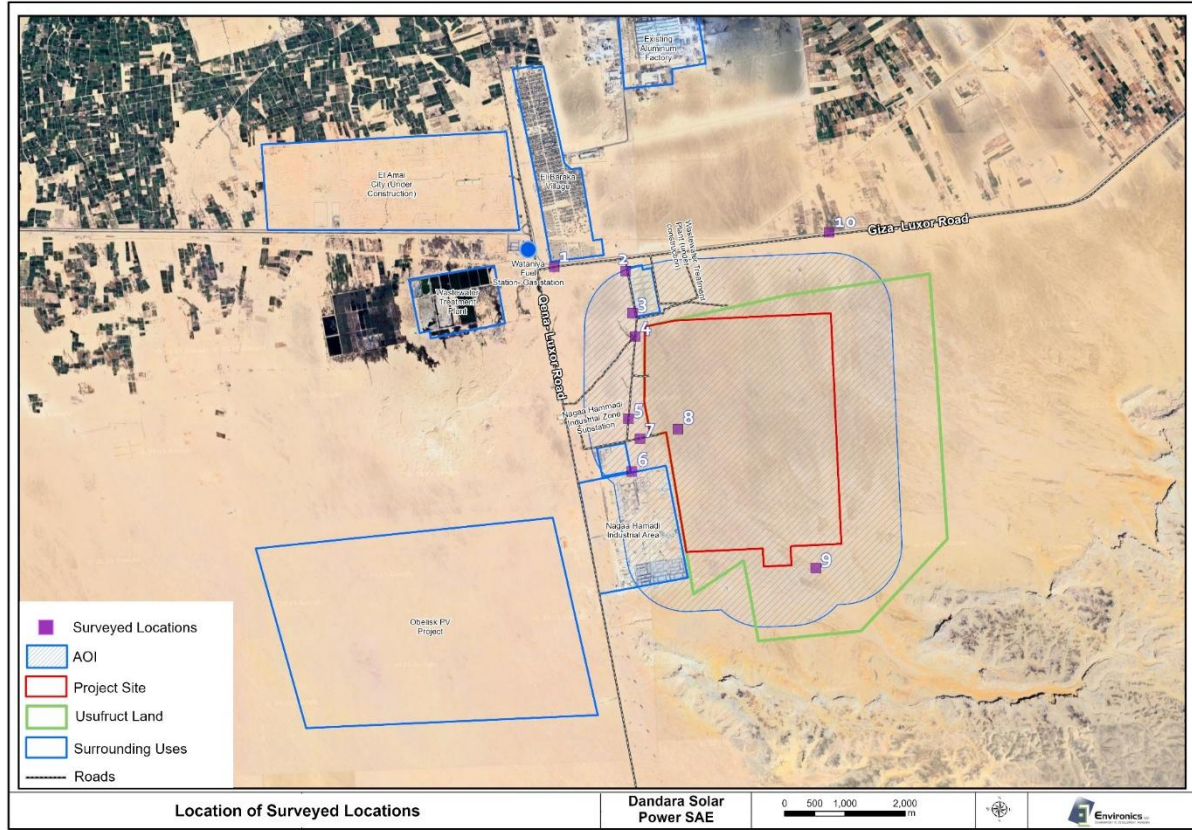
شكل 11: طيور البلشون البقري (*Bubulcus ibis*) في أرض زراعية مستصلحة



شكل 10: طائر الهدهد الشائع (*Upupa epops*) في أرض زراعية مستصلحة

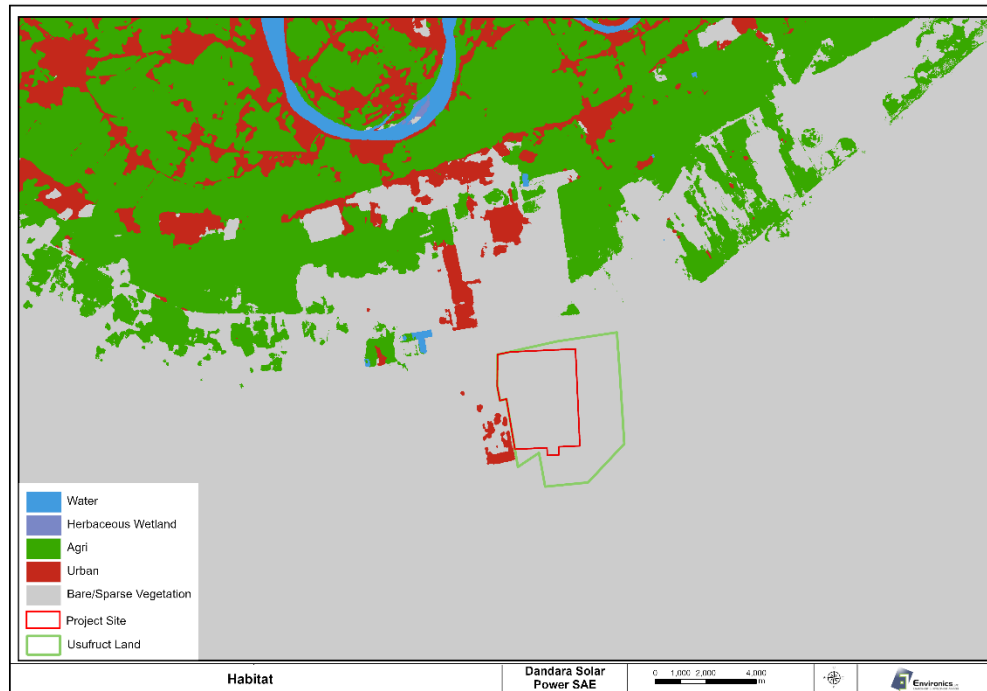
#### 5-5-2 ظروف موقع المشروع

تم تنفيذ مسحين تكمليين لتغطية جميع الموائل الطبيعية التي قد تتأثر بالمشروع، كما هو موضح في شكل 12. وقد تم إجراء أحد المسحين بواسطة شركة Scatec في أغسطس 2025، بينما تم إجراء المسح الآخر بواسطة انفايرونكس في أكتوبر من نفس العام. كما يوضح شكل 12 مواقع ومسارات المناطق التي شملها المسح.



شكل 12: مواقع المناطق التي شملها المسح خلال الزيارة الميدانية في أكتوبر 2025

أكد المسح الميداني وتحليل الاستشعار عن بُعد أن كامل موقع المشروع عبارة عن أرض جرداء خالية من أي غطاء نباتي ذي أهمية أو مصادر مائية. ووفقاً للمعيار البيئي والاجتماعي رقم 6 الصادر عن مؤسسة التمويل الدولية (IFC PS6)، يُصنّف موقع المشروع كموئل طبيعي، مما يعني أنه ما يزال في حالة شبه غير متأثرة بالنشاط البشري.



شكل 13: أنواع الموائل داخل موقع المشروع والمناطق المحيطة به

### • الغطاء النباتي (Flora)

يقع موقع المشروع في الصحراء الغربية وهضبة الحجر الجيري الأوسط، وهي منطقة شديدة الجفاف ذات تنوع نباتي ضعيف ولا تحتوي على أي غطاء نباتي دائم. الأنواع النباتية الوحيدة التي تم العثور عليها في المنطقة المحيطة تشمل الأنواع المقاومة للجفاف مثل الغرقد السوري (*Prosopis farcta*) و *Caroxylon imbricatum*. إلا أن مسح أكتوبر 2025 وجد أن الموقع خالٍ تماماً من أي غطاء نباتي.

### • الحياة البرية (Fauna)

#### الثعابين:

قد يستضيف موقع المشروع عدة أنواع من الثعابين الصحراوية، بما في ذلك: أفعى الرمال الصحراوية (*Cerastes vipera*) ، الأفعى المقرنة (*Cerastes cerastes*) ، ثعبان الرمال الصحراوي (*Psammophis aegyptius*) ، ثعبان الديادم (*Spalerosophis diadema*) ومع ذلك، لم يتم العثور على أي آثار لهذه الأنواع خلال المسوحات الميدانية.

#### السحالي:

قد تشمل الأنواع المحتملة الظهور في المنطقة: ، الورل الصحراوي (*Varanus griseus*) ، السحلية شوكية الأصابع الخاصة ببوسك (*Acanthodactylus boskianus subsp. asper*) بالإضافة إلى أنواع من الوزغ مثل: الوزغ الأنيق (*Stenodactylus sthenodactylus*)، وزغ أندرسون قصير الأصابع (*Stenodactylus petrii*)

#### الطيور:

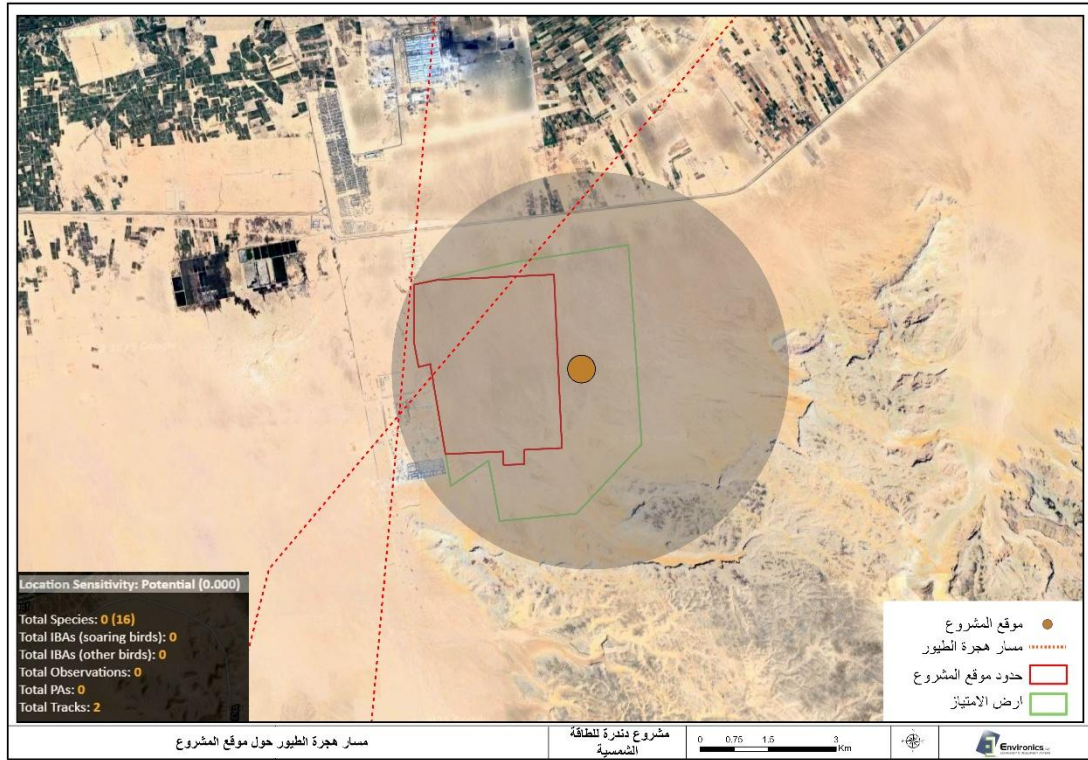
الطيور المقيمة: يفتقر الموقع إلى الغذاء والماء والمأوى، مما يجعله غير مناسب للطيور المقيمة للتعشيش. إلا أن محطة معالجة مياه الصرف الصحي المجاورة تجذب عدداً من الطيور التي ترتبط ببيئة وادي النيل الرطبة، مثل: عصفر الدوري (*Passer domesticus*)، الزقزاق شوكي الجناح (*Vanellus spinosus*) وقد تم تسجيل النوع الأخير في البيئة المعدلة لمحطة المعالجة خلال زيارة أكتوبر 2025.

الطيور المهاجرة: هناك 16 نوعاً من الطيور المحلقة المهاجرة يُحتمل عبورها فوق موقع المشروع. رغم ذلك، لا يُعد الموقع منطقة مهمة للطيور المهاجرة. ويتمتع الموقع بـ "منخفض شدة المرور"، أي عدد قليل من الأفراد لكل نوع يمر فوقه. ويرجع ذلك إلى الطبيعة الصحراوية الجرداء التي لا توفر أي مصادر غذاء أو ماء أو مأوى للطيور خلال توقفها. كما أن معظم هذه الأنواع الـ 16 مصنفة عالمياً ضمن فئة أقل قلقاً

الثدييات: قد تظهر في المنطقة بعض الأنواع مثل: ثعلب روبل – (*Vulpes rueppellii*) متكيف جداً مع البيئة الصحراوية، ثعلب الفنك – (*Vulpes zerda*) قادر على العيش دون ماء



يعرض شكل 14 حساسية منطقة المشروع (موضحة بالدائرة البيضاء) ومسارات هجرة الطيور المهاجرة الحوامة في محيط موقع المشروع.



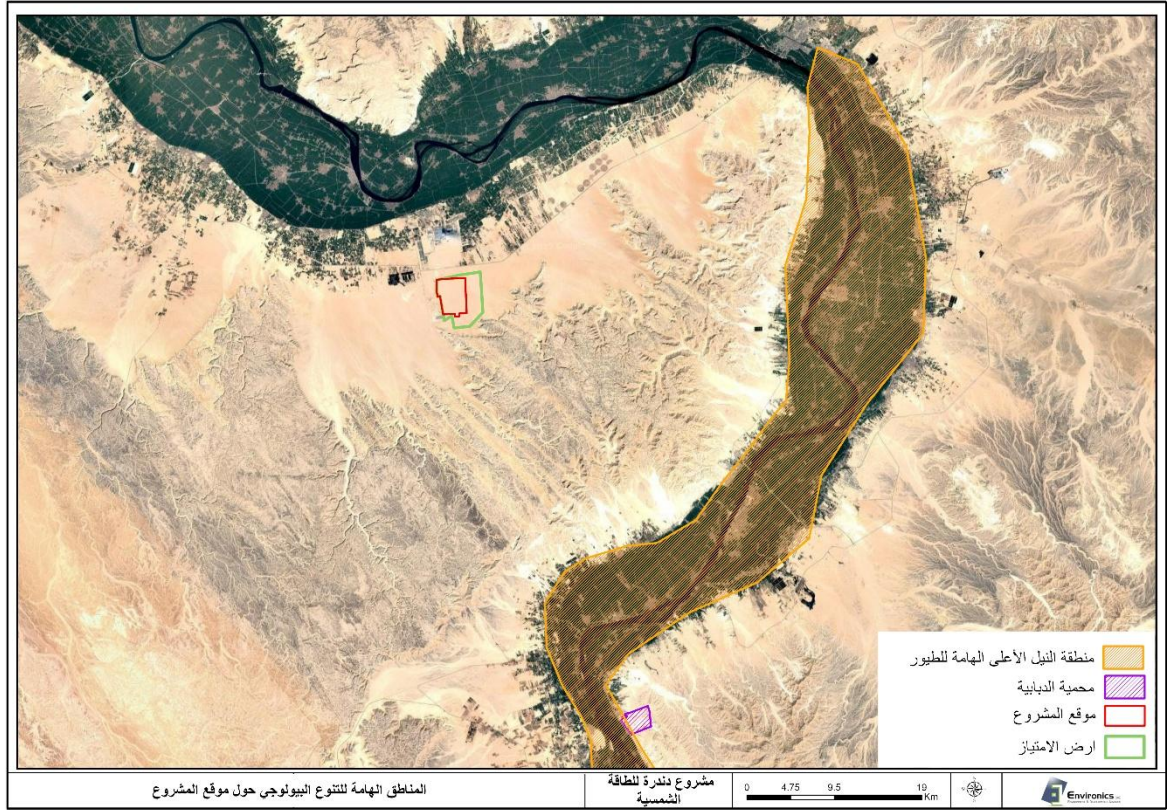
شكل 14: حساسية منطقة المشروع للطيور المهاجرة الحوامة

#### • القيمة البيئية والأهمية الحيوية

لا يحتوي موقع المشروع على أي مناطق تنوع بيولوجي رئيسية (KBAs) أو محميات طبيعية. أقرب KBA هي المنطقة المهمة للطيور بأعالي النيل، وتبعد حوالي 33 كم شرق الموقع. كما توجد محمية دبابية بالقرب من الموقع، على بعد 45.6 كم جنوب شرق المشروع، وهي محمية جيولوجية وليست ضمن مناطق التنوع البيولوجي الرئيسية.

شكل 15 يبين أقرب مناطق التنوع البيولوجي الرئيسية (KBAs) لموقع المشروع





شكل 15: أقرب مناطق التنوع البيولوجي الرئيسية (KBAs) إلى منطقة المشروع

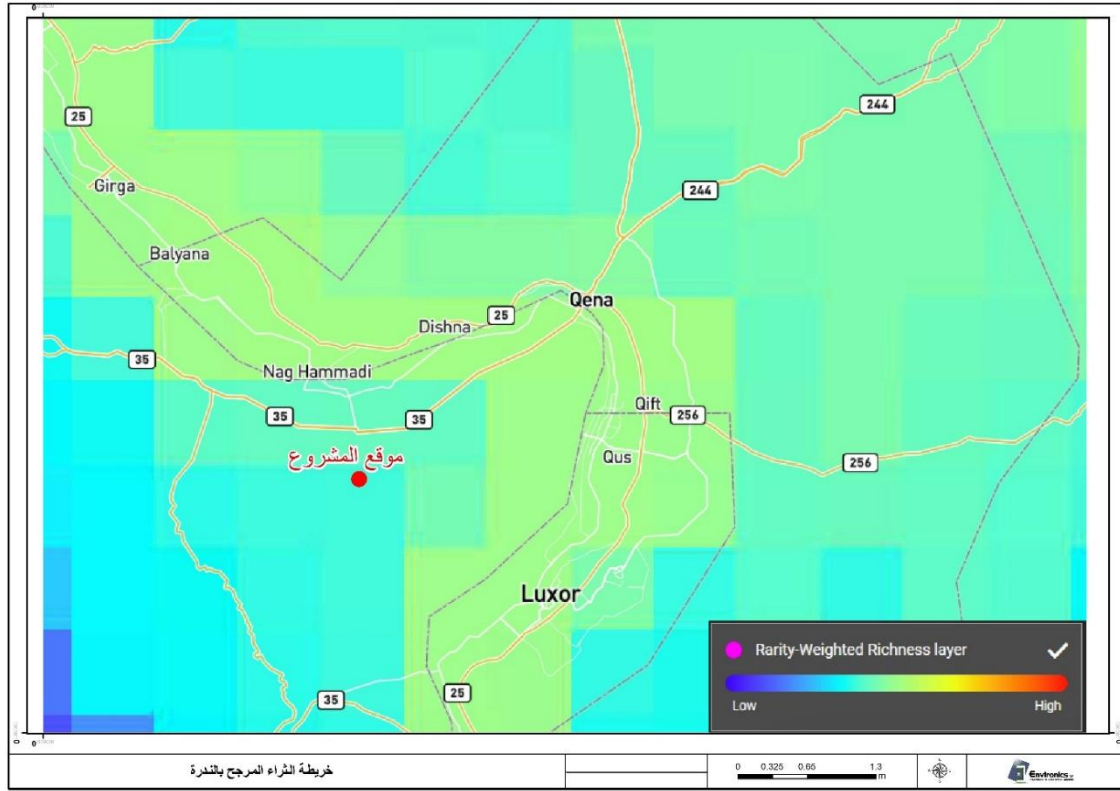


شكل 16: موقع محمية وادي قنا المقترحة بالنسبة لموقع المشروع



### • القيمة البيئية والتنوع الحيوي

يقع موقع المشروع ضمن منطقة ذات مستوى منخفض إلى متوسط من "الغنى الندري الموزون"، مما يعني أن أهميته البيئية متوسطة مقارنة بالتوزيع العالمي للأنواع. وأظهرت قواعد البيانات الدولية للتنوع الحيوي ندرة ظهور الأنواع في المنطقة، حيث تم خلال 25 عاماً تسجيل نوع واحد فقط من الطيور (العقاب النساري) على بعد 7 كم شمال الموقع، وهو غير مهدد عالمياً. كما لم يتم تسجيل أي ثدييات أو زواحف أو برمائيات.



شكل 17: ثراء التنوع البيولوجي المرجح بالندرة بمنطقة المشروع

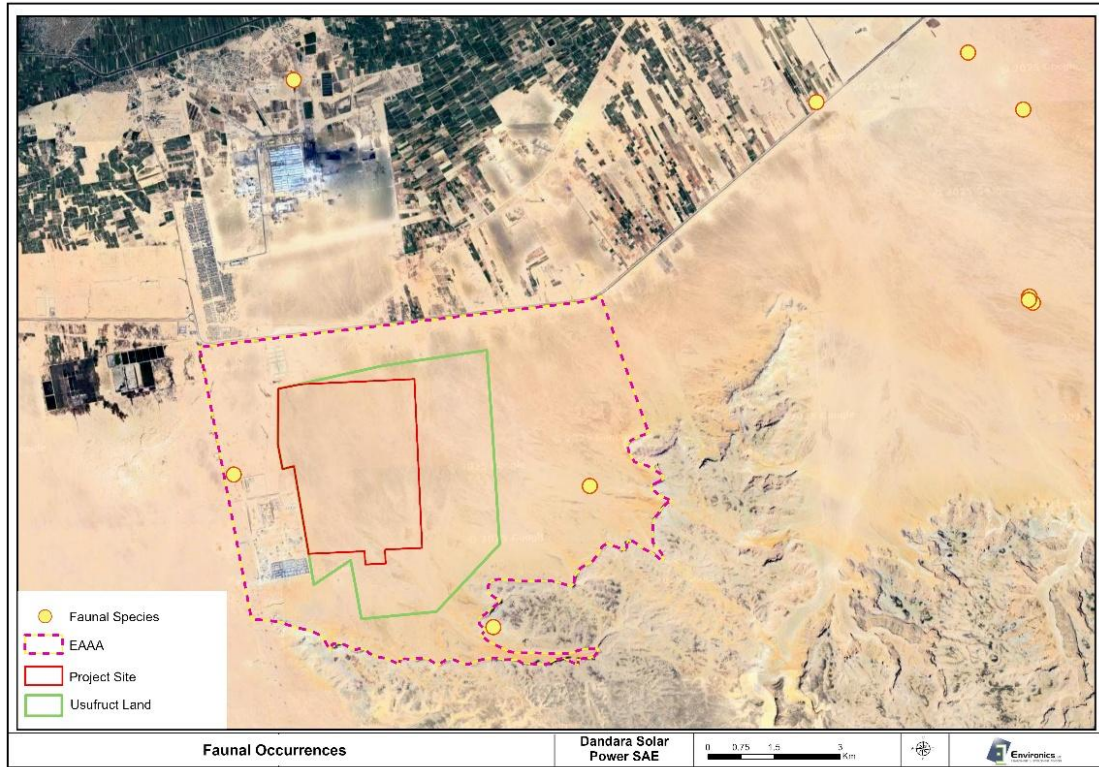
المصدر: أداة التقييم المتكامل للتنوع البيولوجي

### • خدمات النظم البيئية (Ecosystem Services)

- خدمات الإمداد: الغذاء، المياه العذبة، الأخشاب، الألياف، النباتات الطبية.
- الخدمات التنظيمية: تنقية المياه السطحية، تخزين الكربون، تنظيم المناخ، الحماية من الأخطار الطبيعية
- الخدمات الثقافية: المواقع الطبيعية ذات الأهمية الروحية أو الجمالية أو الترفيهية.
- الخدمات الداعمة: العمليات البيئية الأساسية التي تدعم جميع الخدمات الأخرى.

### • تقييم الموائل الحرجة (Critical Habitat Assessment)

لا تُصنّف المنطقة كموطن حرج (CH) وفق المعايير الدولية. ومع ذلك، تم تحديد أربعة أنواع تُعتبر عناصر تنوع حيوي ذات أولوية (PBFs)، وقد تمر بالمنطقة بشكل غير منتظم، وهي: الورل الصحراوي، الضب المصري، خفاش روبل، ثعلب الفنك



شكل 18: سجلات تواجد الكائنات الحيوانية داخل وبجوار منطقة التأثير البيئي الموسعة (EAAA) لموقع المشروع

## 5-6 نظرة عامة اجتماعية-ديموغرافية

تُعد محافظة قنا إحدى محافظات صعيد مصر الجنوبي، وتتميز بقطاعات زراعية وصناعية قوية، كونها المنتج الأول في مصر لمحاصيل مثل قصب السكر، والطماطم، والموز، والسمسم، والكرديه. تبلغ مساحة المحافظة 10,798 كم<sup>2</sup>، ويُسكّل العمران حوالي 16.11% منها.

### السكان والمستوطنات

- يبلغ عدد سكان محافظة قنا حوالي 3.16 مليون نسمة، مع توزيع شبه متساوٍ بين الذكور والإناث.
- يعيش حوالي 81% من السكان في المناطق الريفية مقابل 19% في المناطق الحضرية.
- تنقسم المحافظة إلى عدة مراكز وقرى وعزب، ويقع مركز نجع حمادي ضمن نطاق المشروع، ويبلغ عدد سكانه حوالي 578 ألف نسمة.

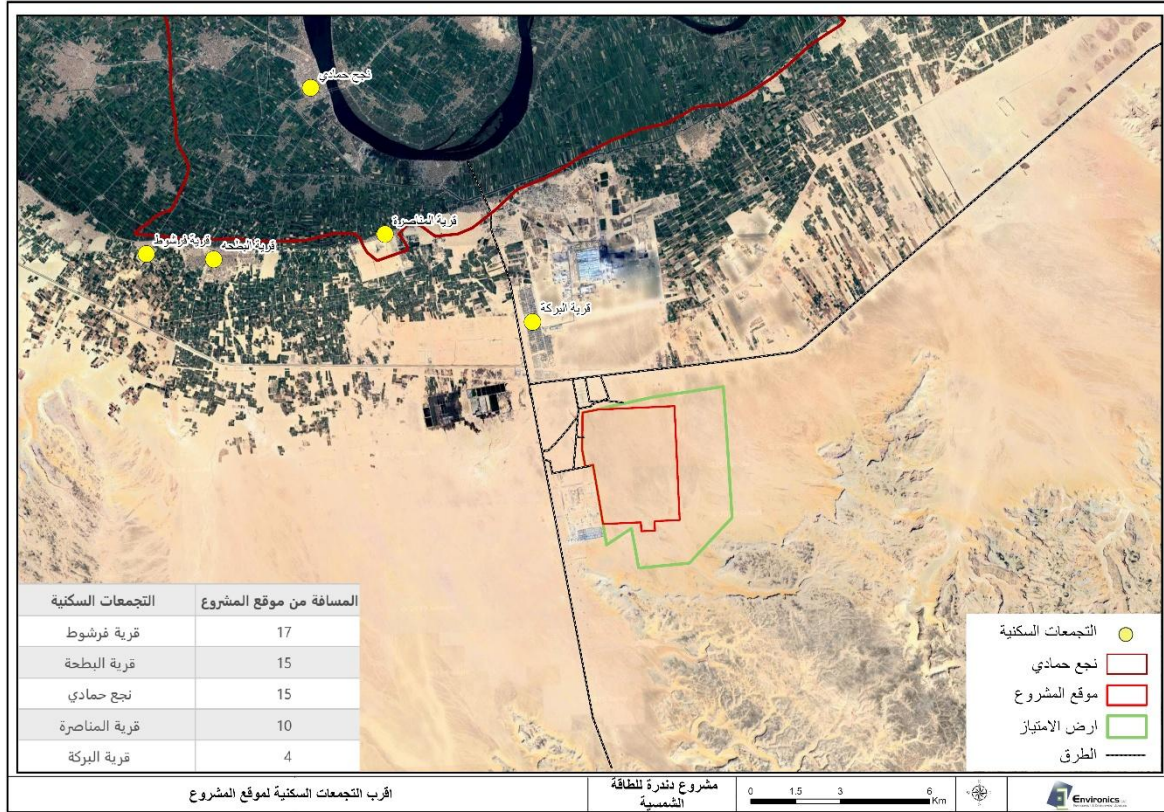
### قوة العمل والاقتصاد

- يبلغ حجم قوة العمل في محافظة قنا حوالي 927 ألف شخص، 75% منهم رجال و25% نساء.
- في مركز نجع حمادي وحده يبلغ حجم قوة العمل حوالي 182 ألف شخص.
- تشمل القطاعات الاقتصادية الرئيسية: الصناعات التحويلية، الإنشاءات، الخدمات الغذائية، النقل، وتجارة التجزئة.



### • الوظائف والتعليم

- يعمل الرجال غالبًا في المهن الحرفية والزراعة وتشغيل الآلات.
- تعمل النساء أساسًا في الخدمات والمبيعات والأعمال المكتبية.
- يتنوع المستوى التعليمي بين التعليم الفني والجامعي، إضافة إلى فئة بدون تعليم رسمي.

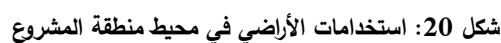


شكل 19: موقع أقرب التجمعات السكنية لموقع المشروع

### 5-7 أنواع استخدامات الأراضي

لا يُستغل موقع المشروع حاليًا لأي أنشطة بشرية. إلا أن استخدامات الأراضي في المناطق المجاورة (شكل 20) تشمل:

- المنطقة الصناعية بنجع حمادي 200 م غرب موقع المشروع
- الأراضي الزراعية المستصلحة 1 كم شمال الموقع
- محطة معالجة الصرف الصحي 2,5 كم شمال غرب الموقع
- محطة معالجة صرف صحي تحت الإنشاء 300 م شمال غرب موقع المشروع
- طريق الجيزة – الأقصر 950 م شمال الموقع
- منطقة سكنية 5,6 كم شمال شرق الموقع
- مجتمعات محلية أخرى بين 3 و 9 كم شمال غرب موقع المشروع



تضم محافظة فنا ما مجموعه 52 مستشفى، و 46 وحدة عناية مركزة (ICUs)، وأكثر من 200 وحدة صحية. وتوضح أقرب المرافق الصحية لموقع المشروع فى جدول 7.

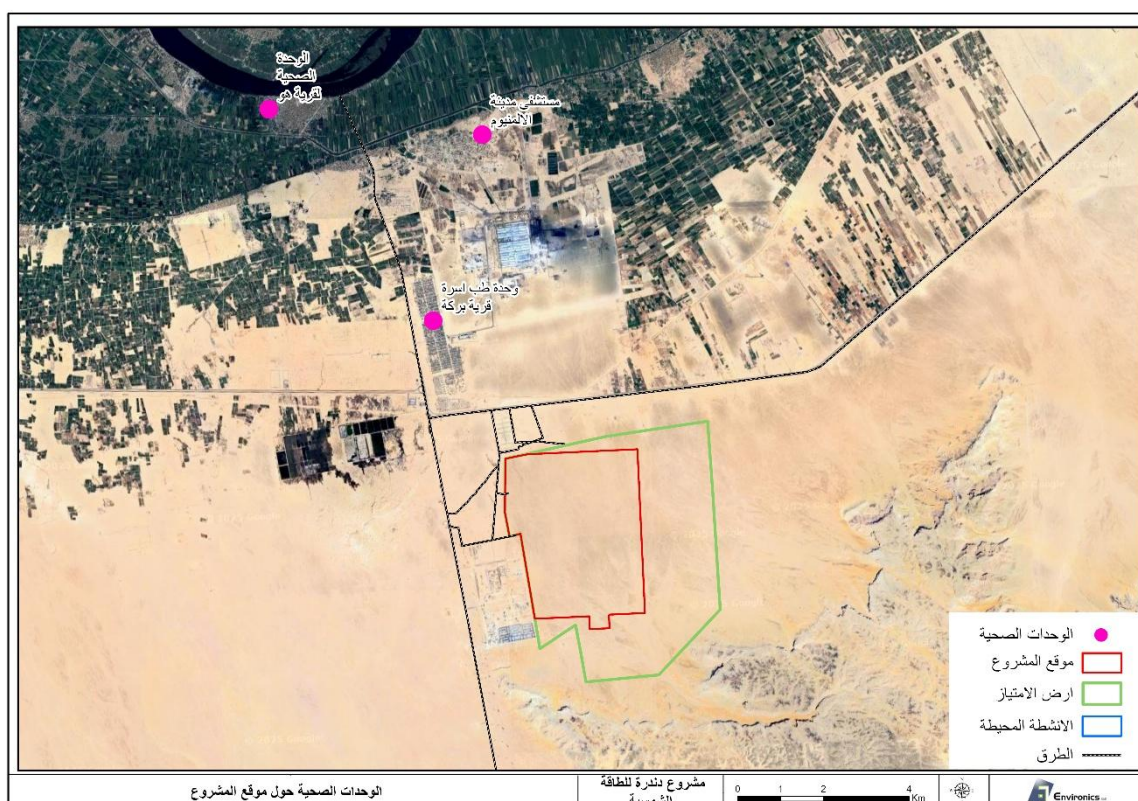
العدد	مرافق الرعاية الصحية
11	المستشفيات العامة والمركزية
14	المستشفيات الخاصة
1	مستشفيات التأمين الصحي
1	المستشفيات التعليمية
18	مراكز غسيل الكلى
241	الوحدات الصحية
2	المستشفيات الجامعية
1	المراكز الطبية المتخصصة
1	المستشفيات العسكرية
1	معاهد الأورام
52	مراكز الإسعاف ونقاط الإسعاف
92	سيارات الإسعاف
20	وحدات الإسعاف على الطريق السريع



العدد	مرافق الرعاية الصحية
1	بنوك الدم الإقليمية
46	وحدات العناية المركزة

المصدر: محافظة قنا (2024)

- كما تقع ثلاث مرافق رعاية صحية تقع على مسافة قريبة من موقع المشروع كالتالي:
- الوحدة الصحية بقرية البركة، تقع على بعد حوالي 6,4 كم شمال موقع المشروع.
  - مستشفى مدينة الألومنيوم، تقع على بعد حوالي 11 كم شمال شرق موقع المشروع.
  - الوحدة الصحية بقرية هو، تقع على بعد حوالي 12 كم شمال موقع المشروع.



شكل 21: أقرب مرافق الرعاية الصحية لمنطقة المشروع

### مياه الشرب

88,58% من الأسر الحضرية و 95,92% من الأسر الريفية متصلة بشبكة المياه العامة. وتعتمد بقية الأسر على الآبار أو الطلمبات أو المياه المعبأة.

### منشآت الصرف الصحي

15,47% فقط من الأسر متصلة بشبكات الصرف الصحي العامة. بالإضافة إلى ذلك، يعتمد 82,14% على خزانات التحليل (البيارات)، بينما تعتمد نسبة صغيرة على أنظمة خاصة أو مصارف مفتوحة. يوجد 9 محطات معالجة صرف صحي تعالج 48,1 مليون م<sup>3</sup> سنوياً، بطاقة معالجة تبلغ 207,000 م<sup>3</sup>/يوم. كما ساهمت المبادرات الحكومية الحديثة (مثل مبادرة حياة كريمة (في تحسين البنية التحتية للصرف الصحي).

### البنية التحتية للنقل

- يمر طريق الجيزة - الأقصر موازياً للحد الشمالي لموقع المشروع، على بعد حوالي 5 كم من هذا الحد
- يتكون طريق الجيزة - الأقصر من حارتين منفصلتين، يبلغ عرض كل منهما 9 أمتار.
- يوجد طريق ممهد ذو حارة واحدة يخدم المنطقة الصناعية غرب موقع المشروع، ويقع على بعد حوالي 0,5 كم شرق موقع المشروع.

## 5-8 التراث الثقافي

### • التراث الثقافي المادي

- وفقاً للخريطة الأثرية المصرية (EAM) لعام 2022 وقائمة مواقع التراث العالمي لليونسكو في مصر، لا توجد أي آثار مسجلة أو مواقع تراث ثقافي داخل موقع المشروع. إلا أنه توجد خمسة مواقع ومعالم أثرية تقع بالقرب من موقع المشروع:
- أبو عموري: تلة أثرية تقع في محافظة قنا ولم يتم حفرها بعد. تقع على بعد حوالي 9 كم شمال موقع المشروع.
  - هور: تم حفرها حديثاً من قبل المجلس الأعلى للآثار، وكشف الحفر عن عدة مقابر من الطوب اللبن تعود إلى الدولة القديمة. تقع على بعد حوالي 9.5 كم شمال موقع المشروع.
  - هيو: معروفة بمقابرها الواسعة ومستوطناتها التي تعود إلى نقادة II-I من عصور ما قبل التاريخ. وتقع في محافظة قنا وكانت عاصمة الإقليم السابع من أقاليم مصر العليا. يقع موقع هيو على بعد حوالي 11.5 كم شمال موقع المشروع.
  - جبل الأرقى: يحتوي بشكل أساسي على بقايا أثرية فقط. يقع على بعد حوالي 14 كم شمال غرب موقع المشروع.
  - الحلفاية قبلي: يضم هذا الموقع قرية صغيرة ما قبل التاريخ ومقبرة كبيرة تعود لعصور ما قبل التاريخ. ولم يتم العثور على أي آثار لعمارة دائمة في الموقع. يقع على بعد حوالي 15 كم شمال شرق موقع المشروع.

### • موقع التراث العالمي لليونسكو

- طيبة القديمة ومقابرها: وهي موقع التراث العالمي الوحيد القريب من موقع المشروع، حيث تقع على بعد حوالي 36 كم جنوبه. كانت طيبة عاصمة مصر خلال الدولة الوسطى والدولة الحديثة. واليوم، تمثل طيبة شاهداً مميزاً على الحضارة المصرية في أوجها من خلال معابدها وقصورها في الكرنك والأقصر، ومقابر وادي الملوك ووادي الملكات (اليونسكو، 2025).

### • التراث الثقافي غير المادي

- استناداً إلى قائمة التراث الثقافي غير المادي (ICH) لليونسكو في مصر، لا توجد أي من عناصر هذا التراث ضمن موقع المشروع. مع ذلك، قد تمارس بعض العناصر من قبل المجتمعات المحلية القريبة من موقع المشروع، وتشمل:
- النسيج اليدوي في صعيد مصر: حرفة تقليدية تواجه تراجعاً بسبب ضعف الجدوى الاقتصادية وانخفاض انتقال المهارة بين الأجيال.
  - التحطيب: فن قتالي قديم تحول إلى رقصة فلكلورية تؤدي بالعصي وترمز للقوة والشرف والهوية الثقافية.
  - السيرة الهلالية: ملحمة شفوية عربية نادرة تروي هجرة قبيلة بني هلال إلى شمال أفريقيا.

– عارف وعادات شجرة النخيل :ممارسات ثقافية مرتبطة بزراعة النخيل، وتشكل جزءاً مهماً من التراث المحلي وسبل المعيشة.

• **عدم توقع تأثير على التراث الثقافي**

لا يتوقع حدوث أي تأثير على هذا التراث للأسباب التالية:

- سيتم توظيف العمال المحليين من المناطق الواسعة حول المشروع (وليس بالضرورة من القرى الأقرب مباشرة).
- جزء من العمال غير المحليين سيقومون في معسكر سكني داخل موقع المشروع، مما يقلل من تفاعلهم مع المجتمع المحلي.
- فترة الإنشاء، التي تشهد أعلى طلب على العمالة، محدودة زمنياً.

## 6- ملخص التأثيرات البيئية وتدابير التخفيف والآثار المتبقية

التأثيرات المتبقية	ملخص تدابير التخفيف	التأثيرات المتوقعة	الجانب البيئي
مرحلة الإنشاء			
جودة الهواء			
غير ملحوظة	<ul style="list-style-type: none"> <li>• تطبيق سياسات وإجراءات للحد من فترات تشغيل المركبات والمعدات دون حاجة (idling).</li> <li>• صيانة المعدات والمركبات بانتظام لضمان عملها بكفاءة وتقليل الانبعاثات الهاربة وانبعاثات العادم.</li> <li>• توعية العمال بأهمية القيادة الآمنة والحفاظ على الممارسات الجيدة في استخدام المعدات؛</li> <li>• إجراء قياسات دورية لمداخل المولدات لضمان الامتثال للقانون 1994/4 ولوائح التنفيذ.</li> <li>• تنفيذ إجراءات فعالة للحد من تطاير الأتربة (dust suppression).</li> </ul>	طفيف	<ul style="list-style-type: none"> <li>• التأثيرات الناتجة عن أعمال التسوية والحفر والردم، وحركة معدات وآليات الإنشاء، بالإضافة إلى مركبات النقل المستخدمة في نقل الألواح الشمسية والمعدات ومواد البناء.</li> </ul>
الضوضاء المحيطة			
غير ملحوظة	<ul style="list-style-type: none"> <li>• ضمان الصيانة الدورية لمعدات وآلات البناء لتقليل انبعاثات الضوضاء.</li> <li>• استخدام الآلات والمعدات منخفضة الضوضاء حيثما أمكن.</li> <li>• جدولة الأنشطة ذات الضوضاء العالية لتجنب العمليات المتزامنة التي يمكن أن تزيد من مستويات الضوضاء.</li> <li>• توفير واقيات الأذن للعمال المعرضين لمستويات ضوضاء عالية.</li> </ul>	طفيفة	<ul style="list-style-type: none"> <li>• الآلات والمعدات</li> <li>• حركة المركبات</li> <li>• عمليات حفر الأساسات</li> <li>• مولدات الطاقة</li> </ul>
التأثيرات علي التربة			
غير ملحوظة	<ul style="list-style-type: none"> <li>• إجراء صيانة للمركبات والشاحنات ومعدات الإنشاء خارج الموقع لتقليل الانبعاثات والانسكابات في الموقع؛</li> <li>• الجمع والتخلص من الانسكابات الناتجة عن تعبئة الخزانات أو تشغيل المولدات كمخلفات خطرة؛</li> <li>• الحفاظ على ممارسات النظافة الجيدة لضمان موقع بناء نظيف ومنظم؛</li> <li>• جمع ونقل مياه الصرف الصحي بواسطة مقاولين معتمدين لضمان التخلص السليم ومنع التلوث؛</li> <li>• اعداد خطه لاداره الانسكابات</li> <li>• المخلفات الصلبة غير الخطرة: <ul style="list-style-type: none"> <li>○ جمع المخلفات في نقاط جمع محددة وتخزينها في حاويات مناسبة وفقاً للوائح.</li> <li>○ التعامل مع مقاولين مرخصين لجمع والتخلص من المخلفات غير الخطرة</li> </ul> </li> <li>• المخلفات الخطرة: <ul style="list-style-type: none"> <li>○ إنشاء مناطق تخزين محددة ومفصولة للمخلفات الخطرة.</li> <li>○ التعامل مع مقاولين مرخصين لجمع والتخلص من المخلفات الخطرة.</li> </ul> </li> </ul>	متوسطة	<ul style="list-style-type: none"> <li>• إدارة مياه الصرف الصحي، تخزين مخلفات البناء، والانسكابات أو التسريبات العرضية من الوقود والزيوت.</li> </ul>

التأثيرات المتبقية	ملخص تدابير التخفيف	التأثيرات المتوقعة	الجانب البيئي
التأثيرات والمخاطر علي البيئة البيولوجية			
غير ملحوظ	<ul style="list-style-type: none"> <li>- ضمان تنظيف الموقع داخل وخارجه لمنع تدهور الموائل المجاورة.</li> <li>- تجنب المناطق خارج الموقع التي تحتوي على أي غطاء نباتي مهما كان بسيطاً.</li> <li>- الالتزام بحدود السرعة داخل وخارج الموقع.</li> <li>- توعية العمال بأهمية عدم الإضرار بالنباتات أو إزعاج الحيوانات البرية.</li> <li>- الحد من تجزئة الموائل : يتم تنفيذ سياج صديق للحياة البرية بمعايير تشمل: <ul style="list-style-type: none"> <li>• أن يكون مرئياً بوضوح للحيوانات الجارية أو الطائرة.</li> <li>• ترك فراغ (حوالي 30 سم) في الأسلاك السفلية على فترات متباعدة لتمكين مرور بعض الأنواع دون إصابة.</li> </ul> </li> </ul>	طفيف	<ul style="list-style-type: none"> <li>• فقدان الموائل، وتعديلها، وتجزئتها</li> </ul>
غير ملحوظ	<ul style="list-style-type: none"> <li>• تنفيذ وتحديث خطط إدارة النفايات والمياه الصرف</li> <li>• توفير الوعي للعاملين</li> <li>• الحفاظ علي ممارسات النظافة الجيدة</li> <li>• الالتزام بممارسات النظافة الجيدة في الموقع.</li> <li>• تجنب توجيه الإضاءة عالية الشدة خارج حدود الموقع بما قد يتسبب في إزعاج الحيوانات.</li> <li>• ضمان التحكم في السرعة ومنع القيادة خارج المسارات المحددة.</li> <li>• التأكد من الصيانة الدورية لمعدات البناء وأي معدات أخرى ذات احتمالية عالية لإحداث الضوضاء والاهتزازات.</li> </ul>	طفيف	<ul style="list-style-type: none"> <li>• اضطراب الحياة البرية</li> </ul>
غير ملحوظ	<ul style="list-style-type: none"> <li>• تطوير وتنفيذ وتحديث خطة إدارة المخلفات الصلبة لتشمل جمع المخلفات وتخزينها ونقلها والتخلص منها بطريقة مستدامة بيئياً لتجنب جذب الآفات.</li> </ul>	طفيف	<ul style="list-style-type: none"> <li>• جذب الآفات وانتشار الأنواع الغازية</li> </ul>
التأثيرات علي البيئة الاجتماعية والاقتصادية			
غير ملحوظ	<ul style="list-style-type: none"> <li>• سيتم وضع خطة شاملة لإدارة المياه.</li> </ul>	غير ملحوظة	<ul style="list-style-type: none"> <li>• الموارد المائية</li> </ul>
غير ملحوظة	<ul style="list-style-type: none"> <li>• إعطاء الأولوية لتوظيف العمال المحليين لتقليل عدد العمال الوافدين وتقليل الاضطرابات الاجتماعية.</li> <li>• انشاء و حفظ الية لشكاوي المجتمع.</li> </ul>	طفيف	<ul style="list-style-type: none"> <li>• تدفق العمالة</li> </ul>

التأثيرات المتبقية	ملخص تدابير التخفيف	التأثيرات المتوقعة	الجانب البيئي
	<ul style="list-style-type: none"> <li>توفير مساكن ومرافق صحية كافية للعمال لمنع تحميل البنية التحتية المحلية فوق طاقتها.</li> <li>تنفيذ خطط شاملة لإدارة المخلفات للتعامل مع زيادة توليد المخلفات، بما في ذلك إعادة التدوير وطرق التخلص المناسبة.</li> <li>الالتزام بمدونة السلوك للعمال وتوفير الوعي حول القضايا المتعلقة العنف القائم على الجنس (GBV) والاستغلال والاعتداء الجنسي</li> </ul>		
غير ملحوظ	<ul style="list-style-type: none"> <li>تدريب أفراد الأمن تدريباً كافياً لضمان تمتعهم بالسلوك المهني المناسب في التعامل مع العمال وأفراد المجتمع.</li> <li>سيُطلب من أفراد الأمن الالتزام التام بالقوانين والأنظمة المعمول بها أثناء أداء مهامهم.</li> <li>تطوير آلية لتقديم الشكاوى تمكن أفراد المجتمع المحتمل تأثرهم من الإبلاغ عن أي مخاوف تتعلق بترتيبات الأمن أو سلوك أفراد الأمن.</li> </ul>	غير ملحوظ	<ul style="list-style-type: none"> <li>تأمين الموقع</li> </ul>
التأثيرات علي البنية التحتية			
غير ملحوظ	لا توجد مطالبات بملكية الأراضي أو أنواع أخرى من استخدامات الأراضي في موقع المشروع. تم تأكيد ذلك خلال اجتماعات أصحاب المصلحة مع ممثلي الحكومة المحلية ومستخدمي الأراضي القريبة للموقع ولا يوجد أي مخاطر فيما يتعلق بملكية الأراضي المحتملة.	غير ملحوظة	استخدام الارض
ضئيلة	<ul style="list-style-type: none"> <li>ستطور شركة دندرة إجراءات إدارة النقل التي تنطبق على مشاريع دندرة وعملياتها وكذلك على مقاوليها والمقاولين من الباطن. تحدد هذه الإجراءات الحد الأدنى من متطلبات السلامة لأنشطة النقل الخاصة بشركة دندرة. تكون هذه المتطلبات مكملية للمواصفات التنظيمية الوطنية ومواصفات المشروع أو وحدة الأعمال و/أو متطلبات التأمين.</li> </ul>	متوسطة	<ul style="list-style-type: none"> <li>المرور</li> </ul>
التأثيرات علي الصحة والسلامة المهنية			
ضئيلة	<ul style="list-style-type: none"> <li>سيتم إحاطة مواقع الحفر بعلامات تحذيرية لمنع الوصول إلى هذه الأماكن.</li> <li>سيضمن المقاولون الإشراف المستمر على عمال البناء من خلال التواجد المستمر للمشرفين في الموقع لمراقبة الأنشطة الإنشائية عن كثب وإدارتها.</li> <li>ضمان التدريب المناسب للمشغلين، الصيانة الدورية للمعدات، وتنفيذ بروتوكولات السلامة.</li> <li>توفير الترطيب الكافي، وجدولة العمل في الأوقات الأبرد من اليوم، والسماح بفترات راحة منتظمة في الأماكن المظلمة.</li> </ul>	متوسطة	<ul style="list-style-type: none"> <li>التأثيرات على صحة وسلامة القوي العاملة</li> </ul>



التأثيرات المتبقية	ملخص تدابير التخفيف	التأثيرات المتوقعة	الجانب البيئي
	<ul style="list-style-type: none"> <li>تقييد سرعة المركبات بحيث لا تتجاوز الحد الآمن داخل موقع العمل (15-20 كم/ساعة).</li> <li>سيتم فحص جميع المعدات قبل بدء العمل لضمان سلامة العمال.</li> <li>توفير مهمات لحماية السمع، وتنفيذ تدابير التحكم في الضوضاء، وجدولة فترات راحة منتظمة للعمال.</li> <li>توفير التدريب على تقنيات الرفع السليمة، واستخدام الوسائل الميكانيكية.</li> <li>تنفيذ تدابير الوقاية من الحرائق، والحفاظ على وجود طفايات الحريق في الموقع، وإجراء تدريب على السلامة من الحرائق.</li> </ul>		
التراث الثقافي			
غير ملحوظ	<ul style="list-style-type: none"> <li>إعداد وتنفيذ إجراءات الاكتشافات العرضية التي توضح الإجراءات الواجب اتخاذها في حال العثور على أي لقي أو شواهد أثرية مهمة أثناء أعمال تسوية الموقع أو مرحلة الإنشاء.</li> </ul>	غير ملحوظ	<ul style="list-style-type: none"> <li>التأثير على التراث الثقافي</li> </ul>
مرحلة التشغيل			
جودة الهواء المحيط			
غير ملحوظة	زيادة كفاءة تشغيل المولدات الاحتياطية لتقليل الاستخدام والانبعاثات.	طفيف	<ul style="list-style-type: none"> <li>الانبعاثات الصادرة عن مولد الطوارئ أ</li> </ul>
الضوضاء المحيطة / بيئة العمل والاهتزاز			
غير ملحوظة	<ul style="list-style-type: none"> <li>سيتم تصميم الآلات والمعدات التي تولد الضوضاء المحتملة لتلبية اللوائح القانونية المتعلقة بالضوضاء.</li> <li>سيتم تزويد العمال الذين يعملون على الآلات والمعدات المولدة للضوضاء بمعدات الوقاية الشخصية المناسبة (PPEs)</li> <li>سيتم اعتماد آلية التظلم لتقييم الشكاوى، والتي ستغطي ضوضاء التشغيل، إن وجد</li> </ul>	طفيف	<ul style="list-style-type: none"> <li>تشغيل المحولات، والمكونات التشغيلية الأخرى لأنظمة تخزين طاقة البطاريات</li> <li>استخدام المولدات الاحتياطية أثناء عدم وجود التيار الكهربائي</li> </ul>
التأثيرات والمخاطر علي البيئة البيولوجية			
غير ملحوظة	<ul style="list-style-type: none"> <li>إعداد وتنفيذ وتحديث خطة لإدارة المخلفات الصلبة والخطرة والمياه العادمة.</li> <li>توعية العمال بالآثار السلبية الناتجة عن إزعاج أي من الكائنات البرية.</li> <li>ضمان تطبيق ممارسات جيدة للنظافة العامة في موقع العمل.</li> <li>التأكد من أن مناطق تخزين الطعام غير قابلة للوصول من قبل الحيوانات.</li> </ul>	طفيف	<ul style="list-style-type: none"> <li>اضطراب الحياة البرية (باستثناء الطيور)</li> </ul>

التأثيرات المتبقية	ملخص تدابير التخفيف	التأثيرات المتوقعة	الجانب البيئي
	<ul style="list-style-type: none"> <li>• تجنب استخدام الإضاءة شديدة السطوع التي قد تُزعج الكائنات البرية خارج الموقع.</li> <li>• الالتزام بضبط السرعة ومنع القيادة خارج المسارات المحددة.</li> <li>• ضمان الصيانة السليمة للمعدات ولأي أجهزة قد تُصدر ضوضاء أو اهتزازات عالية.</li> <li>• ضمان العزل الجيد للمولدات الكهربائية للحد من الانبعاثات الصوتية.</li> <li>• ضمان عدم قيام العمال بإزعاج الكائنات البرية المحلية التي قد يتم رصدها في الموقع.</li> </ul>		
طفيفة	<ul style="list-style-type: none"> <li>• تركيب وسائل ردع للطيور على خطوط النقل الهوائية في نقاط محددة على طول الخط، وذلك لكلٍ من خط النقل الداخلي داخل الموقع وكذلك خط النقل الهوائي الواصل إلى محطة محولات المنطقة الصناعية بنجع حمادي.</li> <li>• تنفيذ تسجيل دوري للنفوق (Carcass Monitoring) لتقييم مدى فعالية إجراءات التخفيف المُتخذة.</li> <li>• تطبيق ممارسات جيدة لتنظيم الموقع وإدارة النفايات والمياه العادمة لمنع وجود مياه راكدة أو نمو الغطاء النباتي الهامشي الذي قد يجعل الموقع أكثر جاذبية للطيور.</li> <li>• لمخاطر الصعق الكهربائي : زيادة عدد العوازل عند نقاط اتصال الموصلات بالأبراج، أو عزل العوارض العرضية بمواد مناسبة، أو تعديل تصميمها لمنع وقوف الطيور أو توفير مجاثم مرتفعة وعزل الموصلات عند نقاط اتصالها بالأبراج للحد من مخاطر الصعق الكهربائي.</li> </ul>	متوسطة	<ul style="list-style-type: none"> <li>• التأثيرات على الطيور <ul style="list-style-type: none"> <li>- تأثير البحيرة</li> <li>- مخاطر التصادم</li> <li>- مخاطر الصعق الكهربائي</li> </ul> </li> </ul>
التأثيرات علي البيئة الاجتماعية			
لا يوجد تأثيرات متبقية	<ul style="list-style-type: none"> <li>• سيتم جمع مياه الصرف الصحي الناتجة أثناء مرحلة التشغيل من قبل مقاول معتمد وتصريفها إلى محطات المعالجة المعتمدة المخصصة للمعالجة.</li> </ul>	غير ملحوظة	<ul style="list-style-type: none"> <li>• الموارد المائية</li> <li>• إدارة المخلفات</li> </ul>
غير ملحوظة	<ul style="list-style-type: none"> <li>• وفقاً لدراسة تقييم التأثيرات للوهج الشمسي للمشروع ، فهو لا يسبب أي مخاطر للانعكاس الشمسي على المناطق المحيطة، ولا توجد آثار بصرية متوقعة. وبالتالي، لا تُلزم أي إجراءات تخفيفية إضافية سوى الصيانة الدورية والحفاظ على نظافة الألواح والطبقات المضادة للانعكاس.</li> </ul>	غير ملحوظة	<ul style="list-style-type: none"> <li>• الوهج واللمعان</li> </ul>
التأثيرات علي الصحة والسلامة المهنية			
غير ملحوظة	<ul style="list-style-type: none"> <li>• التوافق مع قانون العمل رقم 2025/14</li> <li>• تطبيق سياسه السلامة و الصحة المهنية</li> <li>• توفير مصدر لمياه الشرب ملائمه</li> <li>• توفير مهمات الحماية الشخصية المناسبة (PPE) للعمال.</li> </ul>	غير ملحوظة	التأثيرات على مكان العمل

## 7- خطة الإدارة البيئية والاجتماعية

سيتم اعداد وتنفيذ خطة الإدارة البيئية والاجتماعية الخاصة بالمشروع، والتي تتضمن الإجراءات المحددة للتخفيف والمراقبة، بهدف ضمان الالتزام بجميع المتطلبات القانونية والمؤسسية الوطنية المعمول بها، وكذلك متطلبات الأداء الجهات الممولة للمشروع

تشمل خطة الإدارة البيئية والاجتماعية العناصر الأساسية التالية:

- ملخص الآثار البيئية والاجتماعية وإجراءات التخفيف
- خطة الصحة والسلامة والبيئة (HSE)
- خطة إدارة النقل
- خطة إدارة الضوضاء
- خطة إدارة المخلفات الخطرة وغير الخطرة
- إدارة المياه والصرف الصحي
- إجراءات الاكتشاف العرضي للآثار (Chance Find Procedure)
- الصيانة الوقائية والتوصيحية
- خطة إدارة مياه الصرف
- خطة إدارة التنوع البيولوجي
- إجراءات النظافة العامة وتنظيم الموقع (Housekeeping)
- الخطة الاجتماعية، وتشمل خطة إدارة العنف القائم على النوع الاجتماعي والتحرش والاستغلال الجنسي (SEAH & GBV) الخاصة بمشروع دندرة
- الترتيبات المؤسسية: تحديد واضح لأدوار ومسؤوليات جميع الأطراف المشاركة في تنفيذ خطة ESMP، بما يشمل صاحب المشروع، والمقاولين، والجهات الحكومية ذات الصلة، لضمان المساءلة والتنسيق الفعال بين الأطراف.
- بناء القدرات: تنفيذ برامج تدريب ورفع كفاءة للعاملين والمقاولين حول أفضل الممارسات في الإدارة البيئية والاجتماعية، لتعزيز قدرتهم على تنفيذ ومتابعة الخطة بشكل فعال.

يقدم جدول 8 أدناه عرضاً شاملاً لخطة إدارة المشروع، ويشمل الجوانب البيئية والاجتماعية المتوقعة خلال مرحلتي الإنشاء والتشغيل، بالإضافة إلى إجراءات التخفيف المقترحة للحد من هذه الآثار.

جدول 8: خطة الإدارة البيئية والاجتماعية

التأثير البيئي	الإجراءات	الجهة المنفذة	مؤشر الإنجاز	التكلفة التقديرية	تاريخ الإنجاز المطلوب
المرحلة الإنشائية					
جودة الهواء	انبعاثات الغبار	<ul style="list-style-type: none"> <li>• تقليل أوقات التوقف غير الضرورية للمركبات والمعدات.</li> <li>• الحفاظ على المعدات والمركبات في حالة تشغيل جيدة.</li> <li>• فرض قيود على السرعة داخل الموقع.</li> <li>• توعية العمال بممارسات القيادة الآمنة والحفاظ على أفضل استخدام للمعدات.</li> <li>• قياسات دورية لمداخل المولدات.</li> </ul>	مقاول الإنشاءات	<ul style="list-style-type: none"> <li>• خطة المراقبة</li> <li>• قياسات جودة الهواء</li> </ul>	تكاليف القياسات المذكورة في خطة المراقبة أدناه
	ظروف عمل المعدات	<ul style="list-style-type: none"> <li>• ضمان حالة جيدة للمعدات من خلال التفتيش الدوري على جميع معدات البناء.</li> </ul>	مقاول الإنشاءات	سجلات الصيانة	تكاليف الصيانة
مستوى الضوضاء	ظروف عمل المعدات	<ul style="list-style-type: none"> <li>• الصيانة الدورية لمعدات البناء.</li> </ul>	مقاول الإنشاءات	قياسات الضوضاء وسجلات الصيانة	تكاليف القياسات المذكورة في خطة المراقبة
		<ul style="list-style-type: none"> <li>• استخدام معدات منخفضة الضوضاء حيثما أمكن.</li> <li>• جدولة الأنشطة ذات الضوضاء العالية لتجنب العمليات المتزامنة التي قد تضخم مستويات الضوضاء.</li> <li>• جدولة الأنشطة ذات الضوضاء العالية خلال ساعات الصباح.</li> </ul>		تكاليف الصيانة	تكاليف الصيانة
		<ul style="list-style-type: none"> <li>• توفير مهمات الوقاية الشخصية اللازمة للعمال.</li> </ul>			
	توفير مهمات الحماية		مقاول الإنشاءات		
التربة	ممارسات النظافة العامة	<ul style="list-style-type: none"> <li>• اعداد وتنفيذ خطة لإدارة الموقع خطة لإدارة المخلفات الصلبة وخطه التحكم في الانسكابات</li> </ul>	<ul style="list-style-type: none"> <li>• مقاول الإنشاءات</li> <li>• مالك المشروع (تضمين متطلبات إدارة المخلفات في عقود الإنشاء والتأكد من التزام المقاولين).</li> </ul>	<ul style="list-style-type: none"> <li>• عقد إدارة النفايات الصلبة/الخطرة ومياه الصرف.</li> </ul>	جزء من إدارة أنشطة البناء

التأثير البيئي	الإجراءات	الجهة المنفذة	مؤشر الإنجاز	التكلفة التقديرية	تاريخ الإنجاز المطلوب
المرحلة الإنشائية					
إدارة النفايات/المياه العادمة			• مستندات متابعة المقاولين	• تكلفة النقل والتخلص من النفايات	
الصحة والسلامة المهنية	• تنفيذ إجراءات الصحة والسلامة المهنية وفقاً للقوانين المحلية والمعايير الدولية.	المقاول	بنود الصحة والسلامة في عقود البناء	تكلفة الإنشاء	قبل بدء الأنشطة الإنشائية
خطط الاستجابة للطوارئ	• اعداد خطط الاستجابة لحالات الطوارئ.	المقاول	خطة الاستجابة للطوارئ		قبل تشغيل المشروع
اداره المخلفات	• اعداد خطة لإدارة المخلفات الصلبة.	مقاول الإنشاءات	عقد إدارة المخلفات الصلبة	تكلفة النقل والتخلص من النفايات	طوال فترة المرحلة الإنشائية
البيئة	الإدارة السليمة للمخلفات وإجراءات الترتيب والتنظيم والنظافة	مقاولين الانشاء	عقد اداره المخلفات		طوال فترة المرحلة الإنشائية
البيولوجية	• التوعية (اجتماعات لمناقشة مواضيع السلامة وإشارات التوعية) • تنفيذ تدابير وإجراءات التخفيف • التفتيش المنتظم وتنفيذ التدابير الرادعة	مقاولين الانشاء	المتطلبات محددة بالعقد		طوال فترة المرحلة الإنشائية

التأثير البيئي	الإجراءات	الجهة المنفذة	مؤشر الإنجاز	التكلفة التقديرية	تاريخ الإنجاز المطلوب
المرحلة الإنشائية					
البيئة الاجتماعية	تدفق العمالة	<ul style="list-style-type: none"> <li>• إعطاء الأولوية لتوظيف العمال المحليين.</li> <li>• تنفيذ آلية لتلقي شكاوى المجتمع والمحافظة عليها.</li> <li>• اختيار مساكن العمال بعيدًا عن المجتمعات الحالية قدر الإمكان، مع النظر في إنشاء معسكر للعمال في الموقع.</li> <li>• تطوير سياسات الموارد البشرية بما في ذلك خطط مكافحة العنف القائم على النوع الاجتماعي والتحرش.</li> </ul>	مالك المشروع/مقاولو البناء	خطة إدارة العمال وقائمة فحص سكن العمال سياسات مكافحة العنف القائم على النوع الاجتماعي والتحرش	طوال فترة المرحلة الإنشائية
	التراث الثقافي	اعداد اجراءات الاكتشاف عن طريق الصدفة	مالك المشروع/مقاولو الإنشاء	الإجراءات المعدة	قبل بدء المرحلة الإنشائية

مرحلة التشغيل					
جودة الهواء	انبعاثات المولدات الاحتياطية	<ul style="list-style-type: none"> <li>• زيادة كفاءة تشغيل المولدات الاحتياطية لتقليل الاستخدام والانبعاثات.</li> </ul>	مالك المشروع	قياسات الانبعاثات	تكلفة التشغيل بشكل دوري طوال مرحلة التشغيل
الضوضاء	المحولات ونظام تخزين الطاقة (BESS)	<ul style="list-style-type: none"> <li>• توفير مهمات الحماية الشخصية (PPES) للعمال في مناطق توليد الضوضاء.</li> <li>• اعتماد آلية شكاوى لتقييم الشكاوى المتعلقة بالضوضاء.</li> </ul>	مالك المشروع	قياسات الضوضاء	تكلفة التشغيل بشكل دوري طوال مرحلة التشغيل
البيئة البيولوجية	كما هو الحال في مرحلة الإنشاء	كما هو الحال في مرحلة الإنشاء	مالك المشروع	تقارير	طوال عمر المشروع
التأثير على البيئة	استهلاك المياه	<ul style="list-style-type: none"> <li>• يتم جمع المياه العادمة الناتجة عن مرحلة التشغيل من قبل مقاول معتمد وتصريفها إلى محطات معالجة مخصصة.</li> </ul>	مالك المشروع	خطة إدارة المياه العادمة	طوال عمر المشروع

مرحلة التشغيل						
حقوق العمال ورفاهيته	ظروف العمل	• تطوير سياسة الموارد البشرية.	مالك المشروع	العقود (مع العمال)	تكلفة التشغيل	طوال عمر المشروع
التدريب والتوعية	كفاءة العاملين في المشروع	• تدريب العاملين وفقاً لمسؤولياتهم المحددة.	مالك المشروع	خطط التدريب	تكلفة التدريب	طوال عمر المشروع
الصحة والسلامة المهنية	سلامة العاملين في الموقع و موقع العمل	• تطوير إجراءات الصحة والسلامة المهنية (HSE).	مالك المشروع	تطوير سياسات الصحة والسلامة المهنية	تكلفة التشغيل	قبل تشغيل المشروع
التأهب للطوارئ	إدارة مخاطر التشغيل	• اعتماد إطار تقييم المخاطر الاحتمالية.	مالك المشروع	خطة الاستجابة للطوارئ	تكلفة التشغيل	قبل تشغيل المشروع
صحة المجتمع وسلامته وأمن الموقع	• خطر الحوادث المرورية • سلامة الموقع	• تطوير خطة لأمن وسلامة الموقع. • تطوير آلية شكاوى وتسجيلها في سجل مخصص.	مالك المشروع	خطة الأمن آلية المشاركة وخطة الشكاوى	تكلفة التشغيل	طوال عمر المشروع

## 7-1 خطة الرصد البيئي والاجتماعي

ضمان الامتثال للمعايير التنظيمية وفعالية إجراءات التخفيف سيتم من خلال إجراء رصد دوري لجودة الهواء ومستويات الضوضاء في أماكن العمل. كما سيقوم المشروع بمتابعة شكاوى المجتمع المحلي بشكل منتظم، بما في ذلك رصد الاحتياجات المحلية (مثل الرعاية الصحية، والمياه، وغيرها)، ودرجة معرفتهم بآلية الشكاوى، وحصص الشكاوى غير المعالجة لضمان التعامل معها بالشكل المناسب.



## الخطة المقترحة للرصد البيئي للمشروع

المستقبلون / مصدر الأثر	نوع الرصد	موقع الرصد	الهدف / المؤشرات	تكرار الرصد	المسؤولية	التنفيذ
مرحلة الإنشاء						
منطقة العمل والمناطق الصناعية المجاورة	قياسات الضوضاء	موقع المشروع والحدود بالقرب من المنطقة الصناعية	الامتثال لمعايير شدة الضوضاء	القياس في موقعين كل ثلاثة أشهر	جميع المقاولين والمقاولين من الباطن، تحت إشراف دندرة	جهة خارجية (جهة بحثية أو معمل معتمد)
	انبعاثات الهواء	موقع المشروع والحدود بالقرب من المنطقة الصناعية	الامتثال لمعايير انبعاث الهواء	القياس في موقعين كل ثلاثة أشهر	جميع المقاولين والمقاولين من الباطن، تحت إشراف دندرة	طرف ثالث (جهة بحثية أو مختبر معتمد)
	التنوع البيولوجي	الموائل والتنوع البيولوجي	موقع المشروع ومنطقه التأثير	• تأمين المخاطر على الحياة البرية والموائل / البيئات الطبيعية	جميع المقاولين والمقاولين من الباطن، تحت إشراف دندرة	العاملين بالمشروع
				• التنفيذ السليم لإجراءات التخفيف		
				• عدد مشاهدات الحيوانات		
	الحيوانات	• عدم وجود أو انخفاض عدد الوفيات (مثل وفيات الطرقات)	التسجيل عند وقوع الحدث			
الآفات	غياب الآفات معايير التنظيف و الترتيب السليمة	يوميًا				
مرحلة التشغيل						
منطقة العمل	قياسات الضوضاء	منطقة المحولات ومغيرات التيار	الامتثال لمعايير شدة الضوضاء	سنويًا	المشروع	طرف ثالث (جهة بحثية أو مختبر معتمد)

المستقبلون / مصدر الأثر	نوع الرصد	موقع الرصد	الهدف / المؤشرات	تكرار الرصد	المسؤولية	التنفيذ
مداخل المولدات الاحتياطية للطوارئ	قياسات العادم	مداخل المولدات الاحتياطية للطوارئ (ثاني أكسيد الكبريت، ثاني أكسيد النيتروجين، أول أكسيد الكربون، الجسيمات الكلية)	الامتثال لمعايير مصادر تلوث الهواء	سنويًا	المشروع	طرف ثالث (جهة بحثية أو مختبر معتمد)
موقع المشروع و محيطه	التنوع البيولوجي ( كما هو الحال في المرحلة الإنشائية)	( كما هو الحال في المرحلة الإنشائية)	( كما هو الحال في المرحلة الإنشائية)	( كما هو الحال في المرحلة الإنشائية)	المشروع	العاملين بالمشروع

## 8- خطة الإدارة الاجتماعية

### 8-1 تحديد وتحليل أصحاب المصلحة

يستعرض هذا القسم مجموعات أصحاب المصلحة التي تم تحديدها للمشروع، مع التأكيد على أن عملية المراجعة والتحديث ستظل مستمرة طوال دورة حياة المشروع. وقد تم تحديد أصحاب المصلحة بناءً على نطاق التأثير (Aoi) والآثار المحتملة للمشروع.

#### مجموعات أصحاب المصلحة

##### أولاً: أصحاب المصلحة الأساسيون

- وهم الجهات أو الفئات التي ستتأثر بشكل مباشر، إيجاباً أو سلباً، بتطوير المشروع. ويشمل ذلك بشكل خاص:
- الفئات منخفضة الدخل والمهمشة، التي غالباً ما تكون مستبعدة من المشاركة في جهود التنمية ونتائجها.
  - منظمات المجتمع المحلي التي قد تمثل هذه الفئات أو تساعد في الوصول إليها، إضافة إلى دعم التواصل مع المجتمع ككل.

##### ثانياً: أصحاب المصلحة الثانويون

- وهم الجهات التي يمكنها التأثير على نتائج المشروع أو دعمه بالمعلومات والخبرات، وتشمل:
- الجهات الحكومية المركزية.
  - الوزارات والهيئات المختصة.
  - الإدارة المحلية والسلطات التنفيذية.
  - وكالات التنفيذ.
  - المؤسسات التمويلية الوطنية والدولية.
  - وسائل الإعلام والمؤسسات الأكاديمية.
- يمثل أصحاب المصلحة الثانويون مصدراً رئيسياً للبيانات والمعلومات المتعلقة بالمنطقة والمشروع. تم إجراء تحليل أولي لأصحاب المصلحة لتقييم أهمية كل جهة ودورها ونهج المشاركة المناسب لكل فئة.

#### تم تحديد أصحاب المصلحة بناءً على المعايير التالية:

- طبيعة المشروع والأنشطة المرافقة له.
- الامتداد الجغرافي وموقع المشروع.
- الجوانب البيئية والاجتماعية والآثار المحتملة للمشروع.

وبناءً على ذلك، تم تحديد مجموعات أصحاب المصلحة الأولية في جدول 9 أدناه.

جدول 9: فئات أصحاب المصلحة

فئة أصحاب المصلحة	أصحاب المصلحة	التأثير، النفوذ، والاهتمامات
أصحاب المصلحة الأساسيون	الأعمال المحلية والصناعات	أصحاب المشروعات الصغيرة في المدن والقرى القريبة، ومنطقة الصناعات الخفيفة بنجع حمادي. الاهتمامات: فرص اقتصادية عبر توريد السلع والخدمات، تأثير محتمل بأنشطة الإنشاء.
	المنظمات المعنية (المنظمات غير الحكومية)	منظمات محلية ووطنية يمكنها توفير السياق الاجتماعي وقنوات التواصل الفعال مع المجتمعات المعنية.
	المجتمعات / السكان المحليون	أقرب التجمعات السكنية لموقع المشروع. الاهتمامات: فرص عمل، منافع اقتصادية، قد تشمل قادة مجتمعيين يمثلون السكان.
	العمال	موظفو الشركة مالك المشروع والمقاولين. الاهتمامات: التعرض لمخاطر الصحة والسلامة المهنية، الاستفادة الاقتصادية.
أصحاب المصلحة الثانويون	الفئات الضعيفة (يتم تحديدها بدقة مع تقدم مراحل التطوير)	النساء، ذوو الإعاقة، كبار السن... إلخ. الاهتمامات: فرص العمل؛ التعرض لمخاطر محتملة مثل تدفق العمالة، العنف القائم على النوع الاجتماعي والتحرش. (GBVH)
	الجهات التنظيمية والهيئات المانحة للتصاريح	هيئة الطاقة الجديدة والمتجددة (NREA)، جهاز شؤون البيئة (EEAA) إدارة تقييم الأثر البيئي. (الدور: الموافقات التنظيمية، الرقابة على الالتزام).
	جهات حكومية أخرى ذات صلة	الشركة المصرية لنقل الكهرباء، وزارة النقل (هيئة الطرق والكباري)، شركة مياه الشرب والصرف الصحي. الاهتمامات: البنية التحتية للخدمات مثل خط النقل الهوائي (OHTL) والمياه والصرف.
	الحكومة المحلية	محافظة قنا، مدينة نجع حمادي. الدور: أهمية سياسية وإدارية، إصدار تصاريح البناء، توفير المرافق والأمن، دعم الإعلان عن الوظائف وتلقي طلبات المجتمع.
	مقدمو الرعاية الصحية وخدمات الطوارئ	المستشفيات الرئيسية والوحدات الصحية القريبة. الاهتمامات: تلبية احتياجات القوة العاملة الكبيرة خلال مرحلة الإنشاء.
	وسائل الإعلام	وسائل الإعلام والصحف المحلية والوطنية. الدور: قناة لنشر المعلومات والتوعية، والتأثير على الرأي العام.

## 8-2 عملية إشراك أصحاب المصلحة والمشاورات السابقة خلال مرحلتي تحديد النطاق وإعداد دراسة

### الأثر البيئي والاجتماعي

نظرًا لأن إشراك أصحاب المصلحة هو عملية مستمرة، ستضمن الأنشطة المستقبلية خلال مراحل ما قبل الإنشاء والتجهيز، ومرحلة الإنشاء، ومرحلة التشغيل، أن تكون عمليات الإفصاح عن المعلومات وأنشطة التشاور فعالة وذات معنى لجميع أصحاب المصلحة طوال دورة حياة المشروع. وقد تم تنفيذ الأنشطة الأولية لمشاورة أصحاب المصلحة خلال مرحلتي تحديد نطاق الدراسة (Scoping) وإعداد دراسة الأثر البيئي والاجتماعي (ESIA) ويعرض الجدول التالي ملخصًا مختصرًا لأنشطة مشاورة أصحاب المصلحة التي تم تنفيذها حتى تاريخه:

## جدول 10: أنشطة مشاورات أصحاب المصلحة

أصحاب المصلحة	القضايا التي تمت مناقشتها
27 يوليو 2025 - اجتماع محافظة قنا	<p>-تركز الاجتماع بشكل أساسي على مسألة تخصيص الأرض والخيارات المحتملة للاختيار، مع التأكيد على أهمية إتاحة أراضي مناسبة لمشروع الطاقة الشمسية وتجنب أي نزاعات محتملة حول الملكية.</p> <p>-مناقشة مخاطر السيول في المواقع المقترحة ومتطلبات الحماية من السيول.</p>
6 أكتوبر 2025 - جهاز شؤون البيئة - (EEAA) الإدارة المركزية للتقييم البيئي	<p>-مكالمة هاتفية مع رئيس مشروعات الطاقة بالإدارة المركزية للتقييم البيئي، تناولت تصنيف المشروع، وتم التوجيه بأن المشروع يصنف فئة (Scoped B) ولا يتطلب عقد جلسات إعلان عام.</p> <p>-أوضح جهاز شؤون البيئة أن رأيه الرسمي بشأن الدراسة سيصدر خلال 30 يوماً من استلام تقرير تقييم الأثر البيئي والاجتماعي.</p> <p>-فترة تنفيذ المشروع تتراوح بين 18 شهراً كحد أقصى، ويُتوقع أن يصل عدد العمال خلال الذروة إلى 5000 عامل، بينما سيبلغ عدد العمال خلال التشغيل نحو 100 عامل.</p> <p>-مؤهلات العمال المطلوبة تشمل العمالة منخفضة ومحدودة المهارة والعمالة الفنية عالية المهارة، مع تشجيع زيادة نسبة العمالة المحلية.</p> <p>-مصادر العمالة ستكون من المجتمعات المحلية المحيطة ومدينة نجع حمادي ومحافظة قنا، وفي حالة نقص المهارات سيتم الاستعانة بعمالة من باقي المحافظات.</p>
27 أكتوبر 2025 - المجلس المحلي لمدينة قنا	<p>-إعلان الوظائف سيكون من خلال محافظة قنا.</p> <p>-آلية لتلقي الشكاوى المتعلقة بالتوظيف من خلال المحافظة أو الشركة، مع قيام Scatec بالتحقيق في كل حالة والرد على نتائج التقييم.</p> <p>-تمت مناقشة ارتفاع أسعار الإيجارات في قرية البركة بسبب المشروعات السابقة، وتم التأكيد أن العمال لن يقيموا في قرية البركة في مشروع دندرة، وأن التركيز سيكون على التوظيف المحلي والمعسكرات داخل الموقع.</p> <p>-التأثير على الموارد المجتمعية (مياه، طعام...إلخ) كان محدوداً وفق التجارب السابقة.</p> <p>-المشروع سيُسهم في توفير طاقة كانت ستستهلكها شركة مصر للألومنيوم، مما يتيح طاقة إضافية للأغراض التنموية الأخرى.</p> <p>-احتياجات المياه يتم توفيرها من محطة مياه نجع حمادي، ومحطة جديدة لمعالجة الصرف تخدم المنطقة الصناعية قيد الإنشاء.</p> <p>-مساحة المشروع لا يمكن توفيرها داخل حدود مصر للألومنيوم، كما أن الانبعاثات الصناعية قد تؤثر على كفاءة ألواح الطاقة الشمسية.</p> <p>-أوضح ممثلو المنطقة أن الفجوة في الأجور قد تكون نتيجة التزام مشروعات الطاقة الشمسية بالحد الأدنى الوطني للأجور، وهو أعلى من أجور المصانع.</p> <p>-إمكانية مشاركة الصناعات في توريد المواد والغذاء للمشروع، وسيتم إعداد قائمة بالصناعات المحلية وتخصصاتها.</p> <p>-الضوضاء الناتجة عن الدقّ لم تصل للمنطقة، لكن الغبار ظهر في بعض الأيام العاصفة، مع تأكيد استمرار تطبيق إجراءات الحد من الغبار.</p> <p>-التأكيد على أهمية التوظيف من المجتمعات القريبة.</p> <p>-معالجة مشكلة السكن من خلال تقليل الإقامة داخل قرية البركة وتوفير مساكن في مناطق حضرية أكبر، واستخدام معسكرات العمال داخل الموقع.</p>
28 أكتوبر 2025 - وحدة الرعاية الصحية بقرية البركة	

القضايا التي تمت مناقشتها	أصحاب المصلحة
<ul style="list-style-type: none"> <li>-لم يتم تسجيل ضغط على الموارد المحلية بسبب تدفق العمال.</li> <li>-المشروع سيسهم في تدعيم الشبكة الكهربائية وتقليل الانقطاعات المتكررة.</li> <li>-تنفيذ مشروعات مجتمعية عبر خطط المسؤولية الاجتماعية للشركة.(CSR)</li> <li>-توضيح مدة التنفيذ وعدد العمال المتوقعين خلال الإنشاء والتشغيل.</li> <li>-شرح سياسات التوظيف وتشجيع متابعة الإعلانات الرسمية والتقديم من خلال المحافظة.</li> <li>-تشجيع النساء على التقديم للوظائف وفق مؤهلاتهن.</li> <li>-استعراض مساهمات الشركة عبر خطط المسؤولية الاجتماعية.(CSR)</li> <li>-التأكيد على التزام الشركة بالتوظيف المحلي وزيادة المحتوى المحلي في مرحلتي الإنشاء والتشغيل، وإعلان الوظائف عبر الموقع الرسمي للمحافظة ومواقع التواصل الاجتماعي.</li> </ul>	<p>جمعية "انفع بلدك" الخيرية</p>
<ul style="list-style-type: none"> <li>-شرح إجراءات التعامل مع ارتفاع أسعار الإيجارات:</li> <li>-تنفيذ تقييم لتدفق العمال والسكن.</li> <li>-مطالبة المقاولين بالابتعاد عن المناطق ذات الحساسية العالية وتوفير مساكن بديلة.</li> <li>-المتابعة المستمرة لضبط الأسعار وتحقيق الاستقرار في السوق المحلي.</li> <li>-المشروع سيسهم في تحسين أداء الشبكة الكهربائية وتقليل الانقطاعات، إلى جانب دعم مشاريع مجتمعية تحقق دخلاً مستداماً.</li> <li>-أشاد الحضور بزيادة النشاط الاقتصادي المحلي واستفادة خدمات الطعام من المشروع دون تأثير سلبي على الأسعار أو التوافر.</li> </ul>	<p>المجتمعات المحلية: قرية نجع مبارك - قرية البركة - هيو</p>



### 3-8 خطة إشراك أصحاب المصلحة (Stakeholder Engagement Plan)

سيقوم المشروع بتعيين مدير للبيئة والمجتمع (E&S Manager) مقره القاهرة مع زيارات ميدانية متكررة للموقع، بالإضافة إلى مسؤول تواصل مجتمعي محلي) مسئول التواصل المجتمعي (يتولى تنفيذ خطة إشراك أصحاب المصلحة (SEP) ستركز أنشطة الإشراك على ما يلي:

- نشر المعلومات المتعلقة بالمشروع.
- مناقشة الآثار والمخاطر المحتملة وكيفية إدارتها.
- جمع آراء ومخاوف أصحاب المصلحة حول المشروع وأنشطته.
- بناء علاقة ثقة بين المشروع وأصحاب المصلحة، بما في ذلك المجتمعات المحلية.
- إنشاء آليات فعالة لتحليل الملاحظات وتطبيق آلية تظلمات فعالة.

#### 3-8-1 قنوات التواصل مع أصحاب المصلحة

سيتم استخدام قنوات الاتصال التالية:

جدول 11: قنوات التواصل مع أصحاب المصلحة

الوصف	الآلية
يمكن استخدام الصفحة الرسمية لمحافظة قنا ومدينة نجع حمادي على فيسبوك كمصدر رئيسي للمعلومات، حيث يزيد عدد متابعيهما عن 5000 عضو. كما يمكن استخدام صفحات المجتمع المحلية.	وسائل التواصل الاجتماعي
موقع الشركة الخاص بالمشروع والذي يتضمن معلومات وتحديثات رئيسية عن المشروع.	البيانات الصحفية عبر الشركة
سيتم نشر إعلانات الوظائف ومعلومات المشروع على موقع المحافظة ومكاتب العمل المحلية والمنظمات الأهلية ووسائل التواصل الاجتماعي.	نشرات (صفحات معلومات)
يمكن تنظيمه من خلال الجمعيات الأهلية، خصوصًا جمعيات المرأة، حيث يعتبر هذا النوع من التواصل هو المفضل لدى المجتمعات. وسيقوم المشروع بتعيين مسؤول تواصل مجتمعي لتعزيز فعالية هذا النوع من المشاركة.	التواصل المباشر (وجهًا لوجه)
سيعد المشروع مناقشات سنوية مع الفئات الضعيفة مثل كبار السن، النساء، غير المتعلمين، الأشخاص ذوي الإعاقة، وأي فئات لا يمكنها المشاركة في الاجتماعات الرسمية.	مجموعات النقاش البؤرية (FGDs) للفئات الضعيفة

#### 4-8 موارد إشراك أصحاب المصلحة

يعرض الجدول التالي الأدوار والمسؤوليات الخاصة بتنفيذ خطة إشراك أصحاب المصلحة (SEP):

جدول 12: الأدوار والمسؤوليات لتنفيذ خطة إشراك أصحاب المصلحة

الأدوار والمسؤوليات	الجهة المسؤولة
الإشراف على التنفيذ الشامل لخطة SEP بما في ذلك التواصل المستمر مع مسؤولي التواصل المجتمعي.	إدارة المشروع
ضمان توفير الموارد المطلوبة (المالية والبشرية واللوجستية) لتنفيذ SEP.	
المشاركة في تنفيذ آلية التظلمات والموافقة على نماذج حل الشكاوى.	

الأدوار والمسؤوليات	الجهة المسؤولة
<ul style="list-style-type: none"> <li>- تحديث خطة SEP وآلية التظلمات بشكل دوري.</li> <li>- تنفيذ ومتابعة استراتيجيات تبادل المعلومات ومشاركة أصحاب المصلحة.</li> <li>- إعداد التقارير للإدارة العليا للمشروع.</li> <li>- التنسيق مع الجهات الحكومية والجهات التمويلية.</li> </ul>	مدير البيئة والمجتمع (E&S Manager)
<ul style="list-style-type: none"> <li>- المشاركة في تحديث الخطة خلال مراحل المشروع (التخطيط، الإنشاء، التشغيل، الإيقاف).</li> <li>- المسؤولية الكاملة عن تنفيذ متطلبات الخطة</li> <li>- التواصل المستمر مع المجتمع المحلي.</li> <li>- إجراء التدقيق الداخلي الشهري وإعداد التقارير لمدير البيئة والمجتمع.</li> <li>- التنسيق مع فريق المقاول EPC.</li> </ul>	مسؤول التواصل المجتمعي) مسؤول التواصل المجتمعي - (ذكور وإناث
<p>يتولى المقاول الرئيسي ومقاولوه الفرعيون التعامل مع الشكاوى المرتبطة بالقوى العاملة الخاصة بهم وتقديم تقارير منتظمة لمسؤول التواصل المجتمعي.</p>	مقاول / EPC مشغل المشروع

## 8-5 خطة العمل الخاصة بالتواصل مع أصحاب المصلحة

جدول 13: خطة التواصل مع أصحاب المصلحة

أصحاب المصلحة	القضايا / المخاوف المحتملة	الرسائل الرئيسية	آلية التواصل	التكرار	المسؤولية
أصحاب المصلحة الرئيسيون					
الأعمال والصناعات المحلية	تقييم قدرات المورد المحليين وحدّ المقاولين على زيادة المحتوى المحلي	الإفصاح عن تحديثات المشروع واحتياجات التطوير	اجتماعات فردية	مرة قبل الإنشاء، وعند الحاجة أثناء الإنشاء	فريق مالك المشروع، ومسؤول التواصل المجتمعي
المنظمات غير الحكومية (NGOs)	مبادرات الاستثمار المجتمعي، دعم الوصول للفئات الضعيفة	معلومات المشروع، الأنشطة المجتمعية (CSR)، والإفصاح عن خطة إشراك أصحاب المصلحة (SEP) وآلية التظلمات	اجتماعات فردية، مجموعات نقاش بؤرية FGDS، منشورات تعريفية بالعربية	عند الحاجة	فريق مالك المشروع، مسؤول التواصل المجتمعي
العمال	مخاطر الصحة والسلامة المهنية، مدونة السلوك، آلية الشكاوى، الفوائد الاقتصادية	معلومات المشروع، متطلبات الصحة والسلامة، والإفصاح عن آلية التظلمات	تدريبات تعريفية، اجتماعات داخلية / محاضرات Toolbox	عند التوظيف، وبشكل مستمر أثناء الإنشاء والتشغيل	فريق الصحة والسلامة HSSE / فريق EPC
المجتمعات المحلية / السكان	توفير العمالة، وتشمل قادة المجتمع المحلي	الإفصاح عن SEP وآلية التظلمات، احتياجات العمالة، الأنشطة المجتمعية CSR	اجتماعات فردية، FGDS	مرة قبل الإنشاء (مع التحديث عند الحاجة)	فريق مالك المشروع، مسؤول التواصل المجتمعي
أصحاب المصلحة الثانويون					
الحكومة الإقليمية (محافظة قنا - مدينة نجع حمادي)	تجديد التراخيص، الأمن، فرص العمل، مبادرات الاستثمار المجتمعي	الإفصاح عن تحديثات المشروع والتطورات	اجتماعات فردية، مراسلات رسمية	مرتين سنوياً أو عند الحاجة	فريق مالك المشروع
هيئة الطاقة الجديدة والمتجددة NREA	إصدار تصاريح التشغيل	الإفصاح عن تحديثات المشروع والتطورات	اجتماعات فردية، مراسلات رسمية	أثناء تطوير ESIA، وعند إصدار التصاريح، وعند الحاجة	مدير البيئة والمجتمع E&S وفريق مالك المشروع

أصحاب المصلحة	القضايا / المخاوف المحتملة	الرسائل الرئيسية	آلية التواصل	التكرار	المسؤولية
جهاز شؤون البيئة EEA	اعتماد دراسة ESIA ، المتابعة، التفتيش على خطة ESMP	الإفصاح عن تحديثات المشروع	اجتماعات فردية، مراسلات رسمية	أثناء الإطار المرجعي والدراسة، وبشكل نصف سنوي أو عند الحاجة	مدير البيئة والمجتمع
مكتب العمل المحلي	فرص العمل، فرص الأعمال، تصاريح العمل	الإفصاح عن تحديثات المشروع	اجتماعات فردية، مراسلات	قبل التعاقدات الفرعية، وبشكل نصف سنوي أو عند الحاجة	مدير البيئة والمجتمع، مسئول التواصل المجتمعي، الموارد البشرية
مقدمو الخدمات الصحية	التعامل مع إصابات الطوارئ، أنشطة مسؤولية مجتمعية	مخاطر الصحة والآثار وخطط التخفيف	اجتماعات فردية، مراسلات	عند الحاجة	مدير البيئة والمجتمع، مسئول التواصل المجتمعي
مقدمو التعليم (المعاهد الفنية والمهنية)	تحديثات المشروع، فرص التدريب	متطلبات المهارات، الإفصاح عن معلومات المشروع	اجتماعات فردية	عند الحاجة	مدير البيئة والمجتمع، الموارد البشرية، مسئول التواصل المجتمعي
الجهات الحكومية الأخرى المعنية بالمرافق مثل وزارة النقل وشركة المياه والصرف الصحي	تحديثات المشروع ومتطلبات المرافق والتخطيط	الإفصاح عن معلومات الإنشاء والجدول الزمني واحتياجات المشروع	اجتماعات فردية، مراسلات	عند الحاجة	فريق مالك المشروع

## 6-8 الترتيبات المؤسسية

سيتم إدارة خطة إشراك أصحاب المصلحة (SEP) من خلال مسؤول التواصل المجتمعي (CLO) يوضح الجدول أدناه الأدوار والمسؤوليات المؤسسية الخاصة بتنفيذها.

جدول 14: توزيع الأدوار والمسؤوليات

الجهة المسؤولة	الأدوار والمسؤوليات
إدارة المشروع	الإشراف على التنفيذ الشامل للخطة ، بما في ذلك التواصل المستمر مع مسؤولي التواصل المجتمعي
	ضمان توفير الموارد اللازمة (الميزانية، الموارد البشرية، واللوجستية) .
	المشاركة في تنفيذ متطلبات آلية الشكاوى الخاصة بأصحاب المصلحة، بما في ذلك توقيع نماذج حل الشكاوى حسب الاقتضاء .
	التحديث المنتظم للخطة وآلية التظلمات.
مدير البيئة والمجتمع (E&S Manager)	تنفيذ ومتابعة استراتيجيات تبادل المعلومات ومشاركة أصحاب المصلحة.
	رفع التقارير إلى إدارة المشروع.
	التنسيق مع الجهات الحكومية والجهات الممولة.
	المشاركة في تحديث الخطة حسب الحاجة خلال دورة حياة المشروع، بما في ذلك مراحل التخطيط، الإنشاء، التشغيل، وإيقاف التشغيل.
مسؤول التواصل المجتمعي (CLO) - منكم وإناث	المسؤولية الكاملة عن تنفيذ متطلبات الخطة.
	التواصل والتفاعل المباشر مع المجتمع المحلي.
	رفع التقارير إلى إدارة البيئة والمجتمع.
	التنسيق مع فريق مقاول EPC.
مقاول / EPC مشغل المشروع	للمقاول الرئيسي (EPC) والمقاولين من الباطن دور في معالجة الشكاوى المجتمعية المتعلقة بقوتهم العاملة، وإبلاغ مسؤول التواصل المجتمعي بها.

**Scatec**

**Dandara PV Power Plant and BESS in Nagaa  
Hammadi**

***Qena governorate***

***EXECUTIVE SUMMARY***

**Prepared by:**



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## 1. Overview of the Project

### 1.1 Background

Scatec company intends to establish a power plant 1000 Megawatt (AC) coupled with a Battery Energy Storage System (BESS) with a capacity of 200 Megawatt hour which will be built over 2 phases, through its affiliated Company Dandara for Solar Energy, S.A.E., the first phase will have a capacity of 500 Megawatt (AC) coupled with a Battery Energy Storage System (BESS) with a capacity of 100 Megawatt hour. The second phase will be a duplicate of the first phase. The current study focuses on the first phase only. The proposed project is located in Qena Governorate, east of the Nagaa Hammadi Industrial Zone, and near the Egypt Aluminium Company (EgyptAlum) complex. The site has been allocated by the Egyptian government to NREA for Renewable Energy Project.

The project is being implemented in collaboration with international financing institutions, including the European Bank for Reconstruction and Development (EBRD), and the African Development Bank (AfDB). This demonstrates international partners' confidence in Egypt's sustainable investment climate and its capacity to deliver projects with lasting environmental and economic benefits.

Environics was assigned by Dandara to develop the project's ESIA according to the national laws as well as the environmental requirements of the EBRD, and the AfDB.

### 1.2 Goals

Dandara Solar Power Plant Project represents a strategic step in Egypt's efforts to transition to a low-carbon economy and promote the use of renewable energy in industrial sectors, in line with Egypt Vision 2030 and the Sustainable Development Goals.

The Project will enhance the reliability of solar power generation in Egypt by incorporating battery storage, enabling the country to meet its declared renewable energy targets. This project is significant for Egypt, as its implementation will pave the way for a broader rollout of storage-integrated renewable projects, helping to address the challenges posed by the intermittent nature of renewable energy sources. It will also support the country's efforts to increase its renewable energy share of total energy generation.

### 1.3 Objectives

The objective of the ESIA is to ensure that the project is environmentally sound and socially sustainable and that any potential negative environmental consequences

are recognized early in the project cycle and taken into account before project implementation. It also aims to propose appropriate mitigation measures to prevent/reduce potential negative impacts during the construction and operation of the proposed project, to be within the limits of legal environmental and social requirements.

Moreover, the ESIA aims to satisfy the legal environmental requirements, addressed in the Environment Law No. 4 of 1994, amended by Law No. 9 of 2009 and Law No. 105/2015, and the up-to-date Executive Regulations.

Moreover, the ESIA is also intended to satisfy the environmental and social requirements of the international funding institutions, including specifically the European Bank for Reconstruction and Development (EBRD), the African Development Bank (AfDB), European Investment Bank (EIB), and Cassa depositi e prestiti S.p.A. (CDP), as well as the multilateral development banks.

## 1.4 Project Location

The usufruct land, allocated for phase 1 and 2, spans approximately 2335 ha ( $\approx 23,350,000 \text{ m}^2$ ) of which 1130 ha ( $\approx 11,300,000 \text{ m}^2$ ) are designated for the first phase for the development of the 500MWac solar power project. The site is located in a desert area to the east of the Nagaa Hammadi Industrial Zone within Qena Governorate. It lies south-east of the Nagaa Hammadi Aluminum Complex (EgyptAlum) and is positioned adjacent to the existing substation for the Nagaa Hammadi Industrial Zone.

The Giza – Luxor Road lies approximately 1.2 kilometers north of the project site. The site can be accessed via an unpaved road extending westward for about 2.5 kilometers from the Giza–Luxor Road, or through another unpaved road extending approximately 2.5 kilometers westward from the Qena–Luxor Desert Road.

The nearest residential settlement, El Baraka Village, is located approximately 4 km northwest of the project boundary. Additionally, a few scattered reclaimed agricultural areas are found within the broader vicinity. Figure 1 below shows the activities/land uses surrounding the proposed site.

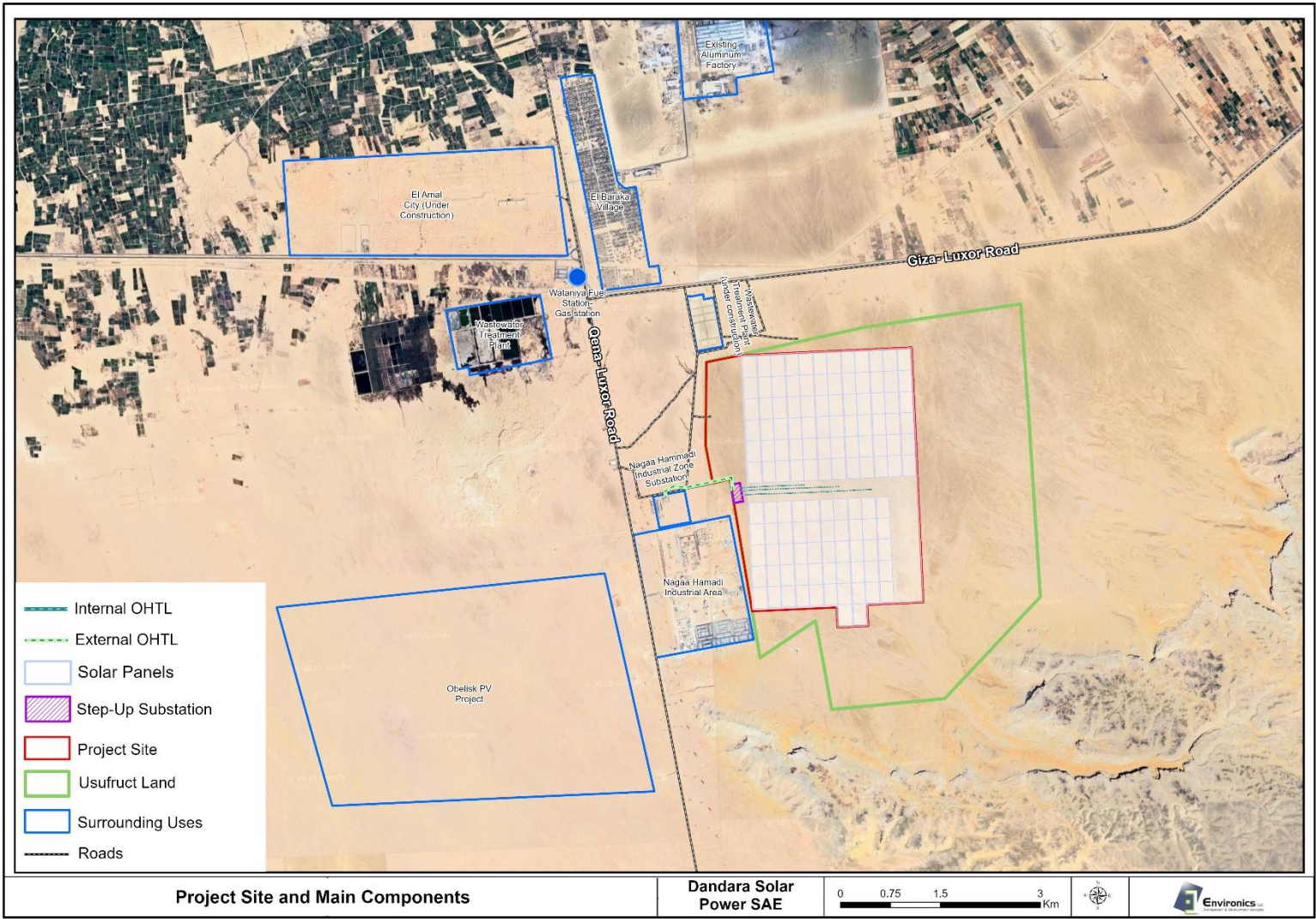


Figure 1: Proposed Project Location and the Surrounding Activities



## 2. Project Description

### 2.1 General Outline

The Photovoltaic Power Plant will utilize high-efficiency mono-crystalline silicon solar panels along with single-axis tracking systems (horizontal single axis tracker -1P) to maximize energy capture. Additionally, a BESS using lithium-ion battery modules will be integrated to store and manage the generated energy.

The project will be connected to the national grid through an overhead transmission line (OHTL) to be constructed by Dandara Solar Power, linking the project substation to the existing Nagaa Hamadi Industry Park Substation. The generated electricity will then be wheeled to EgyptAlum through the existing electricity grid infrastructure.

### 2.2 Project Components

#### a) Component 1: Solar field Photovoltaic modules: High-efficiency mono-crystalline silicon solar panels.

- **Solar Panels**

The PV plant comprises approximately 903,960 high-efficiency, bifacial, monocrystalline silicon photovoltaic modules, each rated at 630 W, providing a total DC capacity of around 569.49 MW. The modules are connected in series to generate DC power from solar irradiance, with key design parameters including panel orientation, row spacing, and tilt angle.

- **Mounting Structures**

PV modules will be installed on a single-axis horizontal tracking system with a maximum height of approximately 2.8 meters and a tracking range of -55° to +55°. The following table describes the PV module.

The PV arrays will be spaced appropriately, considering local topographic conditions. This spacing is designed to minimize shading effects and optimize solar exposure, ensuring maximum efficiency and environmental compatibility.

**Table 1: Module Description (500 MWac)**

No	Item Description	Unit	Total Qty for 500MWac
1.	PV Modules (630Wp)	Nos	903960
2.	Substructure –Tracker	Tables	10044
3.	No. of PV Module per table	Module	90
4.	Inverter	Nos	496
5.	No. of blocks/ MV transformer station	Nos	62
6.	Technology	----	Bifacial
7.	BESS Container	Nos	20

- **Inverter Systems**

- **Inverters**

The project will utilize 496 inverters to convert the DC generated by the photovoltaic modules into AC for use in the power grid. These inverters will handle the conversion process, ensuring efficient energy transmission. The project will employ PV inverters with a total capacity of 545.6 MVA, and approximately 164.34 MVar of reactive power will be supplied by both the BESS and PV Inverters together.

- **Switchgear**

The electrical equipment used to manage and protect the medium voltage (33kV) circuits before the voltage is stepped up to 220kV for transmission. This switchgear is crucial for ensuring the safe and efficient operation of the electrical system within the substation.

## **b) Component 2: BESS**

A Solid-State Battery consists of multiple battery cells assembled into modules. Each cell contains a positive electrode, a negative electrode, and an electrolyte. The lithium-ion BESS primarily uses lithium nickel manganese cobalt oxide (NMC) or lithium iron phosphate (LFP) for its cathodes.

The BESS will comprise multiple battery units or modules housed in shipping containers or suitable housing structures, delivered pre-assembled to the project site. These containers are typically elevated slightly off the ground and arranged in rows.

Supplementary infrastructure and equipment include temperature control equipment, which may be positioned between the battery containers. The solid-state batteries under consideration are Lithium-ion systems.

### **Key Components of the BESS**

#### **1. Battery Modules**

- The core of the BESS, typically lithium-ion batteries with a designed capacity of 100 MWh and a dispatchable capacity of 50 MWac AC-coupled BESS, with no augmentation (degrades over the project lifetime)
- Connected in series and parallel to achieve the required capacity.
- Housed in weatherproof, insulated containers to protect from environmental conditions.
- BESS is designed to operate on only one full cycle per day. Once the BESS is charged to 100% State of Charge (SoC), it could accommodate Ancillary Services and load shifting if agreed by all parties. However, upon the first measurement of 0% SoC, all services will be suspended for the remainder of the day.
- The BESS can store energy and then release it during the specified time frame as agreed with the off taker, depending on how much of its capacity is allocated for Ancillary Services. Ancillary Services are essential for maintaining the stability and reliability of the power grid.

## 2. Battery Management System (BMS)

The BMS is an essential component of the battery-based energy storage system. Some of the main tasks performed by the BMS include:

- Voltage and Current Monitoring: to ensure they operate within safe limits.
- Charge Balancing ensures balanced charging among all cells in the battery, which helps improve performance and extend battery life.
- Temperature Monitoring: The BMS monitors the battery temperatures and activates cooling or heating systems as needed to maintain optimal temperatures.
- Protection system: It protects against abnormal conditions such as overcharging, over-discharging, and short circuits.
- Diagnostics and Maintenance: The BMS provides regular reports on the battery status and helps detect potential faults before they cause significant problems.

## 3. Cooling and Ventilation Systems

During charging and discharging, batteries generate heat that must be controlled to prevent performance degradation or fire risk. A liquid-cooled temperature control system is utilized to maintain safe operating conditions and optimize auxiliary power consumption for cooling fans.

## 4. Control and Monitoring Systems

- Provides real-time data on the performance of the BESS.
- Components include SCADA systems, sensors, and communication interfaces.

## 5. Auxiliary Systems

- Includes lighting, emergency power supplies, and fire suppression systems.
- Supports the safe and reliable operation of the BESS.

### c) Component 3: Internal Medium Voltage Overhead Transmission Line (MV OHTL) Corridor

An internal 33 kV medium-voltage overhead transmission line (OHTL) corridor will be established within the project site boundary to collect and transmit electricity generated from the distributed PV arrays to the on-site substation. The internal 33 kV OHTL comprising about 12 towers network will extend over a span of 2.7 kilometers, running west to east across the central part of the project site. The lines will be supported on steel towers averaging 28 meters in height, with a potential maximum of up to 34 meters depending on the terrain and technical design requirements.

### d) Component 4: Connection to the Grid

This component involves the development of one main step-up substation within the project boundaries. This facility will ensure the efficient transmission of generated power, enhance operational flexibility, and maintain stability and reliability across the national grid.

A 33/220 kV pooling substation will be constructed within the project site to step up the electrical output from the PV plant's 33 kV medium-voltage collection system to 220 kV for efficient long-distance transmission and integration into the national grid. The substation will house two step-up transformers, each rated at 300 MVA, providing a total installed capacity of 600 MVA. Each power transformer will be of the ONAF Type (Oil Natural Air Forced) featuring oil-filled tanks for insulation and cooling. Externally forced Air cooling, provided by multiple fans, will be employed to maintain optimal operating temperatures, thereby enhancing transformer efficiency and extending service life.

**e) Component 5: Overhead Transmission Line (OHTL)**

The proposed project includes the construction of a 220 kV overhead transmission line to facilitate the evacuation of power from the solar PV plant to the national grid. The OHTL will connect the 33/220 kV step-up substation located within the project site to the existing 220 kV Nagaa Hammadi Industrial Zone Substation, situated approximately 1 kilometer to the west of the proposed new 33/220 kV substation.

The OHTL will traverse limited path along government-owned desert land, requiring the installation of transmission towers and the establishment of a right-of-way (ROW) corridor (about 1 km).

The new OHTL will be routed along very limited area, which will help minimize visual, land use, and ecological impacts.

## 2.3 Project Schedule

The Dandara Solar Power Project is planned to commence in the second quarter of 2026, following the receipt of all required permits and approvals. The total implementation period is estimated at approximately 15 months, from March 2026 to June 2027, covering all site establishment, civil, electrical, and mechanical works.

## 2.4 Project Phases

The Project will include three main phases: Construction, Operation, and Decommissioning.

**a) Construction Phase**

Major on-site activities will include civil works, construction of buildings, installation of equipment and utilities, and testing and commissioning of equipment. Key activities during the construction phase include:

- Site preparation: Includes land surveys, ground levelling, and clearing; concrete works, utility installations, and laydown areas for materials and equipment.

- Panel and access road construction: Installation of PV panel supports and development of a 1.5 km gravel access road connecting the site to the main road, along with internal gravel roads for equipment movement and operations.
- Stormwater and drainage system: Protection against flash floods through a trapezoidal open channel or compacted earthen berm along the eastern fence line, designed to follow natural drainage paths and accommodate a 100-year flood event with erosion control and energy dissipation measures.
- Fencing and gates: The entire site will be enclosed with perimeter fencing and main/emergency gates, while the HV substation and O&M building will have separate fencing for enhanced security and safety.

### **Workers Accommodation**

During the construction phase, workforce accommodation will be arranged through a combination of on-site and off-site facilities, depending on workers' roles and their permanent residence. The primary accommodation will be a dedicated camps within the project site, while subcontractors may arrange additional housing for non-local workers, if needed, in rented apartments within nearby villages and urban centres. However, all contractors will be encouraged to continuously increase percentage of local workforce.

All accommodation will comply with Good International Industry Practice, EBRD PR2, IFC PS2, the 2009 IFC/EBRD "Workers' Accommodation" guidelines, Egyptian Labour Law No. 14/2025, relevant safety decrees, and Civil Defense fire-safety requirements.

### **Temporary structures**

During the construction phase, the following facilities are required on site to service employees, contractors, and employer's representatives (laydown areas).

- Offices for the employers (air-conditioned)
- Mess / eating facilities
- Sanitary facilities

When the construction work is completed, most of the temporary structures and facilities will be dismantled.

## **b) Operation Phase**

Once construction is complete, the clean energy will be generated and stored. Key activities include:

- Energy Production: The solar panels convert sunlight into electricity, which is fed into the grid.
- Battery Storage & Management: The BESS stores excess energy during the day and releases it in the evening to stabilize the power supply.
- System Monitoring & Maintenance: Regular inspections, cleaning, and repairs of panels, inverters, and batteries to ensure efficiency.

- Safety & Compliance: Continuous monitoring of environmental and safety standards, including temperature control, fire prevention, and worker safety measures.

### c) Decommissioning Phase

At the end of the project's life span, the site will be safely dismantled and restored. Activities include:

- Removal of Equipment: Solar panels, batteries, and supporting structures will be safely dismantled.
- Recycling and Waste Management: Reusable components will be recycled, while hazardous materials will be disposed of according to environmental regulations.
- Site Restoration: The land will be restored to its original state or re-purposed for other sustainable uses.

## 2.5 Environmental and Social Aspects

Based on the project components, the key environmental and social aspects of the PV project are summarized in Table 2 for both construction and operation phases:

**Table 2: Project E&S aspects**

Environmental & Social Aspects		Source(s)	
		Construction phase	Operation phase
Land Uptake	Land Access Restriction	- Project infrastructure and assets (e.g., laydown areas, temporary facilities, and site security)	- Project infrastructure and asset (e.g., fenced PV field, substations, BESS) security
	Land Transformation	- Site clearing, leveling, grading - Excavation for foundation construction - Lay down area - Substation construction - Construction of temporary facilities (e.g., construction workforce camps)	Permanent transformation of the project footprint, fully stripped of its natural state.
	Land Acquisition	- Potential private ownership or land use along the OHTL (associated facility) - The project site itself is state-owned desert land	- N/A
Transportation Demand		- Transportation of project components - Transportation of machinery & equipment - Transportation of water, fuel, and other materials for construction activities - Transportation of workers to and from project sites and accommodation camps	- Limited transportation needs for O&M workforce, spare parts, and maintenance equipment.



Environmental & Social Aspects	Source(s)	
	Construction phase	Operation phase
<b>Workers Influx</b>	<ul style="list-style-type: none"> <li>- Skilled and non-skilled construction workers (site preparation activities, assembly, technical installations, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>- Limited workforce</li> </ul>
<b>Worker welfare</b>	<ul style="list-style-type: none"> <li>- In the work environment</li> <li>- In the workers' camp</li> </ul>	<ul style="list-style-type: none"> <li>- In the work environment</li> <li>- In the workers' camp, if any</li> </ul>
<b>Water Demand</b>	<ul style="list-style-type: none"> <li>- Construction activities (preparation of concrete)</li> <li>- Potable (drinking) water</li> <li>- workers (workforce accommodation, sanitation, catering &amp; other facilities)</li> <li>- Dust suppression</li> </ul>	<ul style="list-style-type: none"> <li>- Limited O&amp;M workforce, sanitation, and other facilities.</li> <li>- Panel cleaning.</li> </ul>
<b>Noise &amp; Vibration</b>	<ul style="list-style-type: none"> <li>- Site preparation grading, leveling, clearing, concrete mixing, trucks, deliveries, piling/ramming works.</li> <li>- moving machines (mixers, tippers, communicating workers)</li> <li>- Incoming vehicles to deliver construction materials, components, and workers to the site</li> <li>- Installation of the components (especially ramming machines)</li> </ul>	<ul style="list-style-type: none"> <li>- Limited activities from O&amp;M (inverters, transformers, cooling fans, and trackers)</li> <li>- Limited Worker's transportation and maintenance activities</li> </ul>
<b>Dust/Particulate Matter/Gaseous Emissions</b>	<ul style="list-style-type: none"> <li>- Site preparation (site clearance, excavation, and spreading of the topsoil)</li> <li>- Movement of vehicles across dirt/unpaved roads, topsoil, and excavated soil handling</li> <li>- Increased traffic flows (vehicle emissions)</li> <li>- Emissions from onsite diesel power generators</li> </ul>	<ul style="list-style-type: none"> <li>- Negligible – only workforce transport and minor maintenance vehicles.</li> </ul>
<b>Wastewater Generation</b>	<ul style="list-style-type: none"> <li>- Domestic waste from a large number of workers</li> </ul>	<ul style="list-style-type: none"> <li>- Limited generation from sanitation facilities</li> </ul>
<b>Waste Generation (Hazardous and non-hazardous)</b>	<p><b>Non-hazardous</b></p> <ul style="list-style-type: none"> <li>- Construction material packaging, debris. and waste</li> <li>- Non-hazardous off-cuts</li> <li>- Domestic waste from workforce (e.g., food waste, plastic bottles &amp; cans, Paper, and Glass)</li> </ul> <p><b>Hazardous</b></p> <ul style="list-style-type: none"> <li>- Empty containers of hazardous substances</li> <li>- waste paints, coatings, adhesives, cleaning solvents</li> <li>- Spent lubricating oils and hydraulic fluid</li> </ul>	<p><b>Non-hazardous:</b></p> <p>Limited quantities of</p> <ul style="list-style-type: none"> <li>- O&amp;M material packaging (e.g., spare parts)</li> <li>- Domestic waste from workforce (e.g., food waste, plastic bottles &amp; cans, glass, and mud)</li> <li>- Paper &amp; other office supplies</li> <li>- Cardboard.</li> </ul> <p><b>Hazardous</b></p> <ul style="list-style-type: none"> <li>- Absorbent material, waste oil from machinery lubricants</li> <li>- Empty containers of hazardous substances</li> <li>- Waste cleaning solvents</li> <li>- End-of-life lithium batteries</li> </ul>
<b>Visual Aspects</b>	<ul style="list-style-type: none"> <li>- Heavy construction machinery, equipment, and vehicles</li> </ul>	<ul style="list-style-type: none"> <li>- PV panels are alien to the desert landscape</li> </ul>
<b>Glare</b>	N/A	<ul style="list-style-type: none"> <li>- Sunlight reflected off the modules and the metal mounting structure</li> </ul>
<b>Electromagnetic waves</b>	N/A	<ul style="list-style-type: none"> <li>- Substation and Transformer</li> <li>- Switch gears</li> </ul>

Environmental & Social Aspects	Source(s)	
	Construction phase	Operation phase
		- Transmission Lines (associated facility)
Lake effect	N/A	<ul style="list-style-type: none"> <li>- Smooth and uniform appearance of PV solar plants, similar to a sheet of water, as they reflect light just as a lake or a pond is said to attract birds</li> <li>- For PV panels with a tracking system, this will happen only during a short portion of the day</li> </ul>

## 2.6 Area of Influence

The identified project E&S aspects within the project's direct area of influence are described in the tables below.

**Table 3: Environmental and Social Aspects AoI during the construction phase**

Environmental & Social Aspects		Area of Influence (AoI)
		Construction phase
Land uptake	Land Access Restriction	the project footprint
	Land Transformation	the project footprint
	Land Acquisition (for the transmission line)	The project area and the transmission line are on government-owned desert land (1km to the substation)
Transportation Demand		<p>The project site can be accessed through the national and regional road network linking the Red Sea ports with Upper Egypt. The following main corridors and right-of-way (ROW) options are relevant for the transportation of imported equipment and materials:</p> <ul style="list-style-type: none"> <li>From Red Sea Ports (Ain Sokhna / Adabeya): Cargo can be transported westward via the Red Sea coastal highways towards Safaga Port and then inland.</li> <li>Safaga – Qena Corridor: The Safaga–Qena Road provides a direct inland route across the Eastern Desert, leading to the Qena Bridge over the Nile, offering access into Upper Egypt.</li> <li>Eastern Desert Road – Luxor Bridge Option: Alternatively, the Eastern Desert Highway can be used to reach the Luxor Bridge, providing another Nile crossing point south of Qena.</li> <li>Connection to Giza–Luxor Road: Both Nile crossings (Qena Bridge or Luxor Bridge) link to the Giza–Luxor (Western Desert) Road, which serves as the principal north–south arterial route along the west bank of the Nile.</li> <li>Site Access: From the Giza–Luxor Road, access to the project site is gained through the industrial area access road, located east of the corridor, leading directly to the designated project location.</li> </ul>
Workers Influx		The nearest communities are located in Baraka village, approximately 4 km from the project site.
Water Demand		To be trucked from the nearest water supply plant.
Wastewater		To be trucked from the nearest wastewater plant
Waste Generation		To be trucked from the nearest waste management facility
Noise & Vibration		The immediate project footprint and construction areas
Dust/Particulate Matter/Gaseous Emissions		The immediate vicinity of the project area (A general default distance of 350 m to be considered for dust effects, (IAQM, 2012)

Environmental & Social Aspects	Area of Influence (Aoi)
	Construction phase
<b>Biodiversity Disturbance</b>	Desert habitat along the site footprint and OHTL alignments
<b>Community Health &amp; Safety</b>	Baraka Village (nearest settlement), roadside communities along transport routes.

Table 4: Environmental and Social Aspects Aoi during the operation phase

Environmental & Social Aspects		Area of Influence (Aoi)
		Operation phase
<b>Land Uptake</b>	<b>Land Access Restriction</b>	Project footprint
	<b>Land Transformation</b>	Project Footprint
	<b>Land Acquisition</b>	N/A - no new land anticipated during O&M.
<b>Transportation Demand</b>		Limited needs for the same roads as for construction for transportation during O&M
<b>Workers Influx</b>		N/A .
<b>Water Demand</b>		Limited needs during O&M; supply to be secured either through trucking or a dedicated water connection.
<b>Noise &amp; Vibration</b>		Limited to the workplace - Localized within the project footprint, primarily from inverters, transformers, and occasional vehicle movements.
<b>Dust/Particulate Matter/Gaseous Emissions</b>		N/A
<b>Visual Aspects</b>		The project site boundaries
<b>Glare</b>		<p>Potential glare impacts on nearby receptors are considered minimal.</p> <ul style="list-style-type: none"> <li>- The nearest airport is Luxor Airport (~50 km away), with a NNE–SSW runway orientation; no significant glare risk is expected.</li> <li>- Potential glare toward the Giza–Luxor Road is expected to be limited, as this corridor lies about 3 km north of the site and is partially shielded by on-site infrastructure, including the substations, BESS complex, and O&amp;M facilities located along the western and southwestern boundaries. These structures effectively block potential reflected sunlight from the PV modules toward the road user.</li> </ul>

Environmental & Social Aspects	Area of Influence (Aoi)
	Operation phase
	Overall, based on the above, the glare potential to off-site receptors—such as airports, roads, and nearby communities—is considered negligible.
<b>Electromagnetic waves</b>	<ul style="list-style-type: none"> <li>- Project footprint.</li> <li>- Along the OHTL corridor: within a Right of Way (RoW) of 25 m on each side of the transmission line.</li> </ul>

Based on the two tables above, the Aoi during the construction phase includes the project site and its immediate surroundings. During operation, although the IFC standards do not define a specific extent of the Aoi for solar panels' projects, previous studies proposed best practices that consider a buffer area of 1 km from the project site boundaries (ERM, 2018; Masdar, 2022). Accordingly, the Aoi considered for the project extends for 1 km from the project site boundaries.

### 3. Environmental and Social Legislation and Regulations Related to the Project.

#### 3.1 National Legislations

As per Egypt's Environmental Law 4 of 1994 (as amended by Laws 9 of 2009 and 105 of 2015), an Environmental Impact Assessment (EIA) must be conducted for new projects. The New and Renewable Energy Authority (NREA) serves as the Competent Administrative Authority (CAA) for this project, overseeing the submission and review process through the Egyptian Environmental Affairs Agency (EEAA).

The EEAA classifies projects into four categories (A, B, Scoped B, and C) based on their potential environmental impact. The Dandara PV Plant and Battery Energy Storage System (BESS) are classified as a Scoped B project, meaning a full Environmental and Social Impact Assessment (ESIA) is not required, and public consultation is not mandatory.

The table below lists the key relevant legislation and regulatory entities associated with each environmental and social parameter assessed within this ESIA. Throughout the following chapters, reference is made to the applicable legislative requirements under each relevant parameter.

**Table 2: National Regulations and Laws**

<b>Legislation Related to the Project</b>
Management of non -hazardous solid waste and hazardous waste generated from the facility during generation, handling, transportation and disposal
Law 4/1994 amended by Law 9/2009, and its ER 1095/2011, amended by Decree 710/2012
Law 202/2020 on waste management and its executive regulation 722/2022 and 1113/2024
Biodiversity Protection
Article 28 of the Environmental Law 4 of 1994
Annex 4, as amended by ERs 1095 of 2011 of the Environmental Law 4 of 1994,
Law 102 of 1983 Concerning Natural Protected Areas
Law 53 of 1966 (the Law of Agriculture) and amended by Decree 1227 of 1988
Cultural Heritage
Antiquities Protection Law 117/1983 amended by Laws 3/2010, 61/2010, 91/2018 and 20/2020
Air quality and noise
Article 36 of Environmental Law 4/1994 and Article 37 of ER 1095/2011
Article 35 of Environmental Law 4/1994, article 34 of its modified ER 1741/2005, and annex (5) of modified ER 710/2012
Article 42 of Environmental Law 9/2009 and Article 44 of its modified ER (1095/2011)
Annex 7 of the ER replaced by Decree 710/2012
Executive regulations 81/2023 amended by decree 164/2025
Register/Records: Environmental Register & Hazardous Materials & Waste Register
Article 22 of Environmental Law 9 of 2009

Article 17 of Law 1741 of 2005 Article 17 and Annex 3 of the executive Regulation.
Article 56 of Waste Law 202 of 2020
Appendix (3) of the ERs of Environmental Law 4/1994
Article 50 and Appendix (7) of the ER of Waste Law 202/2020 on waste management and its executive regulations (654/2021)
<b>Workplace Emissions</b>
The Ministerial Decree 134/2003 concerning committees for vocational safety and health
Ministerial Decree 211/2003 concerning safety levels, precautions, and terms to prevent detrimental physical, chemical, biological, and mechanical hazards
<b>Workplace Noise</b>
Annex 7 of the ER 710/2012 of the Environmental Law 4/1994, amended by decree 2466/2024.
<b>Occupational health and safety</b>
Law 14/2025 on Labour and Workforce Safety
Ministerial decree 211/2003 concerning safety levels, precautions, and terms to prevent detrimental physical, chemical, biological, and mechanical hazards
<b>Child Labour</b>
Article 64 of the “Child Law” 12/1996
Articles 62, 63, 64, and 65 of the Labor Law 14/2024
Decree 215/2021 regarding the child employment and training
<b>Persons with Disabilities</b>
Law 10 of 2018 amended by Law 156/2021 on the Rights of Persons with Disabilities
Article 37 of Labour Law 14/2025
<b>Equal opportunities</b>
Article 9 of the Egyptian Constitution
Article 5 of Labour Law 14/2025
Law 10/2018 related to the rights of people with disabilities
<b>Protection from Harassment</b>
Article 254 of Labour Law 14/2025
Anti-harassment Law 141/2021
<b>Grievance</b>
Article 85 of the Egyptian Constitution
Article 103 of the Environmental law 4/1994
<b>Community Investment:</b>
the Egyptian Investment Law 72/ 2017

## 3.2 Strategic National Initiatives

### Egypt National Climate Change Strategy (NCCS) 2050

Launched in May 2022, the NCCS 2050 provides a roadmap for Egypt’s climate action through five key pillars: mitigation, adaptation, governance, financing, and scientific research.

The PV and BESS projects contribute to the following national objectives:



- Renewable Energy Goals: Supporting Egypt's target of achieving 42% renewable energy by 2035.
- Climate Resilience: Incorporating measures to withstand extreme weather conditions in Qena.
- GHG Emissions Reduction: Replacing fossil fuel-based energy with renewable sources.
- Sustainable Development: Aligning with Egypt's Vision 2030 for low-emission economic growth.

### **Nationally Determined Contribution (NDC)**

Egypt signed the Paris Agreement in 2016 and ratified it in 2017, outlining its commitments to GHG emission reduction and climate adaptation. The updated NDC (2023) includes the following key elements:

- Sectoral Emission Reductions: Targeting key sectors including energy, oil and gas, transport, industry, waste management, and tourism.
- Oil & Gas Sector Targets: Reducing emissions from 2,575 Gg CO<sub>2</sub>-eq (BAU scenario) to 0.89 Gg CO<sub>2</sub>-eq by 2030 through the use of cleaner fuels and alternative energy sources.

### **Egypt's National Strategy for the Empowerment of Egyptian Women 2030**

Launched in 2017, this strategy aims to promote women's empowerment across four key pillars:

- Political Empowerment: Increasing women's participation and leadership in decision-making roles.
- Economic Empowerment: Expanding employment opportunities and supporting female entrepreneurship.
- Social Empowerment: Enhancing access to education, healthcare, and social services.
- Protection and Response: Addressing and preventing all forms of violence against women.

## **3.3 International Conventions**

### **Biodiversity Conventions**

Egypt has ratified several international agreements aimed at protecting biodiversity, including:

- AEWA (1995): Protects migratory waterbirds and their wetland habitats.
- UNCBD (1992): Promotes the sustainable management of biological diversity.
- CMS (1979): Ensures the conservation of migratory species.
- CITES (1973): Regulates international trade in endangered species.
- African Conservation Convention (1968): Promotes the sustainable use of natural resources.

### Climate Change Conventions

Egypt has taken significant steps to address climate change through the ratification of:

- UNFCCC (1992): Establishes a global framework for addressing climate change.
- Kyoto Protocol (1997): Sets binding emission reduction targets.
- Paris Agreement (2016): Aims to limit the global temperature increase to below 2°C.

### Cultural Heritage Conventions

Egypt is committed to safeguarding its cultural heritage through:

- UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage (2003): Protects traditions, expressions, and traditional knowledge.
- World Heritage Convention (1972): Identifies and preserves sites of cultural and natural heritage.

### Work Environment Conventions

Egypt adheres to international labor standards established by the International Labour Organization (ILO):

- Freedom of Association and Protection of the Right to Organize Convention, 1948 (No. 87)
- Right to Organise and Collective Bargaining Convention, 1949 (No. 98)
- Forced Labour Convention, 1930 (No. 29) and its 2014 Protocol
- Abolition of Forced Labour Convention, 1957 (No. 105)
- Minimum Age Convention, 1973 (No. 138)
- Worst Forms of Child Labour Convention, 1999 (No. 182)
- Equal Remuneration Convention, 1951 (No. 100)
- Discrimination (Employment and Occupation) Convention, 1958 (No. 111)
- Occupational Safety and Health Convention, 1981 (No. 155)
- Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187)

## 3.4 International Standards and Guidelines

The Environmental and Social Impact Assessment (ESIA) for the Dandara PV Power Plant and Battery Energy Storage System (BESS) in Nag aa Hammadi complies with both Egyptian Law 4/ 1994 and international financial institutions' requirements, including mainly AfDB, and EBRD standards.

### **AfDB Operational Safeguards (OSs)**

- OS1: Addresses environmental and social risk management throughout the project life cycle.
- OS2: Supports fair labor practices and ensures a safe and healthy workplace.
- OS3: Covers pollution control and promotes resource efficiency.
- OS4: Ensures community health, safety, and security.
- OS5: Land acquisition and resettlement provisions are not applicable to this project.
- OS6: Focuses on biodiversity conservation and the sustainable use of natural resources.
- OS7: Protects vulnerable groups from potential negative impacts.
- OS8: Addresses cultural heritage protection (no expected impacts identified).
- OS9 & OS10: Financial intermediary provisions are not applicable, but stakeholder engagement is required.

### **EBRD Performance Requirements (PRs)**

- PR1: Calls for integrated environmental and social impact assessment and stakeholder engagement.
- PR2: Ensures fair labor conditions, health and safety standards, and monitoring of suppliers.
- PR3: Focuses on pollution prevention and resource efficiency.
- PR4: Addresses health, safety, and security risks, including gender-based violence risk assessment.
- PR5: Land acquisition and resettlement provisions are not applicable to this project.
- PR6: Assesses biodiversity conservation and sustainable resource management.
- PR7: Indigenous peoples' provisions are not applicable.
- PR8: Ensures protection of cultural heritage (no registered sites found).
- PR10: Emphasizes stakeholder engagement and transparent information disclosure.

### **European Investment Bank (EIB)**

- Standard 1: Environmental and Social Impacts and Risks
- Standard 2: Stakeholder Engagement
- Standard 3: Resource Efficiency and Pollution Prevention
- Standard 4: Biodiversity and Ecosystems
- Standard 5: Climate Change
- Standard 6: Involuntary Resettlement
- Standard 7: Vulnerable Groups, Indigenous Peoples and Gender
- Standard 8: Labour Rights
- Standard 9: Health, Safety and Security
- Standard 10: Cultural Heritage
- Standard 11: Intermediated Finance

### **Cassa Depositi e Prestiti S.p.A. (CDP) Sustainability Framework (2020)**

The Cassa Depositi e Prestiti S.p.A. (CDP) Sustainability Framework (Version 1.0, 2020) establishes a comprehensive environmental, social, and governance (ESG) system that applies to all projects and entities benefiting from CDP financing.

The Framework aligns with international sustainability principles and ensures that all CDP-supported activities respect human rights, prevent adverse environmental and social impacts, and contribute positively to sustainable development objectives

### **IFC E&S Performance Standards**

- PS1: Social and Environmental Assessment and Management System
- PS2: Labor and Working Conditions
- PS3: Pollution Prevention and Abatement
- PS4: Community Health, Safety, and Security
- PS5: Land Acquisition and Involuntary Resettlement
- PS6: Biodiversity Conservation and Sustainable Natural Resource Management
- PS7: Indigenous Peoples
- PS8: Cultural Heritage

### **World Bank EHS Guidelines**

The World Bank Group members are committed to abiding by the general EHS Guidelines for different projects where they are involved. These are complemented by industry-specific guidelines for complex projects.

## **4. Analysis of Alternatives**

The "no-project" alternative was excluded from consideration, as the proposed land would still be utilized for other renewable energy projects. Key alternatives considered include:

**Site Location:** The proposed project, located in a vacant desert land south of Nagaa Hammadi. It has been allocated by the Egyptian government to NREA for Renewable Energy Project and does not conflict with other land uses. Therefore, alternative site options were not considered, making the selected site suitable for the project.

**PV Panel Types:** Different PV panel technologies, including monocrystalline and thin film, were assessed. High-efficiency mono-crystalline silicon panels were selected for their optimal balance of performance, cost-effectiveness, and environmental considerations.

**Tracking Systems:** The investigation of tracking systems for maximizing solar energy capture led to the selection of an active single-axis solar tracking system for the

project. This choice was made because it is generally less expensive and requires less maintenance due to having fewer moving parts.

**Module Cleaning:** Various module cleaning methods, including manual cleaning and automated systems, were evaluated. The selected option for PV Module Cleaning is the automatic robotic dry- cleaning system.

**BESS Alternatives:** Different BESS technologies, such as lithium-ion and flow batteries, were considered. Lithium nickel manganese cobalt oxide (NMC) or lithium iron phosphate (LFP) were selected for their high energy density, efficiency, and proven track record in utility-scale applications.

**Water Sources:** Alternative water sources, including groundwater abstraction and water trucking from the nearest water plant, were investigated. Ultimately, the project will utilize water trucking and pipeline supply for its water needs will also be considered.

## 5. Environmental and Social Baseline

### 5.1 Project Site Location

The project is located within the area of Naga Hammadi, Qena Governorate. The coordinates of the boundaries of the usufruct area and the included project site, along with the locations of the nearest roads and residential settlements, are provided below (Figure 2).

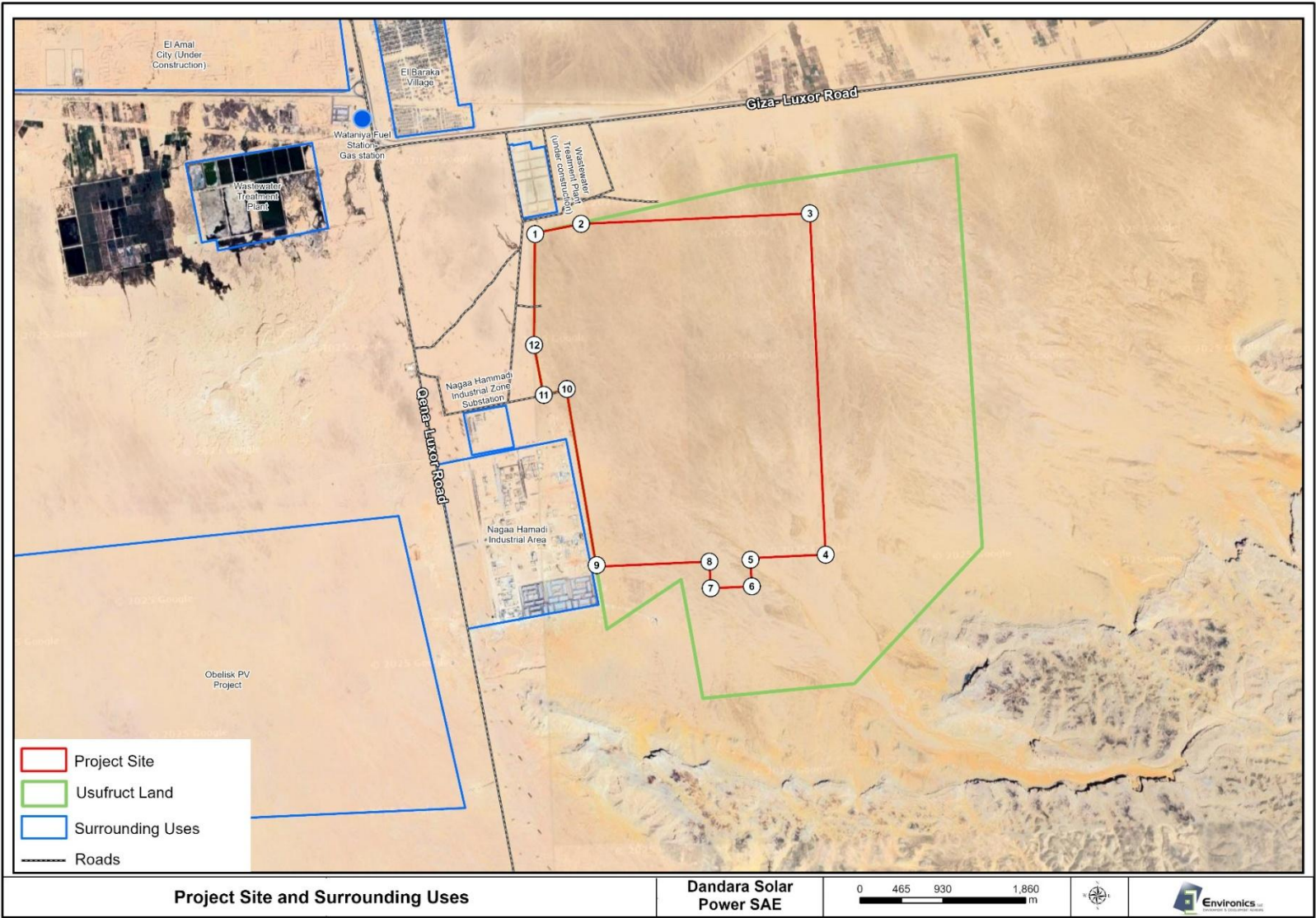


Figure 2: Project Site within Scatec’s usufruct land



**Table 5: Location coordinates for the four corners of the Project Site**

Corner No.	Latitude	Longitude
1	32° 19' 39.83" E	25° 56' 40.63" N
2	32° 19' 58.42" E	25° 56' 43.62" N
3	32° 21' 30.43" E	25° 56' 44.04" N
4	32° 21' 31.11" E	25° 54' 40.0" N
5	32° 21' 0.92" E	25° 54' 39.31" N
6	32° 21' 0.97" E	25° 54' 29.59" N
7	32° 20' 44.46" E	25° 54' 29.51" N
8	32° 20' 44.41" E	25° 54' 39.24" N
9	32° 19' 59.11" E	25° 54' 39.59" N
10	32° 19' 50.01" E	25° 55' 43.93" N
11	32° 19' 40.6" E	25° 55' 42.12" N
12	32° 19' 37.62" E	25° 56' 0.4" N

## 5.2 Climate and Meteorology

The Qena governorate experiences extreme temperature variations, with very hot summers, cold winters, and significant daily temperature differences. The region is characterized by arid conditions, minimal rainfall, and high solar radiation levels, particularly in summer.

- **Temperature:** The annual average temperature is 23.9°C, peaking at 37.9°C in July and dropping to 5.3°C in January.
- **Solar Radiation:** High solar radiation levels range between 2,191–2,264 kWh/m<sup>2</sup> per year, peaking in July at 27 MJ/m<sup>2</sup>/day and reaching a minimum of 12 MJ/m<sup>2</sup>/day in December.
- **Day Length:** Varies between 11 hours in December and 14.2 hours in June.
- **Wind Speed and Direction:** The average wind speed is 12 km/h, with a peak of 13.7 km/h in April. Winds predominantly blow from the north and northwest.
- **Precipitation:** Rainfall is negligible, with an annual peak of 0.4 mm in May.
- **Relative Humidity:** Ranges from 30% in May to 54.2% in December, with an annual average of 41%.

### Dust and Sandstorms

The project site, similar to other areas in Upper Egypt, is exposed to dust, sandstorms, and haze, as recorded over a 22-year monitoring period:

- **Haze Events:** Recorded for 2,864 hours (1.5% of total time), peaking in February, and typically associated with low wind speeds.
- **Dust Storms:** Occurred for 544 hours (0.29% of total time), mainly in March, under moderate wind speeds (2–5 m/s).
- **Rising Sand:** Recorded for 446 hours (0.23% of total time), linked to high wind speeds (>5 m/s), peaking in March.
- **Sandstorms:** Rare, occurring for 34 hours (0.02% of total time), mostly in March, driven by strong westerly winds.



## Air Quality

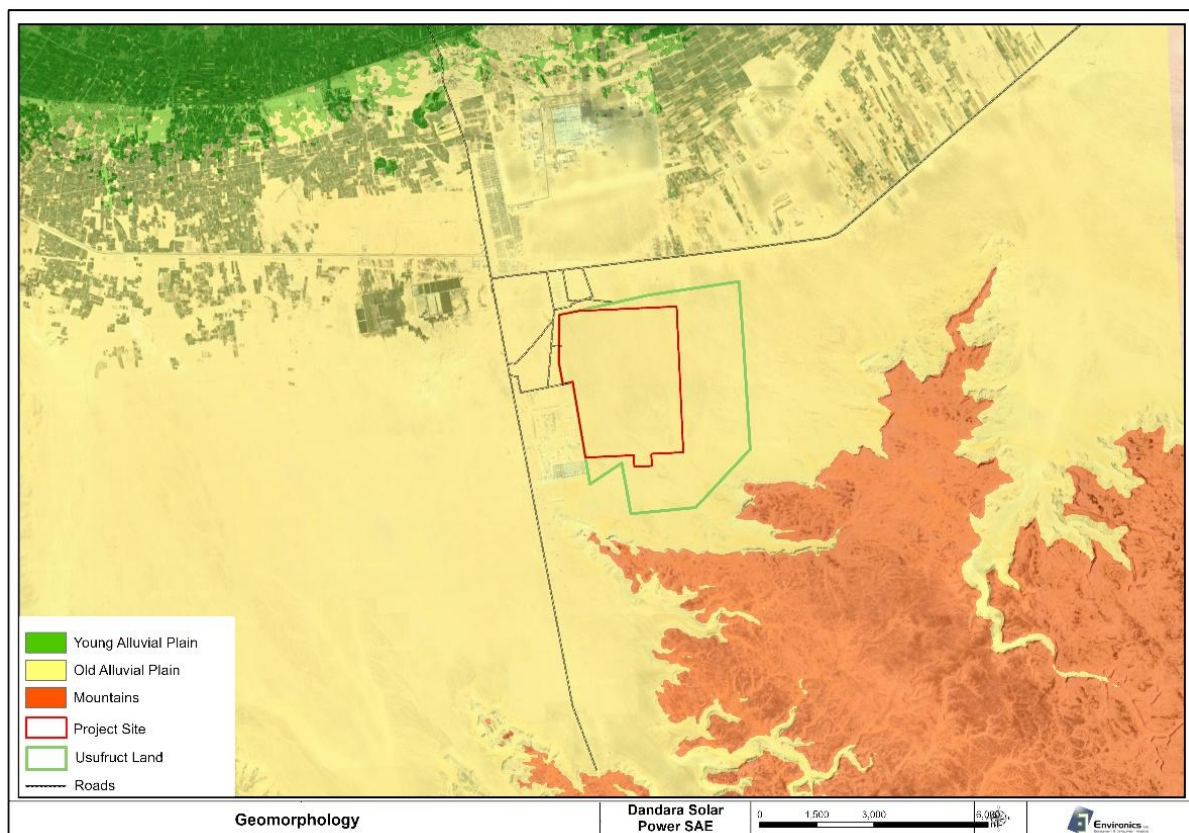
Air quality data from the Qena Meteorological Station (December 2023) indicate elevated PM<sub>10</sub> concentrations (166 µg/m<sup>3</sup>), exceeding the regulatory threshold of 70 µg/m<sup>3</sup>, primarily due to the surrounding desert environment. Other pollutants, including sulfur dioxide (SO<sub>2</sub>), nitrogen dioxide (NO<sub>2</sub>), and ammonia (NH<sub>3</sub>), remained within safe limits.

Annual data from 2022 also recorded elevated PM<sub>10</sub> levels (149 µg/m<sup>3</sup>), surpassing both national and WHO guidelines, while SO<sub>2</sub> and NO<sub>2</sub> remained within acceptable ranges.

## 5.3 Geomorphology and Topography

The project site lies within the ancient alluvial plains, situated between rugged terrain and the limestone plateau to the south, and the younger alluvial plains along the valley to the north. The old alluvial plains form terraces at varying elevations above the younger plains.

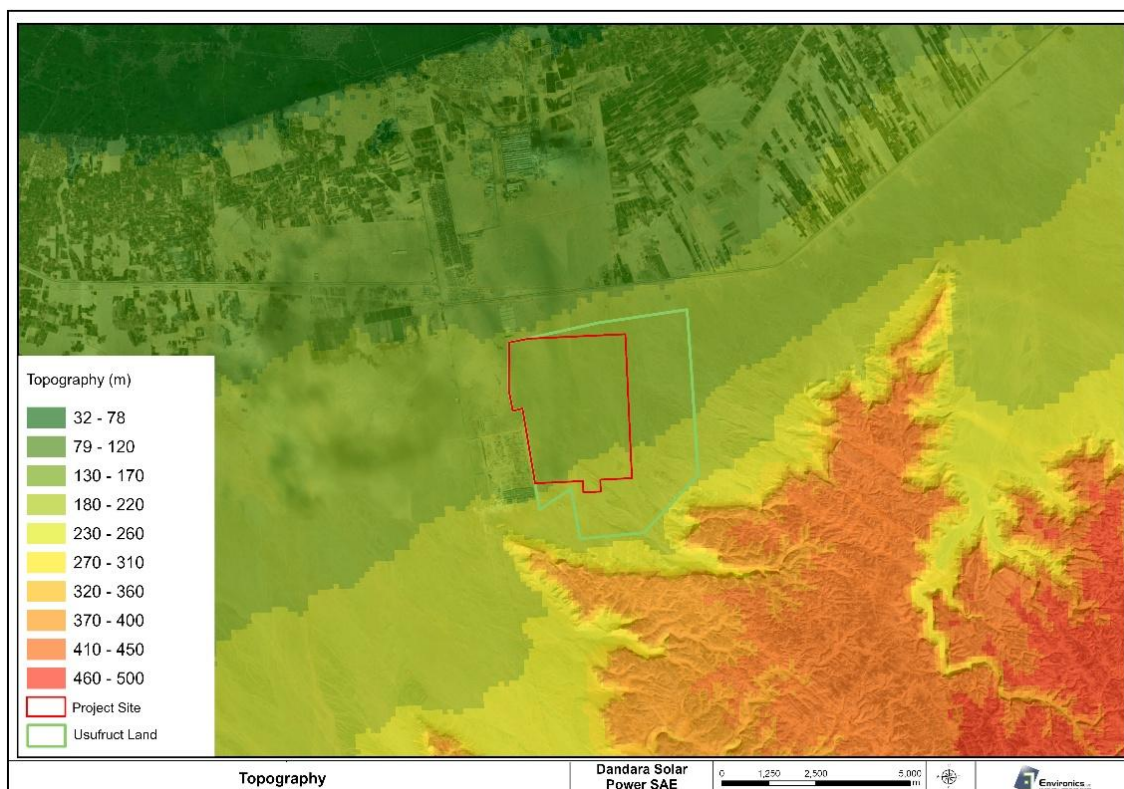
According to Egypt's national soil map, the soils across the project area are primarily derived from limestone. Specifically, the site's soil type is classified as sandy loam, which is generally shallow or stony in nature.



**Figure 3: Geomorphological features of the Project Site**

## Topography

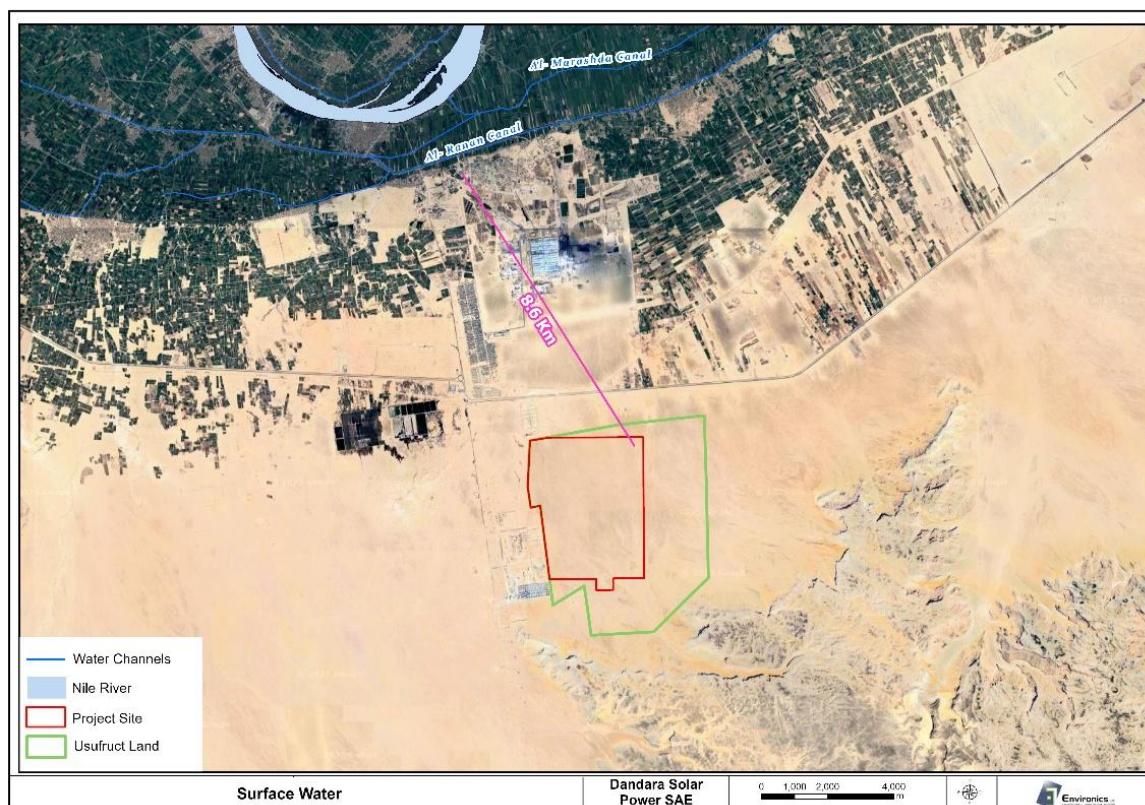
Elevations at the project site and its surroundings increase towards the south, reaching a maximum of approximately 450–500 m above mean sea level (MSL). Within the project site and the usufruct area, elevations generally range between 130 and 170 m above MSL, except in the southern part, where the elevation rises to a peak of about 220 m above MSL.



**Figure 4: Topography of the Project Site (indicated in blue)**

## 5.4 Hydrology and Hydrogeology

The Project Site is situated in the desert hinterland of Markaz Nagaa Hammadi. As such, the Project Site is devoid of any surface water bodies or surface canals within its boundaries. There are three water bodies near the Project Site. These are the Alranan Canal, Almarashda Canal, and the river Nile, all of which are located north of the Project Site. The Alranan Canal is the closest water body to the Project Site and is located 8.5 km north of it, then Almarashda Canal (9 km away from the project site).



**Figure 5: Surface water bodies and canals in close proximity to the Project Site**

## Groundwater

The site is underlain by the Quaternary aquifer, the primary groundwater resource in the Nile Valley. This aquifer consists of sand, gravel, and clay layers, with groundwater occurring under unconfined conditions. The thickness of the aquifer varies from about 200 m at the center of the cultivated floodplain to about 80 m at the desert fringes. It is recharged continuously from the excess irrigation water and occasionally from infrequent rainfalls. The old alluvial floodplain is characterized by moderate to very high recharge potentialities. The Project Site is located in an area of moderate recharge groundwater potentiality. The groundwater in the Project Site occurs at moderate depth that ranges between 36 meters to 41 meters.



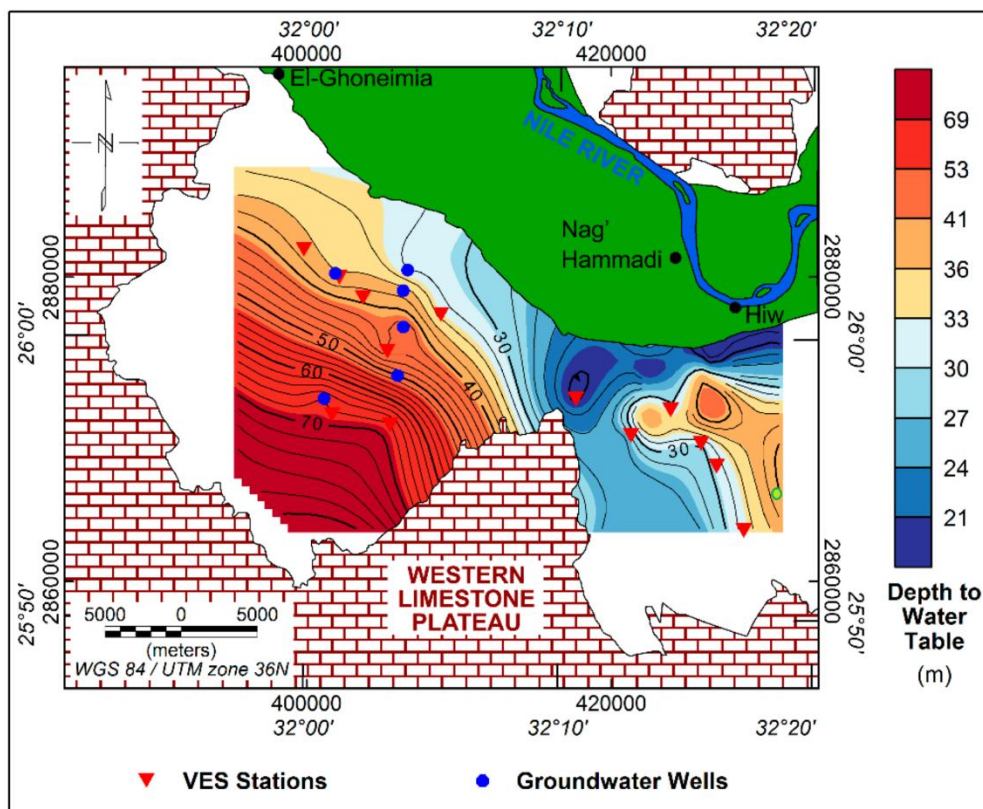


Figure 6: Depth to water contour map in relation to the Project Site

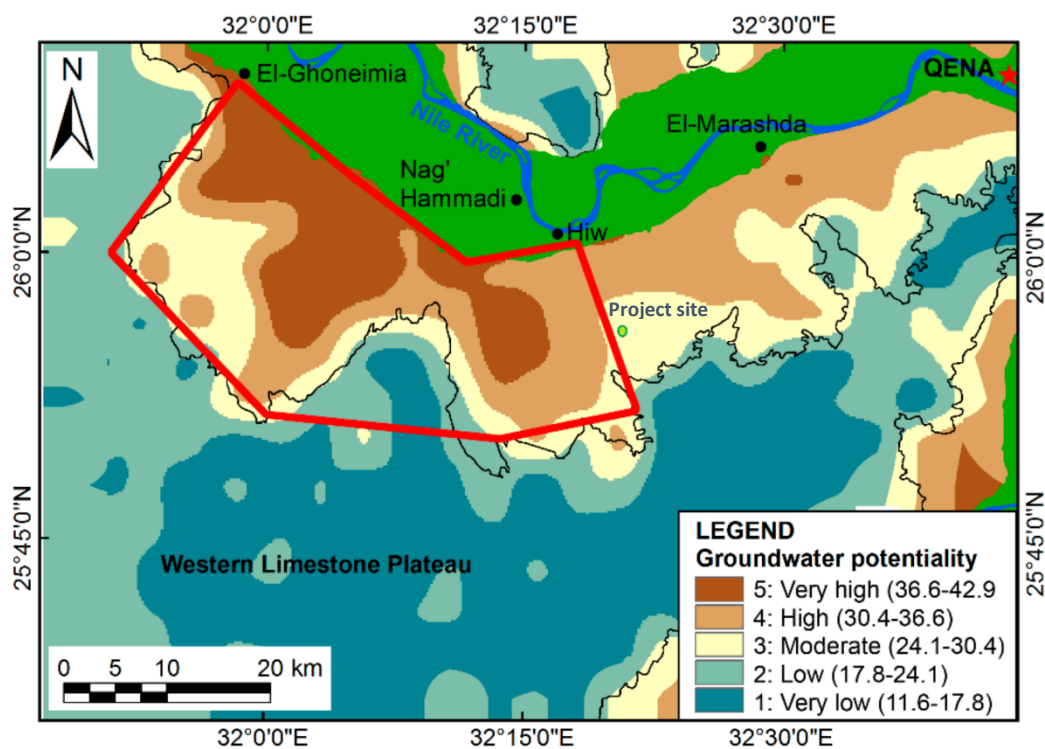


Figure 7: Groundwater recharge potentiality map including the Project Site, indicated by a green circle

### Flash Flood Hazards

Despite low annual rainfall, Qena governorate is one of the most susceptible regions in the Nile Valley to flash flooding, particularly in winter (October–February). Historical records of flooding in the region date back to 1938.

The following provides a brief on the protection options against flash floods.

- The project site will be protected against flash floods via a trapezoidal open channel spanning from the mouth of the wadi south of the project site and running south to north along the eastern fence line of the project site. The design will accommodate a 100-year event. The open channel will largely maintain the natural stream path and not change the point of discharge. The outlet will be designed such that no change in the natural velocity occurs at the discharge point.
- Alternatively, the project site will be protected by means of a compacted earthen berm (with erosion protection on the stream side) running south to north along the eastern fence line of the project site. Energy dissipation measures will be employed at the outlet end of the project site, ensuring no increase to the natural discharge velocity downstream.

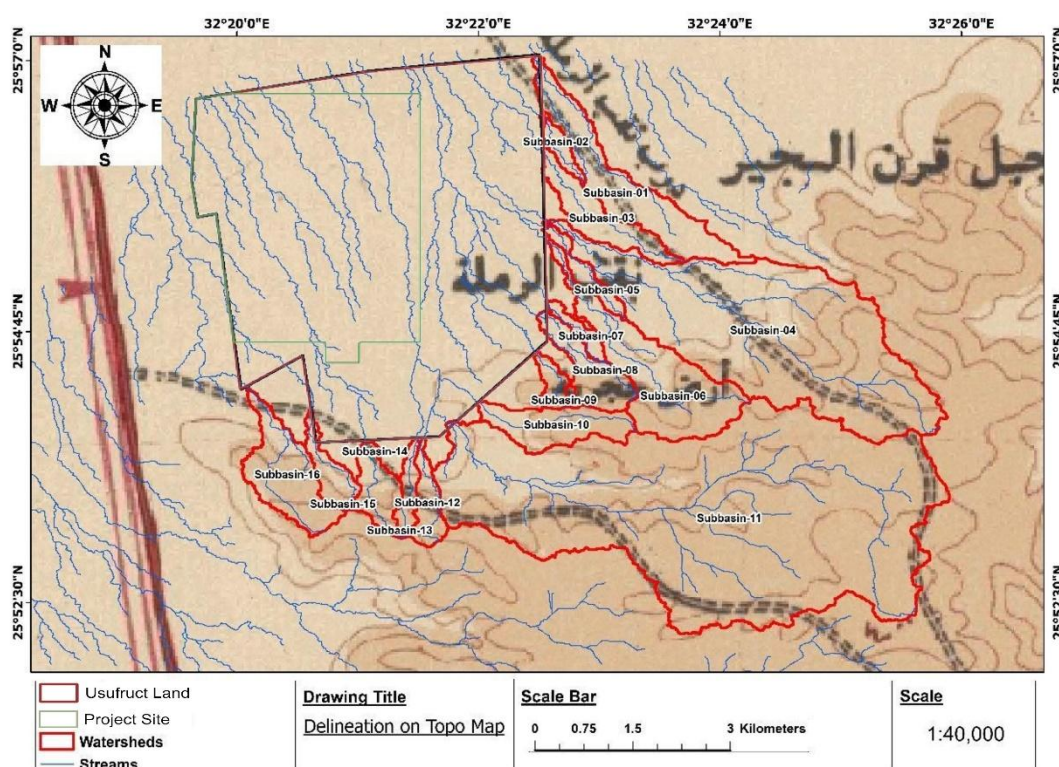
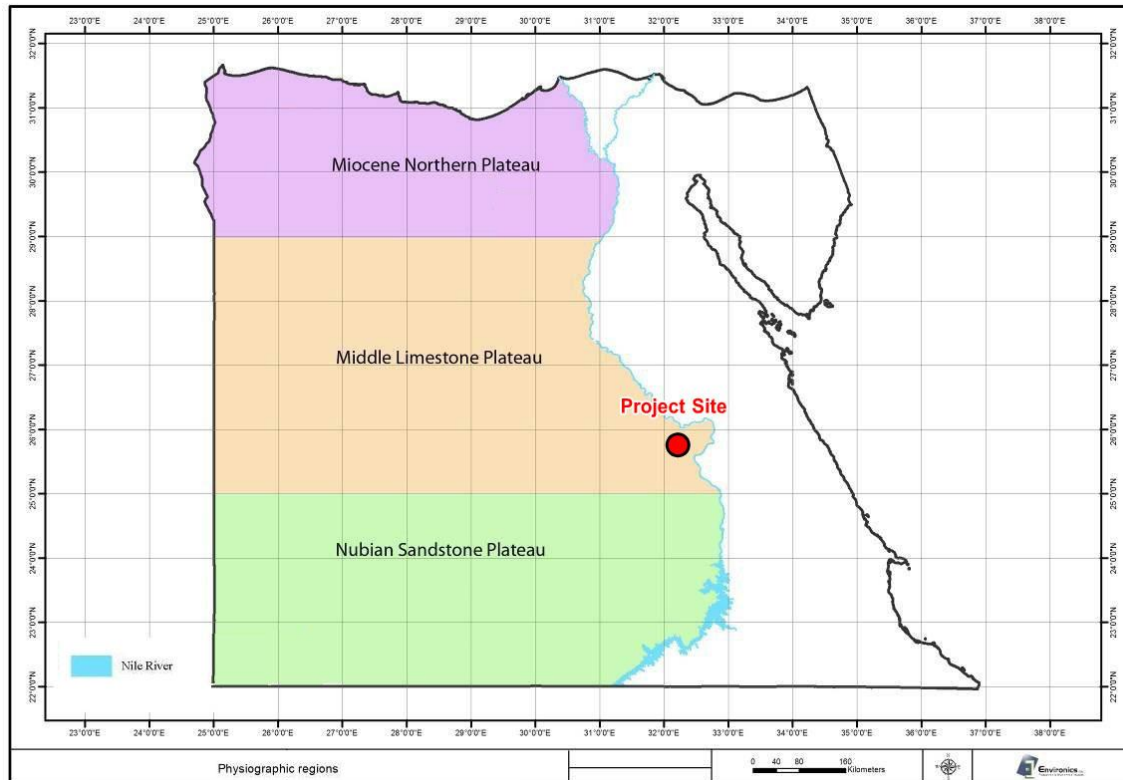


Figure 8: Natural Wadis in the project area

## 5.5 Biological Environment

The Project Site is located within the Middle limestone Plateau (MLP) of the Western Desert, a vast arid region covering two-thirds of Egypt's total area. This plateau

extends from latitude 25° N to 29° N and includes several oases that rely on groundwater for sustenance. The Project Site is specifically situated in the southeastern part of the MLP, characterized by dry sandy terrain with minimal vegetation.



**Figure 9: Physiographic regions of the Western Desert and location of the Project Site**

### Habitat Near the Project Site

The habitat topologies of the ecosystems in close proximity to (i.e., localities situated 15 km or less away from the Project Site) can be broken down into four main habitat types:

**Nile Valley Farmlands:** Located about 8.5 km north of the project site, separated by the Aswan–Giza Road. These are essentially nearly completely modified habitats, providing habitat for a variety of weeds and ruderal plants in the fields, canals, and drain banks.

**Reclaimed Agricultural Lands:** The closest reclaimed desert agricultural areas is 1 km north of the project. Additional reclaimed lands are located to the north and northwest of the project site.

**Urban Habitats:** Scattered throughout the Nile Valley farmlands and reclaimed agricultural lands, such as banks of canals and drains, roadsides, railways and wastelands, home to exotic plants and trees introduced for ornamental purposes, as well as opportunistic fauna associated with human activities (e.g., feral dogs, rats, and birds).

**Middle Limestone Plateau:** Arid, dry sand plateau with very little or no precipitation, and outside of its depressions and oases, the only other habitats available are bare ground



habitats. It is totally devoid of flora, save for a few desert-adapted floral species distributed as scattered, isolated shrubs throughout the plateau. The Project Site is located within the southeastern part of the Middle Limestone Plateau.



**Figure 10: Cattle Egrets (*Bubulcus ibis*) in a reclaimed agricultural land**

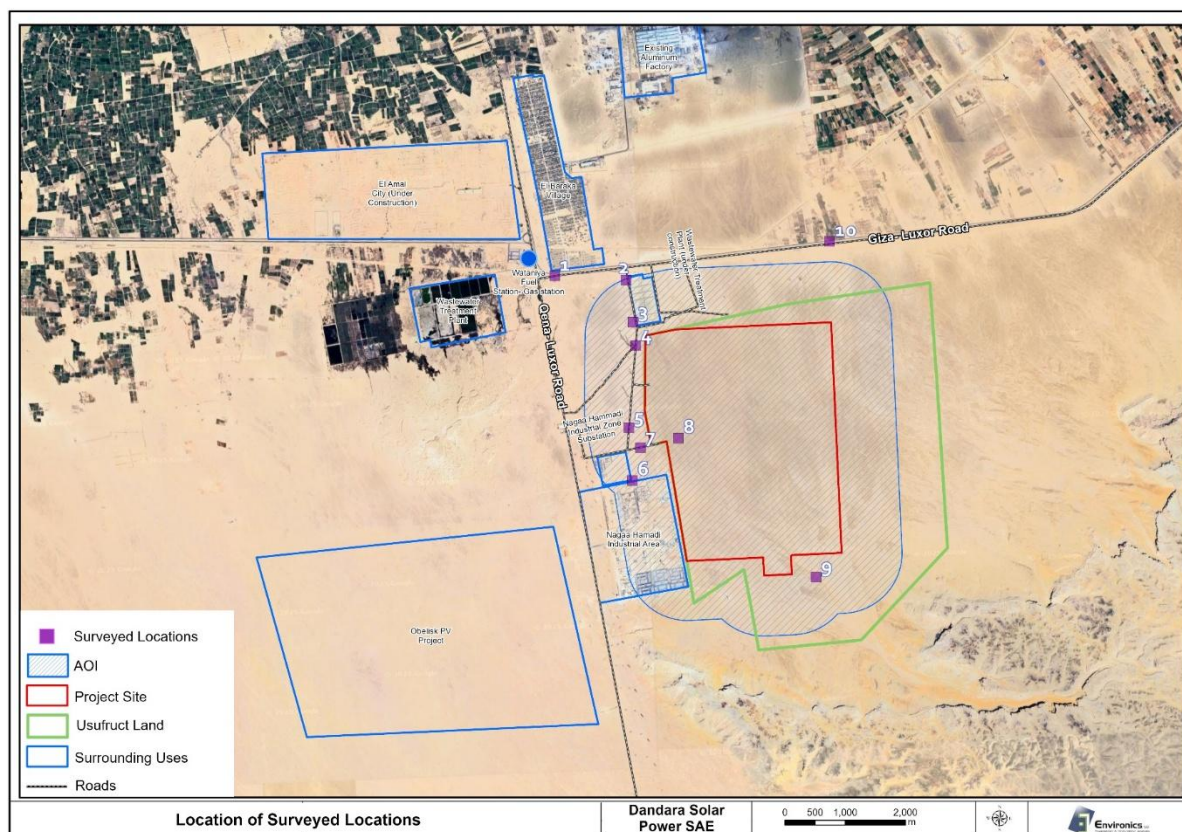


**Figure 11: A Common Hoopoe (*Upupa epops*) in a reclaimed agricultural land**

### The Project Site Conditions

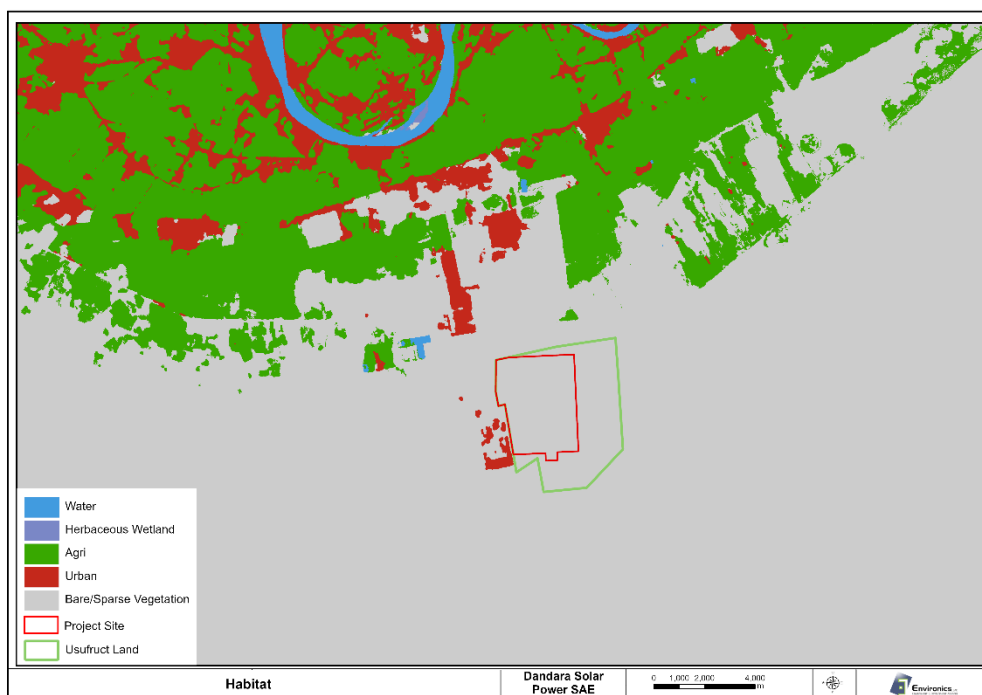
Two complementary surveys were conducted to cover all habitats potentially influenced by the project, as shown in Figure 12. One survey was conducted by Scatec in August 2025, and the other by Environics in October of the same year. The surveyed locations and tracks are also illustrated in Figure 12.





**Figure 12: Location of surveyed sites during the October 2025 field visit**

The site survey and remote sensing analysis confirmed that the entire Project Site consists of bare ground with no significant vegetation or water sources. According to IFC Performance Standard 6 (IFC PS6), the Project Site is categorized as a natural habitat, meaning it remains largely undisturbed by human activity.



**Figure 13: Habitat types of the Project Site and the localities within its vicinity**

## Flora

The Project Site in the Western Desert (WD) and Middle Limestone Plateau (MLP) is extremely arid, with poor plant diversity and no permanent vegetation. The only plant life found in the surrounding region includes drought-resistant species such as Syrian mesquite (*Prosopis farcta*) and *Caroxylon imbricatum*. However, the October 2025 survey found the site completely devoid of vegetation.

## Fauna

**Snakes:** The Project Site could potentially host desert-welling snakes, including Sahara Sand Viper (*Cerastes vipera*), Homed Viper (*Cerastes cerastes*), Saharan Sand Snake (*Psammophis aegyptius*), and Diadem Snake (*Spalerosophis diadema*). However, no traces of these species were found during site surveys.

**Lizards:** Species like the Desert Monitor (*Varanus griseus*) and Bosc's Fringe-toed Lizard (*Acanthodactylus boskianus* subsp. *asper*) could occur in the area, along with geckos such as the Elegant Gecko (*Stenodactylus sthenodactylus*) and Anderson's Short-fingered Gecko (*Stenodactylus petrii*).

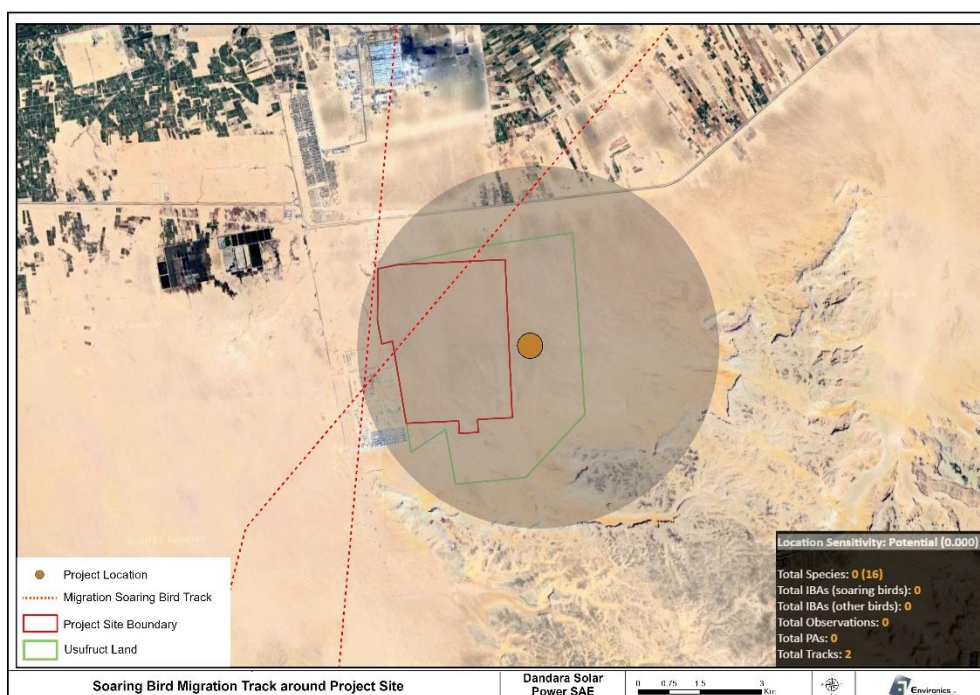
## Birds:

**Resident Birds:** The site lacks food, water, and shelter, making it inhospitable for breeding birds. However, the nearby wastewater treatment plant attracts several birds, including species typical to the mesic habitats of the Nile Valley, such as the House Sparrow (*Passer*

*domesticus*) and the Spur-Winged Lapwing (*Vanellus spinosus*). The later species was recorded in the modified habitat of the water treatment plant near the project site during the site visit in October 2025.

**Migratory Birds:** There are 16 migratory soaring bird species with a likelihood of crossing over the Project Site. Despite this, the Project Site is not an important location for migratory birds. On the other hand, the Project Site has a low 'intensity passage', a low number of individuals per species passing over it. This is probably because the barren and arid nature of the Project Site does not provide any advantages to migrating avifauna in terms of providing food, shelter, and water required during rest-stops. In addition, most of the 16 migratory birds are categorized at the global level as species of Least Concern (LC) in terms of their susceptibility to extinction.

**Mammals:** Possible species include Rüppell's Fox (*Vulpes rueppellii*), which is well-adapted to desert conditions, and Fennec Fox (*Vulpes zerda*), that can survive without water.

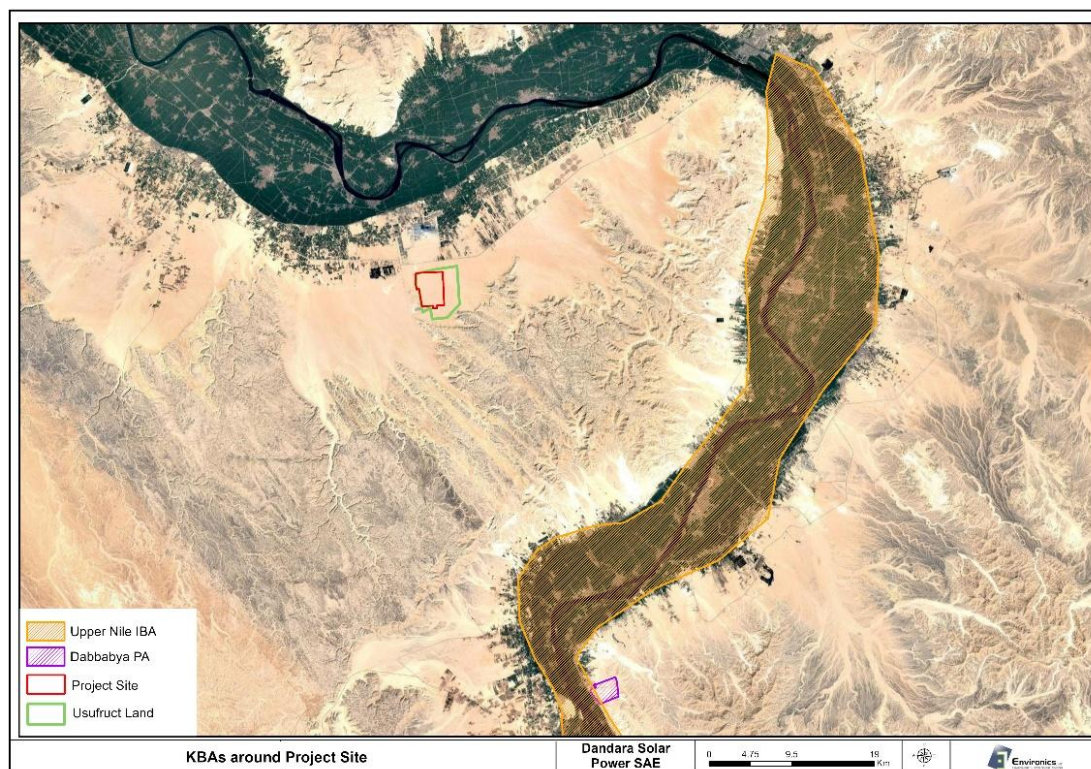


**Figure 14: Location sensitivity of the Project Site to migratory soaring birds**

### Ecological Value and Significance

The Project Site does not encompass any Key Biodiversity Areas (KBAs) or Protected Areas (PAs). The only KBA in the vicinity, located about 33 km east of the Project Site, is the Upper Nile IBA. There is one PA also in the vicinity of the Project Site, the Dababia PA. However, this PA is not considered a KBA. The Dababia PA is a geological protectorate and is located approximately 45.6 km southeast of the Project Site and is separated from it by the Nile Valley (Figure 15).





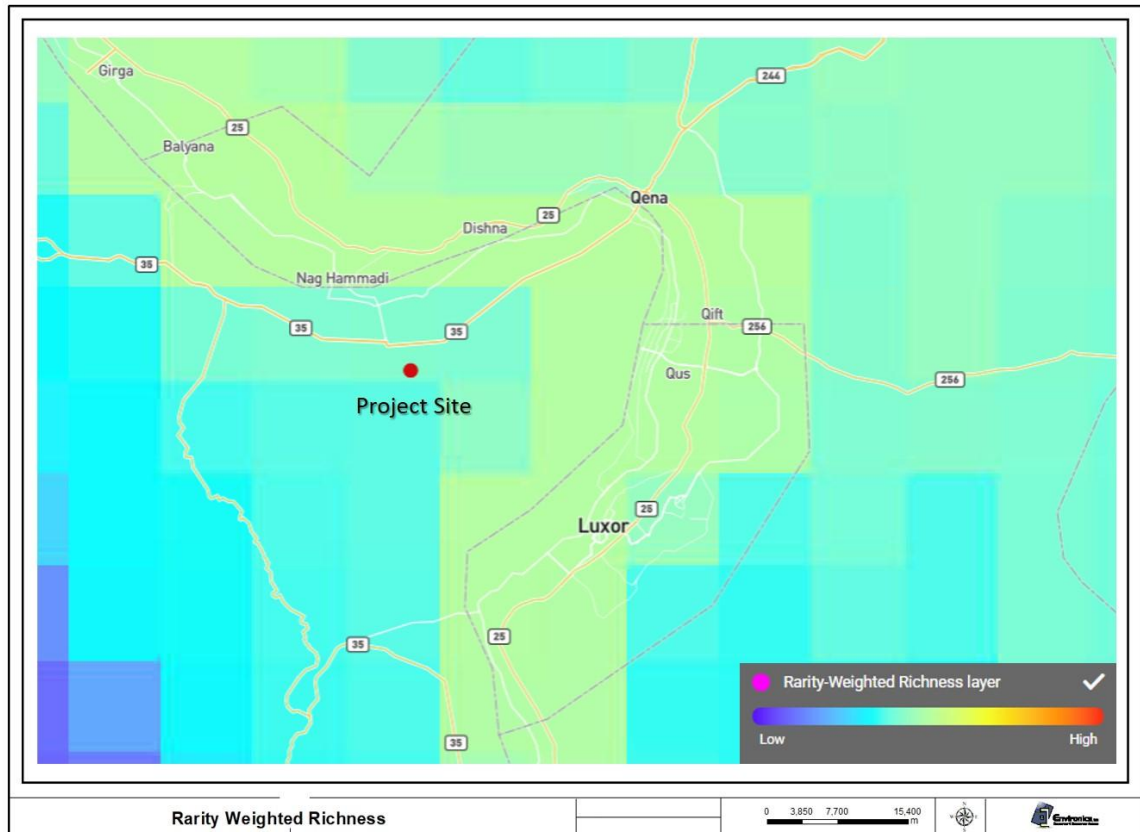
**Figure 15: Nearest Key Biodiversity Areas (KBAs) to the Project Site**



**Figure 16: Location of Wadi Qena proposed PA Related to the Location of the Project Site Ecological Value and Biodiversity**

The Project Site is located in an area of low to medium rarity-weighted richness, i.e., its relative importance is moderate to the global distribution of different categories of species,

ranging between low and moderate importance. An assessment using international biodiversity databases showed minimal species occurrence in the area. Over a 25-year period, only one bird species, the Osprey, was recorded around 7 km north of the site, and it is not considered a conservation concern. No mammals, reptiles, or amphibians were recorded.



**Figure 17: Rarity-weighted richness map of the Project Site**

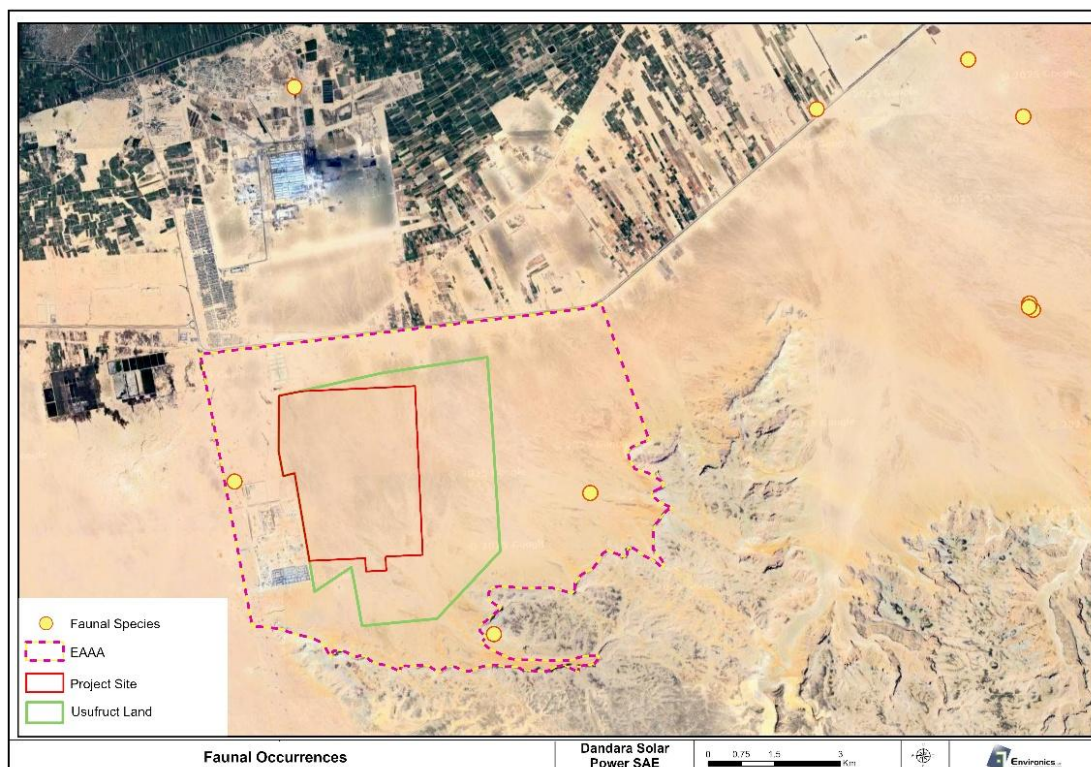
### Ecosystem Services

- Provisioning services, which are the products people obtain from ecosystems such as food, freshwater, timber, fibers and medicinal plants.
- Regulating services, which are the benefits people obtain from the regulation of ecosystem processes such as surface water purification, carbon storage and sequestration, climate regulation and protection from natural hazards.
- Cultural services, which are the nonmaterial benefits people obtain from ecosystems and may include natural areas that are sacred sites and areas of importance for recreation and aesthetic enjoyment, and
- Supporting services, which are the natural processes that maintain the other services.



### Critical Habitat Assessment

The area does not qualify as a Critical Habitat (CH) under international biodiversity standards. However, four species (Desert Monitor, Egyptian spiny-tailed lizard, Rüppel's Pipistrelle, and Fennec Fox) were identified as Priority Biodiversity Features (PBFs) and may occasionally pass through the area.



**Figure 18: Faunal occurrences within and adjacent to the Project Site's EAAA**

### 5.6 Socio-Demographic Overview

The Qena governorate is one of Egypt's South Upper Egypt governorates. It is known for its strong agricultural and industrial economic sectors, particularly as the nation's leading producer of sugar cane, tomato, banana, sesame, and hibiscus. The governorate covers an area of 10,798 km<sup>2</sup>, with 16.11 % of this being inhabited land.

#### Population & Settlements

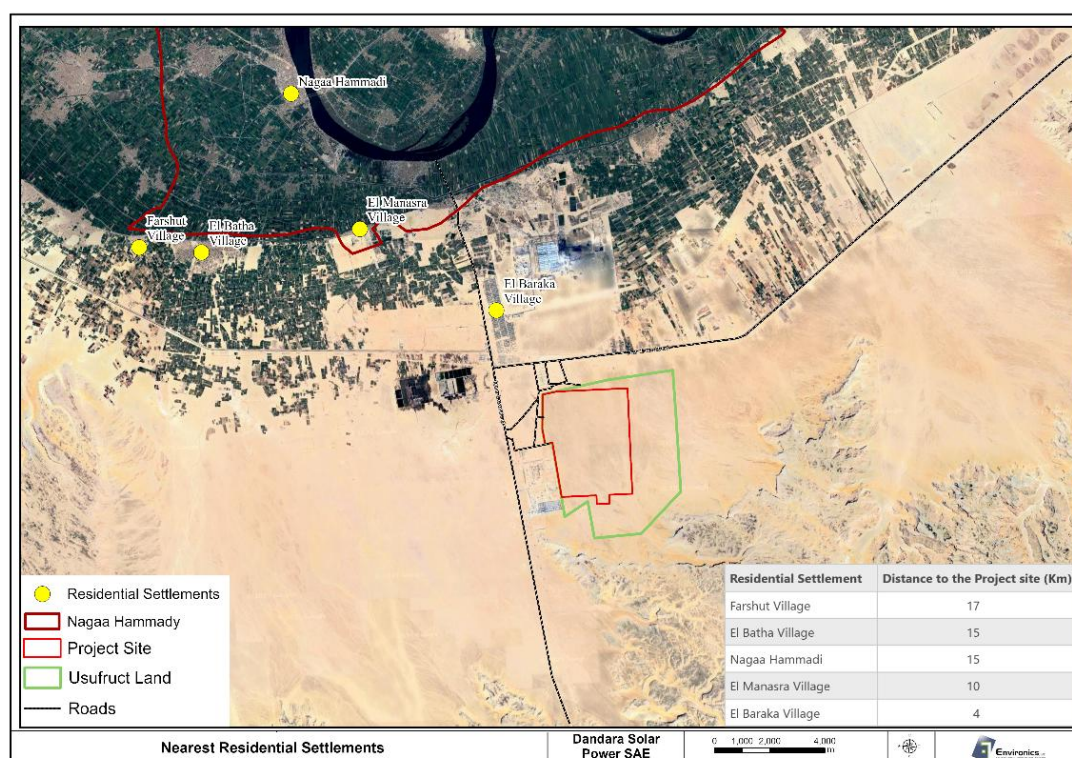
- Qena has a population of approximately 3.16 million, with an almost equal gender distribution.
- Around 81% of residents live in rural areas, while 19% live in urban centers.
- The governorate is divided into several districts, villages, and hamlets, including Markaz Nagaa Hammadi, where the project is located, with a population of about 578,000.

## Labour Force & Economy

- The labour force in Qena totals around 927,000 people, with men comprising 75% and women 25%.
- In Markaz Nagaa Hammadi, the labour force is approximately 182,000.
- Key economic sectors include manufacturing, construction, food services, transportation, and retail trade.

## Occupations & Education

- Men are mainly employed in skilled trades, agriculture, and machine operations.
- Women are primarily engaged in services, sales, and clerical positions.
- Education levels vary: many workers have technical education, while others hold university degrees or have no formal education.



**Figure 19: Location of residential settlements in close proximity to the Project Site**

## 5.7 Land Use Types

The Project Site is not currently utilized for any anthropogenic purposes. However, land use types in close proximity to the Project Site (**Error! Reference source not found. 20**) are as follows:

- The Nagaa Hammadi industrial zone (200 m west of the Project Site)
- Reclaimed agricultural lands (1 km north of the Project Site)



- Wastewater treatment plant (2.5 km northwest of the Project Site)
- Under construction wastewater treatment plant (300 m northwest of the project site).
- The Giza – Luxor Road (950 m north of the Project Site)
- A residential area (5.6 km northeast of the Project Site)
- Other local communities located between 3 km and 9 km northwest of the Project Site

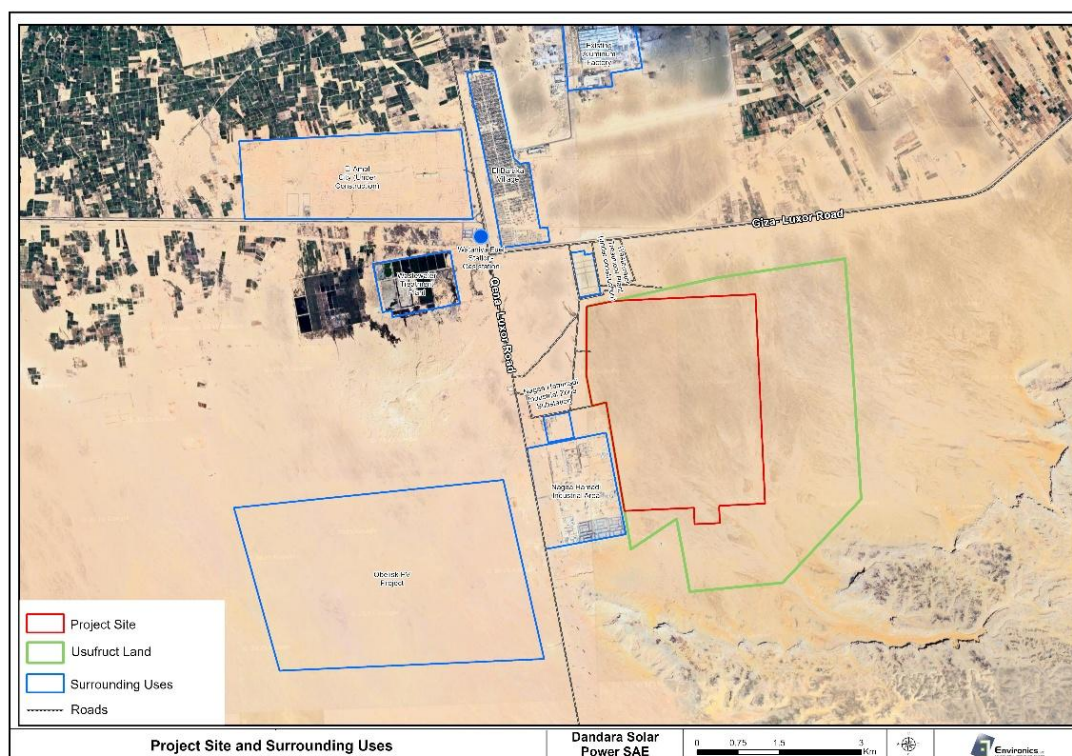


Figure 20: Land use types in close proximity to the Project Site

### Infrastructure, Utilities, and Services

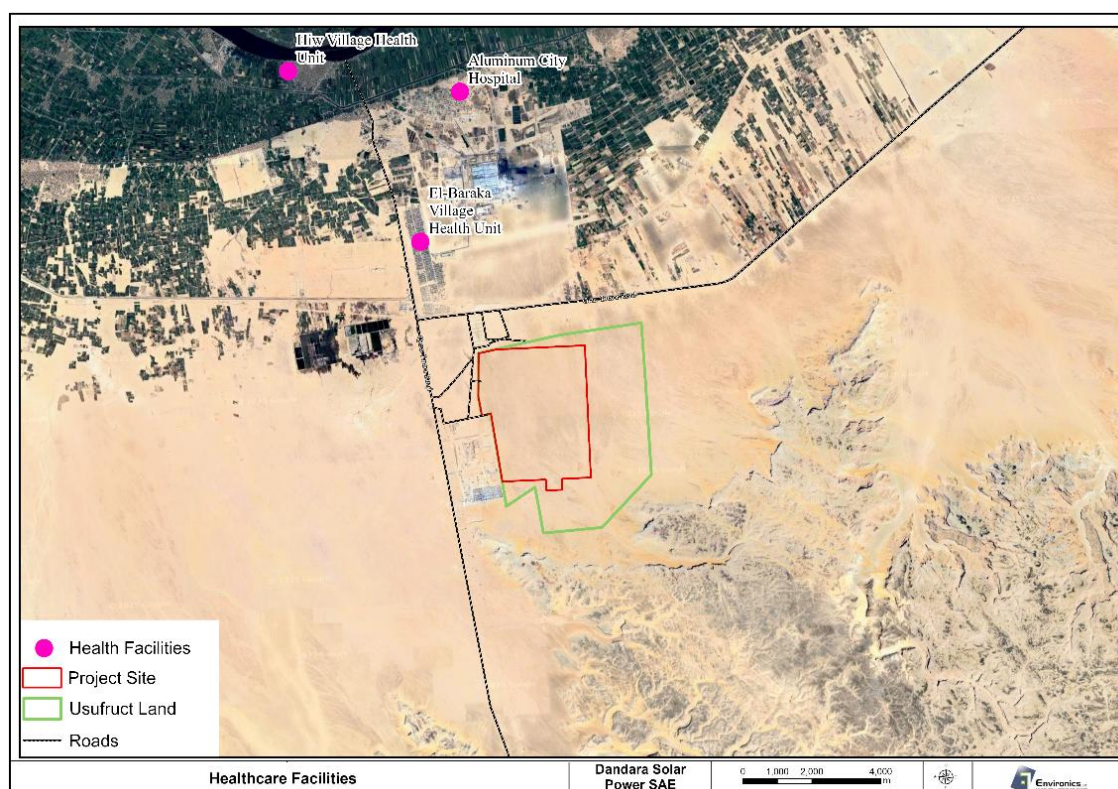
The Qena governorate boasts a total of 52 hospitals, 46 ICUs (intensive care units), and over 200 health units. Nearest health facilities are shown in Table 3.

Table 6: Hospitals and other healthcare facilities in the Qena Governorate

Healthcare Facility Type	Quantity
Central Hospitals	11
Specialised Hospitals	11
Private Hospitals	14
Health Insurance Hospitals	1
Educational Hospitals	1
Dialysis Centres	18
Health Units	241
University Hospitals	2
Specialised Medical Centres	1
Military Hospitals	1
Oncology Institutes	1

Healthcare Facility Type	Quantity
Ambulance Points and Centres	52
Ambulances	92
Highway Ambulance Units	20
Regional Blood Banks	1
Intensive Care Units	46

Furthermore, there are three healthcare facilities located in close proximity to the Project Site: the El-Baraka Village Health Unit (3 km north of the Project Site), the Aluminum City Hospital (located 7.5 km north of the Project Site), and the How Village Health Unit (9.5 km northwest of the Project Site) (Figure 21).



**Figure 21: Healthcare Facilities in Close Proximity to the Project Site**

### Potable Water

99.58% of urban households and 95.92% of rural households are connected to the public water supply. Remaining households rely on wells, pumps, or bottled water.

### Sewage Facilities

15.47 % of households are connected to public sewage networks. Additionally, 82.14% rely on cesspits, while a small percentage use private systems or open drains. 9 sewage treatment plants process 48.1 million m<sup>3</sup> of sewage per year, with 207,000 m<sup>3</sup>/day capacity. Recent government initiatives (e.g., Hayah Karima) have improved sewage infrastructure.

### Transport Infrastructure

- The Giza – Luxor Road runs parallel to the northern boundary of the Project Site, approximately 5 km away from this northern boundary.
- The Giza – Luxor Road consists of two separate lanes, each 9 meters wide.
- A paved, single lane road serving the industrial area west of the Project Site, located approximately 0.5 km east of the Project Site.

## 5.8 Cultural Heritage

### Tangible Cultural Heritage

According to the Egyptian Archeological Map (EAM) (2022) and the UNESCO World Heritage List of Egypt, there are no registered antiquities or cultural heritage sites within the Project Site. However, there are five archaeological sites and monuments located in close proximity to the Project Site:

- **Abu Amuri:** an archaeological mound found in the Qena governorate, but one that has not yet been excavated. It is located around 9 km north of the Project Site.
- **Hur:** recently excavated by the Supreme Council of Antiquities, revealing several mud-brick tombs dating to the Old Kingdom. It is located about 9.5 km north of the Project Site.
- **Hiw:** known for its extensive cemeteries and settlements dating back to the Naqada I-II of the Predynastic Period. Hiw is located in the Qena governorate and was the capital of the 7th Upper Egyptian Nome. The Hiw site is located approximately 11.5 km north of the Project Site.
- **Gebel El-Arqi:** essentially solely contains archaeological remnants. The Gebel El-Arqi site is located about 14 km northwest of the Project Site.
- **El-Halfaya Qibli:** This archaeological site consists of the prehistoric small village of El-Halfaya Qibli and its associated large Predynastic cemetery. No evidence of permanent architecture was found at the site. It is located about 15 km northeast of the Project Site.

### UNESCO World Heritage Site

- **Ancient Thebes and its Necropolises:** Thebes is the only UNESCO world heritage site located in the vicinity of the Project Site, as it is situated roughly 36 km south of it. Ancient Thebes was the capital of Egypt during the Middle and New Kingdoms. Today, Thebes is a striking testimony to Egyptian civilization at its height, with its temples and palaces at Karnak and Luxor, and the necropolises of the Valley of the Kings and the Valley of the Queens (UNESCO, 2025a).

### Intangible Cultural Heritage

Based on UNESCO's List of Intangible Cultural Heritage (ICH) in Egypt, none of the identified ICH elements are practiced within the Project Site. However, some elements may be practiced by the local communities in the vicinity of the Project Site. Examples include the following.

- **Handmade Weaving in Upper Egypt:** A traditional craft facing decline due to reduced economic viability and limited transmission.
- **Tahteeb (Stick Game):** A martial art turned folk dance performed with sticks, symbolizing strength, honor, and cultural identity.
- **Al-Sirah Al-Hilaliyyah Epic:** A rare surviving Arabic oral epic narrating the migration of the Bani Hilal tribe to North Africa.
- **Date Palm Knowledge & Traditions:** Cultural practices linked to date palm cultivation, essential to the region's heritage and livelihoods.

No impact on such culture is expected for the following reasons:

- The workers will be local hires (from the wider region and not necessarily from the closest villages)
- A part of the non-local workers will be accommodated in an onsite worker camp, with no major interaction with the community
- The whole construction period, during which the demand for labor will be substantial, is limited in time.

## 6. Summary of Impacts and Mitigation Measures

**Table 7: Summary of the Project Impacts and Mitigation Measures**

Environmental and social Aspects	Expected Impacts	Mitigation Measures Summary	Residual Impacts
<b>Construction Phase</b>			
<b>Air Quality</b>			
<ul style="list-style-type: none"> <li>Air Quality Impacts from levelling, excavation and backfilling activities from construction vehicles machinery as well as use of transportation vehicles to transport the PV panels and other components equipment and construction materials.</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>Implementing policies to reduce idling times for vehicles and machinery;</li> <li>Maintaining machinery and vehicles in good working conditions to minimize fugitive emissions and exhaust;</li> <li>Speed restriction on site to minimize dust emissions;</li> <li>Ensuring workers with awareness of safe driving and maintain good practices in machinery usage; and,</li> <li>Conducting periodic measurements for stacks of generators to ensure their compliance with Law 4/1994</li> </ul>	INSIGNIFICANT
<b>Ambient Noise</b>			
<ul style="list-style-type: none"> <li>Equipment and machinery</li> <li>Vehicle Movement</li> <li>Power Generators</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>Ensuring regular maintenance of construction equipment and machinery to minimize noise emissions;</li> <li>Use low-noise machinery and equipment, where possible;</li> <li>Schedule high-noise activities to avoid simultaneous operations that could amplify noise levels;</li> <li>Schedule high-noise activities to take place in morning hours, as possible; and,</li> <li>Provide hearing protection equipment to workers exposed to high noise levels.</li> </ul>	INSIGNIFICANT
<b>Impacts on Soil</b>			
<ul style="list-style-type: none"> <li>Domestic wastewater tanks, material and wastes storage, and accidental spills</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>Conduct maintenance of vehicles, trucks, and construction equipment off-site to reduce on-site emissions and spills;</li> <li>Collect and dispose of spillages from tank filling or generator operation as hazardous waste;</li> <li>Maintain good housekeeping practices to ensure a clean and organized construction site:</li> </ul>	INSIGNIFICANT



Environmental and social Aspects	Expected Impacts	Mitigation Measures Summary	Residual Impacts
		<ul style="list-style-type: none"> <li>Collect and transport wastewater by authorized contractors to ensure proper disposal and prevent contamination; and</li> <li>Implement precautionary measures to protect local wildlife from construction activities.</li> <li>Develop spill prevention and management plan.</li> <li><b>Non-Hazardous Solid Waste:</b> <ul style="list-style-type: none"> <li>Collect waste at designated collection points and store it in appropriate containers following regulations; and</li> <li>Use licensed contractors for collection and disposal of non-hazardous waste.</li> </ul> </li> <li><b>Hazardous Waste:</b> <ul style="list-style-type: none"> <li>Establish marked and physically separated bunded storage areas for hazardous waste; and</li> <li>Use licensed contractors for the collection and disposal of hazardous waste.</li> </ul> </li> </ul>	
<b>Impacts on the Biological Environment</b>			
<ul style="list-style-type: none"> <li>Waste and wastewater generation</li> <li>Fence construction</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>Ensure proper housekeeping onsite and offsite;</li> <li>Ensure proper speed limits onsite and offsite; and</li> <li>Provide awareness to the workers.</li> <li>A visible fence to fauna and avifauna, and</li> <li>The lowest wires should provide some distance at different intervals to allow wildlife species to crawl under them without injury.</li> </ul>	INSIGNIFICANT
<ul style="list-style-type: none"> <li>Offsite driving</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>implement and update waste and wastewater management plans;</li> <li>Provide awareness to the workers;</li> <li>Ensure proper housekeeping practice;</li> <li>Ensure speed control and the prohibition of off-track driving; and</li> <li>Ensure the proper maintenance of construction equipment.</li> </ul>	INSIGNIFICANT
<ul style="list-style-type: none"> <li>Habitat disruption, flora, fauna, and avifauna</li> </ul>	INSIGNIFICANT	<ul style="list-style-type: none"> <li>Develop, implement, and update a solid waste management plan to include waste collection, storage, transport, and disposal in an environmentally sustainable manner to avoid the attraction of vermin.</li> </ul>	INSIGNIFICANT
<b>Impacts on the Social Environment</b>			
<ul style="list-style-type: none"> <li>Water Resources</li> </ul>	INSIGNIFICANT	<ul style="list-style-type: none"> <li>A water management plan will be developed</li> </ul>	INSIGNIFICANT

## Non-Technical Summary

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Environmental and social Aspects	Expected Impacts	Mitigation Measures Summary	Residual Impacts
<ul style="list-style-type: none"> <li>Worker Influx</li> </ul>	Moderate	<ul style="list-style-type: none"> <li>Prioritize hiring local workers to reduce the number of incoming workers and minimize social disruption;</li> <li>Implement and maintain a community grievance mechanism; and,</li> <li>Selection of labour accommodation, as far away from existing communities as possible, and considering establishing a labour camp on site.</li> <li>Develop workers' code of conduct and provide awareness on GBV and SEAH related issues</li> </ul>	INSIGNIFICANT
<ul style="list-style-type: none"> <li>Cultural heritage</li> </ul>	INSIGNIFICANT	<ul style="list-style-type: none"> <li>Develop chance find procedures to indicate the actions to be taken in case of any finds during the construction activity excavations</li> </ul>	INSIGNIFICANT
<b>Infrastructure</b>			
<ul style="list-style-type: none"> <li>Land use</li> </ul>	INSIGNIFICANT	<ul style="list-style-type: none"> <li>No land ownership claims or other types of land uses exist at the project site. This was confirmed during stakeholders' meetings with local government representatives and nearby land uses and no risks are perceived in this regard</li> </ul>	INSIGNIFICANT
<ul style="list-style-type: none"> <li>Traffic</li> </ul>	MODERATE	<ul style="list-style-type: none"> <li>Dandra shall develop Transportation Management Procedures that apply to Dandra projects and operations, as well as their contractors and subcontractors. The procedure defines the minimum safety requirements for Dandra's transportation activities. The requirements are supplementary to national regulatory specifications and project or business unit specifications and/or insurance requirements</li> </ul>	MINOR
<b>Occupational Health and Safety</b>			
<ul style="list-style-type: none"> <li>Impacts on workforce health and safety</li> </ul>	Moderate	<ul style="list-style-type: none"> <li>The excavation sites will be surrounded with warning signs to prohibit access to these places;</li> <li>Contractors will ensure that construction workers will be continuously supervised, through the continuous presence of on-site supervisor(s) for close inspection and management of the construction activities;</li> <li>Ensure proper training for operators, regular maintenance of equipment, and implementation of safety protocols.</li> <li>Provide adequate hydration, schedule work during cooler parts of the day, and allow for regular breaks in shaded areas.</li> <li>Restrict vehicles speed so that they do not exceed the safety limit inside the site premises (15-20 km/h)</li> <li>All equipment will be inspected before the start of the job to ensure the safety of the workers;</li> <li>Use of personal protective equipment (PPE)</li> </ul>	MINOR



## Non-Technical Summary

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Environmental and social Aspects	Expected Impacts	Mitigation Measures Summary	Residual Impacts
		<ul style="list-style-type: none"> <li>Provide hearing protection, implement noise control measures, and schedule regular breaks for workers.</li> <li>Provide training on proper lifting techniques, and the use of mechanical aids.</li> <li>Implement fire prevention measures, maintain fire extinguishers on-site, and conduct fire safety training.</li> </ul>	
Operation Phase			
Air Quality			
<ul style="list-style-type: none"> <li>Emissions from emergency generator</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>Optimize the operation of backup generators to reduce usage and emissions.</li> </ul>	INSIGNIFICANT
Ambient Noise & Vibration			
<ul style="list-style-type: none"> <li>Operation of Transformers, and other operational components of battery energy storage systems.</li> <li>Use of backup generators during power outages</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>Potential noise generating machines and equipment are designed to meet statutory regulations concerning noise.</li> <li>Workers at noise generating machinery and equipment will be provided with suitable personal protective equipment (PPEs).</li> <li>A grievance mechanism will be adopted for assessing complaints, which would cover operation noise, if any</li> </ul>	INSIGNIFICANT
Impact on the Biological Environment			
<ul style="list-style-type: none"> <li>Waste and wastewater generation</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>Ensure proper housekeeping onsite and offsite;</li> <li>Ensure proper speed limits onsite and offsite; and</li> <li>Provide awareness to the workers.</li> </ul>	INSIGNIFICANT I
<ul style="list-style-type: none"> <li>Offsite driving</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>implement and update waste and wastewater management plans;</li> <li>Provide awareness to the workers;</li> <li>Ensure proper housekeeping practice; and</li> <li>Ensure speed control and the prohibition of off-track driving.</li> </ul>	INSIGNIFICANT
Impact on the Social Environment			

### Non-Technical Summary

46

Environmental and social Aspects	Expected Impacts	Mitigation Measures Summary	Residual Impacts
<ul style="list-style-type: none"> <li>Water Resources</li> </ul>	INSIGNIFICANT	<ul style="list-style-type: none"> <li>Wastewater generated during the operation phase is minimal and will be collected by an approved contractor and discharged to designated treatment plants.</li> </ul>	No residual impact
<b>Impacts on Occupational Health and Safety</b>			
<ul style="list-style-type: none"> <li>Impacts on workplace</li> </ul>	INSIGNIFICANT	<ul style="list-style-type: none"> <li>A health and safety policy will be applied</li> <li>Abide by all national occupational health and safety regulations, Law 14/2025</li> <li>Provision of suitable PPE</li> <li>Sufficient drinking water supply</li> </ul>	INSIGNIFICANT

## 7. Environmental and Social Management Plan (ESMP)

The project will develop and implement an Environmental and Social Management Plan (ESMP) outlining specific mitigation and monitoring measures to ensure compliance with all applicable legal and institutional requirements, as well as EBRD Performance Requirements.

The ESMP encompasses the following key components:

- Summary of Impacts and Mitigation Measures
- Health, Safety and Environment (HSE) Plan
- Transportation Management Plan
- Noise Management plan
- Hazardous and Non-hazardous Waste Management Plan
- Water and Wastewater Management
- Chance Find Procedure
- Preventive and Corrective Maintenance
- Wastewater Management Plan
- Biodiversity Management Plan
- Housekeeping and Cleanliness
- Social Management Plan includes Dandara's SEAH and GBV Management Plan
- Institutional Arrangements: Defined roles and responsibilities for implementing the ESMP, involving the project proponent, contractors, and relevant government agencies to ensure accountability and effective coordination among stakeholders.
- Capacity Building: Provisions for training and capacity building for project staff and contractors on best practices in environmental and social management, enhancing their ability to effectively implement the ESMP.

Table ? below provides a comprehensive overview of the project management plan, including potential environmental aspects identified in the ESIA for both the construction and operation phases of the project, as well as the proposed mitigation measures designed to minimize these impacts.

Table 8: Overview of the ESMP Plan

Aspect	Issues of concern	Actions	Party Implementing the Action	Indicator of completion	Estimated Cost	Required Completion Date
<b>Construction Phase</b>						
Air Quality	Dust emissions	<ul style="list-style-type: none"> <li>- Reduce idling times for vehicles and machinery;</li> <li>- Maintaining machinery and vehicles in good working</li> <li>- Speed restriction on site s;</li> <li>- Ensuring workers with awareness of safe driving and maintaining good practices in machinery usage; and,</li> <li>- Periodic measurements for stacks of generators</li> </ul>	Construction contractor	<ul style="list-style-type: none"> <li>- Monitoring plan</li> <li>- Air quality measurements</li> </ul>	Cost of measurements in the monitoring plan below	Throughout the construction phase period
	working conditions of machinery	<ul style="list-style-type: none"> <li>- Ensure good working conditions through frequent inspection of all construction equipment</li> </ul>	Construction contractor	Maintenance logs	Cost of maintenance	
Noise Level	working conditions of machinery	<ul style="list-style-type: none"> <li>- Regular maintenance of construction equipment</li> <li>- Use low-noise equipment, where possible;</li> <li>- Schedule high-noise activities to avoid simultaneous operations that could amplify noise levels;</li> <li>- Schedule high-noise activities to take place in morning hours</li> </ul>	Construction contractor	Noise measurements and Maintenance logs	Cost of measurements in the monitoring plan + cost of maintenance	Throughout the construction phase period
	Provision of PPEs	<ul style="list-style-type: none"> <li>- Providing necessary PPEs for workers</li> </ul>	Construction contractor			
Soil	housekeeping practices	<ul style="list-style-type: none"> <li>- Develop and implement site management plan, solid waste management plan and spill prevention plan</li> </ul>	Construction contractor Developer (include provisions in the	- Solid/hazardous waste and wastewater	- Part of construction activities management	Throughout the construction phase period

Aspect	Issues of concern	Actions	Party Implementing the Action	Indicator of completion	Estimated Cost	Required Completion Date
<b>Construction Phase</b>						
	Waste/wastewater management		construction contracts. Developers to ensure contractors compliance)	management contract - Contractor follow up documents	- Cost of transportation and disposal of waste	
Occupational Health and Safety	Site Staff and Workplace Safety	- Developing HSE procedures according to national requirements and international standards	Contractor	HSE provisions in the construction contracts	Construction cost	Before construction activities
Emergency Response plans	Site Staff and Workplace Safety	- Develop procedures for emergency control	Contractor	Emergency response plan		Before project commissioning
Waste management	Worker's health	- Developing a solid waste management plan	Construction contractor	Solid waste management contract	Cost of transportation and disposal	Throughout the construction phase period
Biological Environment	Pests and invasive species	- Good housekeeping and proper waste management	Construction contractor	Waste management contract		Throughout the construction phase
	Disturbance to wildlife	- Awareness (toolbox talks and awareness signs) - Implementation of mitigation measures - Supervision and implementation of deterring measures	Construction contractor	Requirements specified in contracts		Throughout the construction phase
Social Environment	Workers influx	- Prioritize hiring local workers - Implement and maintain a community grievance mechanism; and,	Developer/Construction contractors	Labour management plan, workers		Throughout the construction phase period

Aspect	Issues of concern	Actions	Party Implementing the Action	Indicator of completion	Estimated Cost	Required Completion Date
<b>Construction Phase</b>						
		<ul style="list-style-type: none"> <li>- Selection of labour accommodation, away from existing communities, as possible, and considering establishing a labour camp on site.</li> <li>- Develop HR policies including GBV and SEAH plans</li> </ul>		accommodation inspection checklist  GBV and SEAH policies  Workers Awareness		
	Cultural heritage	- develop chance find procedure	Developer/Construction contractors	Developed procedures	Management cost	Before construction activities

## Non-Technical Summary

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Aspect	Issues of concern	Actions	Party Implementing the Action	Indicator of completion	Estimated Cost	Required completion Date
<b>Operation Phase</b>						
Air quality	Backup generator emissions	- Optimize the operation of backup generators to reduce usage and emissions.	Developer	Emission measurements	Operation cost	Periodically Throughout operation stage
Noise	Transformers and BESS	- Provide workers at noise generating machinery and equipment will be provided with suitable (PPEs). - A grievance mechanism will be adopted for assessing complaints,	Developer	Noise measurements	Operation cost	Periodically Throughout operation stage
Biological Environment	Same as for construction phase	- Same as for construction phase	Developer	Reports	Operation cost	Throughout the project lifetime
Impact on social environment	Water consumption	- Wastewater generated during the operation phase is minimal and will be collected by an approved contractor and discharged to designated treatment plants	Developer	Wastewater management plan	Operation cost	Throughout the project lifetime
Labour rights and welfare	working conditions	Develop Human Resources policy	Developer	Contracts (with workers)	Operation cost	Throughout the project lifetime
Training and Awareness	competence of the project personnel	training for the personnel according to the particular responsibility	Developer	Training plans	Training cost	Throughout the project lifetime
Occupational Health and Safety	Site Staff and Workplace Safety	- Developing HSE procedures	Developer	Development of HSE policies	Operation cost	Before project commissioning



Aspect	Issues of concern	Actions	Party Implementing the Action	Indicator of completion	Estimated Cost	Required completion Date
Emergency Preparedness and Response	Operation risk management	- Adopt a probabilistic risk assessment framework	Developer	Emergency response plan	Operation cost	Before project commissioning
Community health, safety and site security	- risk of road traffic accidents - Site security	- Develop site security and safety plan - Develop grievance mechanism	Developer	- security plan - SEP and grievance mechanism and register	Operation cost	Throughout the project lifetime

**Environmental and Social Monitoring Plan**

Ensuring compliance with regulatory standards and the effectiveness of mitigation measures through regular checks of air quality and noise levels in workplace. Also, the project will regularly monitor community satisfaction, local needs (healthcare, water, etc.), understanding of the grievance mechanism, and unresolved grievances.

Table 9: Proposed Environmental Monitoring Plan

Receptors / Source of impact/risk	Type of monitoring		Monitoring location	Target / Indicators	Frequency of monitoring	Responsibility	Implementation	Approximate annual costs
Construction phase								
Workplace and neighbouring industrial area	Noise measurements		Project site and borders near the industrial zone	Compliance of noise intensity to standards	Measurement at two locations quarterly	All contractors and sub-contractors, supervised by Dandra	Third party (research entity or certified lab)	~10,000 EGP
	Air emissions		Project site and borders near the industrial zone	Compliance of air emission standards	Measurement at two locations quarterly	All contractors and sub-contractors, supervised by Dandra	Third party (research entity or certified lab)	~ 35,000 EGP
	Biodiversity	Habitats and biodiversity	Project site and Vicinity (Aol)	- Absence of hazards to wildlife and habitats - Proper implementation of mitigation measures	Daily	All contractors and sub-contractors, supervised by Dandra	Project personnel	Included in staff salaries
		Fauna		- Number of fauna encounters - No or reduced number of fatalities (such as road mortalities)	Chance encounters			
		Pests		- Good housekeeping - Absence of pests	Daily			
Operation phase								
Workplace	Noise measurements		Transformers and inverters area	Compliance of noise intensity to standards	Annually	Project	Third party (research entity or certified lab)	~10,000 EGP

Receptors / Source of impact/risk	Type of monitoring	Monitoring location	Target / Indicators	Frequency of monitoring	Responsibility	Implementation	Approximate annual costs
Emergency generators stacks	Exhaust measurements	Stacks of emergency generators (SO <sub>2</sub> , NO <sub>2</sub> , CO, PM <sub>10</sub> )	Compliance with point source air emissions standards	Annually	Project	Third party (research entity or certified lab)	~ 25,000 EGP
Project site and vicinity	Biodiversity (same as for construction phase)	Same as for construction phase	Same as for construction phase	Same as for construction phase	Project	Project personnel	Included in staff salaries

## 8. Stakeholders Engagement

### 8.1 Stakeholder Identification and Analysis

This section outlines the stakeholder groups identified for the project, with ongoing reviews and updates. Stakeholders were determined based on the Project's Area of Influence (Aoi) and potential impacts.

#### Stakeholder Groups:

**Primary stakeholders:** those who will be directly affected, positively or negatively by a development. These would, in particular, include low-income and marginalized groups who have traditionally been excluded from participating in development efforts and outcomes; as well as the local community-based organizations which might represent their interests in the project, and in all cases, can help to access communities in general and these groups in particular.

**Secondary stakeholders:** include agencies, experts, interested parties and anyone able to influence the outcome of the development. These mainly include Central Government, line ministries, local government/authorities, implementing agencies, national and international lending institutions, media, and academic institutions. Secondary stakeholders are important as they provide valuable data and information specific to the area, i.e. they are a source of secondary data.

A preliminary stakeholder analysis was conducted to assess their importance, roles, and engagement approach.

Stakeholders have been identified considering the following factors:

- Project's nature and activities.
- Geographical extension and location of the project; and
- Environmental and Social aspects and potential impacts of the project

Accordingly, the following preliminary key stakeholder groups have been identified in Table (3) below:

**Table 10: Stakeholders Groups**

Stakeholder Category	Stakeholders	Impact, Influence and Interests
<b>Primary Stakeholders</b>		
<b>Local Businesses &amp; Industry</b>	Small business owners in the nearest cities and towns	<b>Economic interest in the project (providers of goods and services).</b>
	Neighbouring Nagaa	<b>Potentially affected by the project construction activities</b>

Stakeholder Category	Stakeholders	Impact, Influence and Interests
	Hammadi Light Industries area	
Interested organizations	NGOs <sup>1</sup>	National and local, which can provide social context and effective contacts to concerned communities
Local Communities/ residents	Nearest communities to the project site <sup>2</sup>	Provision of workforce, may include key leadership figures of community stakeholders
Workers	Employees of the developer and the contractors	Exposure to occupational health and safety risks Economic benefits
Vulnerable groups (specific vulnerable groups will be identified as the Project development proceeds)	women groups, disabled groups, elderly groups, etc..	Such groups have a vested interest in the project due to mainly potential for job opportunities. In addition, such groups could be impacted by other potential negative impacts (e.g., worker influx, Gender Based Violence and Harassment (GBVH), etc.)
<b>Secondary Stakeholders</b>		
National Regulators/ agencies & Permitting Authorities	NREA EEAA EIA,	Includes authorities and agencies responsible for project permitting approvals.
Other relevant agencies	Egyptian Electricity Transmission Company Ministry of Transport (roads and bridges Authority) Water and Wastewater company	Mostly related to utilities infrastructure such as the OHTL, water and wastewater services
Local Government	Qena Governorates and Nagaa Hammdai city.	The Governorate is of political importance and are home to the primary stakeholder and therefore could have a role in maximizing benefits and/or controlling adverse impacts. They also have a key role in issuing project construction permits as well as supplying utility services and security. In addition, support in facilitating advertisement of job opportunities and receiving applications from the communities
Healthcare Providers and emergency services	Main hospitals and healthcare units	Would need to cater to the large workforce attracted by the project

<sup>1</sup>On the local level the following CDAs have been identified Elderb NGO, Baraka Village Charity Organization and “Moaasaset Al Nedaa El Khaireya, Enfaa Baladak Charity NGO have been identified so far and on the national level Nature Conservation Egypt, the local representative of BirdLife International. The updating, mainly expansion, of these lists on both levels will be a continuous activity throughout the project lifetime .

<sup>2</sup> Include El Baraka village, Nagaa Mubarak village and agriculture reclamation activities



Stakeholder Category	Stakeholders	Impact, Influence and Interests
Media	National and local mass media and newspapers	Channel to disseminate information; key public opinion influencers.

## 8.2 Stakeholder Engagement Process and Previous Consultation during the Scoping and ESIA stages

As stakeholder engagement is an ongoing process, future engagement activities during the pre-construction and mobilization, construction and operations will ensure that information disclosure and consultation activities are effective and meaningful for all stakeholders over the lifetime of the project. Initial stakeholder consultation activities were initiated at the scoping and ESIA stage. The following table presents a brief summary of the stakeholders' consultation activities to date:

Table 11: Summary of the Stakeholder's Consultation Activities to Date

Stakeholders	Issues discussed
<b>27<sup>th</sup> July 2025</b>	
Qena Governorate Meeting	<ul style="list-style-type: none"> <li>– The meeting primarily focused on the land allocation issue and the possible options for selection. One of the key selection criteria discussed was the availability of land suitable for the solar project while ensuring the avoidance of any potential land ownership disputes.</li> <li>– The meeting also addressed flood hazards at the proposed locations and the corresponding flood protection requirements</li> </ul>
<b>6<sup>th</sup> October 2025</b>	
EEAA- Central EIA department	<ul style="list-style-type: none"> <li>– A phone call took place with the head of energy projects at the central EIA department of EEAA. The discussions primarily focused on the categorization of the PV project where it has been advised that the project is to be categorised as Scoped B, which does not require organizing public disclosure meetings. As per the national environmental law, EEAA is to issue its opinion on the ESIA within 30 days from receipt of the ESIA for review.</li> </ul>
<b>27<sup>th</sup> October 2025</b>	
Qena City Council Local Office	<ul style="list-style-type: none"> <li>– The duration of project construction phase is expected to be maximum 18 months. This stage is the most labour intensive where the number of labour is expected to range within an average of 5000 workers during peak construction. During operation the expected number of labour would be about 100 personnel</li> <li>– The labour qualifications required for construction works will include low and semi-skilled labour as well as highly skilled technical qualifications. All contractors are encouraged to continuously increase the percentage of local content.</li> <li>– for the installation of the PV panels in addition to project management engineers. During operation, the labour required include highly qualified and experience technical personnel for operating and maintaining the operation of the PV and the substation.</li> <li>– The sources of labour will be primarily from the local communities from the surrounding villages as well as from Nagaa Hammadi city and Qena governorate. It was emphasized that in cases of lack qualifications within the local communities and/or the Qena governorate, such qualifications will be sought from around Egypt.</li> <li>– Job opportunities announcements will be through Qena governorate.</li> <li>– In case there are grievances related to the hiring process that are submitted to the governorate or the company, Scatec investigates each case and notifies the governorates about the grievance investigation results.</li> <li>– It was indicated that as result of concentration of workers accommodation within the village significant increase of rental prices which decreased the availability of apartments to the local communities. Accordingly, Sactec instructed all contracts to withdraw their workers from the El Baraka housing and provide alternative housing in the surrounding urban centers in addition to the onsite workers camps.</li> <li>– No workers accommodation with take place at El Baraka village for the proposed Dandara project. In addition, with maximizing the number of workers form the local communities, the need for accommodation of workers will considerably decrease.</li> <li>– The potential impact on nearby community resources, such as food, water, etc., as result of workers influx, was reported to be insignificant since the labour needs are sought for allover the governorate.</li> <li>– Moreover, as result of the project, the project will result in saving energy that would have been consumed by the EgyptAlum from the electricity grid and make it available for other development purposes</li> </ul>
	<ul style="list-style-type: none"> <li>– The water needs of the current Obelisk project are sought from Nagaa Hammadi water plant that has the capacity to meet the demand of the new Dandara project especially that there will not be significant overlap between the two project activities.</li> <li>– The project's wastewater is managed through the existing wastewater treatment plant northwest the project site. Reportedly, a new wastewater treatment plant is currently under construction to meet the expansion needs of Nagaa Hammadi industrial area.</li> </ul>

Stakeholders	Issues discussed
Nagaa Hammadi Industrial area	<ul style="list-style-type: none"> <li>– The land area required for the Dandar PV project could not be accommodated within the limited land areas available within EgyptAlum premises. Moreover, the area within EgyptAlum is subject to various air emissions from the Aluminium production which may deposit on the surface of the PV panels and affects its production efficiency. In addition, allocation for renewable energy projects is managed and granted through the New and Renewable Energy Authority (NREA).</li> <li>– Regarding wage gaps, it was also advised that this issue may be result due to the fact that the PV projects are committed to comply with the national minimum wage rates that are higher than those currently offered by the manufacturing facilities.</li> <li>– It was advised that the industries can participate in the bidding requirements issued for food and material supply. A list of available industries and their specializations and products will be compiled and provided to Scatec to enable identifying areas of potential cooperation in the future.</li> <li>– Based on the experience with the current Obelisk project the noise from ramming did not reach the industrial area and no impacts have been identified. However, dust was identified as occasional issues mainly during windy conditions. With the continued implementation of existing dust suppression measures—such as soil damping—dust impacts are expected to be minimized. The same mitigation measures would be implemented for the proposed Dandara project.</li> </ul>
<b>28<sup>th</sup> October 2025</b>	
El Baraka Healthcare unit	<ul style="list-style-type: none"> <li>– The project team emphasized the importance of hiring from local communities near the project area.</li> <li>– The project team advised that the issue has been addressed through maximizing the local employment enhancing the on-site accommodation in workers camps. Contractors has also been instructed to minimize the accommodation in El Baraka and provide alternative the accommodation within larger urban areas.</li> <li>– The strain on local resources as result of workers influx was raised. It was advised by the attendees that no shortage in resources, food, water, or other services and utilities has been experienced as result of workers influx.</li> <li>– Regarding the community benefits and potential community support, the project team indicated that the proposed project together with the existing one, will help strengthen the electricity grid, thereby indirectly benefiting grid users by making additional power available and minimize the national regular power cuts that has been witnessed in Egypt over the last years.</li> <li>– In addition, Scatec through its corporate social responsibility plans (CSR) has provided support to various families through projects that would ensure sustainable income.</li> </ul>
Enfa'a Baladak "Support your community" Charity NGO	<ul style="list-style-type: none"> <li>– The project team clarified that the duration of project construction phase is expected to be maximum 18 months. This stage is the most labour intensive where the number of labour is expected to range within an average of 5000 workers during peak construction. During operation the expected number of labour would be about 100 personnel</li> <li>– The hiring policy and procedures were explained, and the attendees were encouraged to follow the jobs advertisements and apply through the governorate.</li> <li>– The project team also stressed that women are encouraged apply for jobs depending on their qualifications.</li> <li>– Regarding community support, the project team clarified that Scatec through its corporate social responsibility plans (CSR) has provided support to various families through projects that would ensure sustainable income</li> <li>–</li> </ul>
Local communities: Nagaa Mubarak Village next to El Baraka Village - Hiw	<ul style="list-style-type: none"> <li>– The project team reaffirmed Scatec's strong commitment to maximizing local employment and ensuring high local content during both construction and O&amp;M phases. The employment is done typically through advertisement on the governorate website as well as social media.</li> <li>– The project team explained that the issue of increase housing rental was addressed through the following measures: <ul style="list-style-type: none"> <li>○ Conducting labor and accommodation influx assessments to quantify impacts, identify hotspots, and determine suitable alternative accommodation areas for workers.</li> <li>○ Requiring contractors to avoid high-impact areas and seek housing options in lower-density zones.</li> <li>○ Monitoring implementation of these measures, which reportedly helped stabilize and reduce rental prices</li> </ul> </li> </ul>

Stakeholders	Issues discussed
	<ul style="list-style-type: none"><li>– Regarding the community benefits and potential community support, the project team indicated that the proposed project together with the existing one, will help strengthen the electricity grid, thereby indirectly benefiting grid users by making additional power available and minimize the national regular power cuts. Through Scatec corporate social responsibility plans (CSR) support was provided to various families through projects that would ensure sustainable income.</li><li>– Attendees advised that the ongoing Obelisk project has a positive impact on the local business in the area specifically in areas of food services areas. It was advised that the increased demand as result of the project did not put pressure on the availability of food or the food prices.</li></ul>

### 8.3 Stakeholders Engagement Plan

The project will deploy an E&S manager based in Cairo with frequent site visits and a local Community Liaison Officer (CLO) responsible for implementing the Stakeholder Engagement Plan (SEP). Engagement activities will focus on:

- Disseminating Project information.
- Discussing potential impacts and risks and how they will be managed.
- Seeking views and concerns on the Project and its activities.
- Building trust with the Project and stakeholders including communities.
- Establishing effective feedback analysis mechanism and Grievance Mechanism.

#### Stakeholder Engagement Channels

The following communication channels would be used

Mechanism	Description
Social media	The official Facebook page of Qena governorate and the Nagaa Hammadi city could be used as a primary source of information. Both Facebook groups have more than 5000 members. There are also communities Facebook that could be used.
Press Release via Company	The company project website, which contains key project information and updates. Updates on the project can be found at <a href="https://scatec.com/2025/03/13/scatec-signs-ppa-with-egypt-aluminium-for-major-solar-bess-project/">https://scatec.com/2025/03/13/scatec-signs-ppa-with-egypt-aluminium-for-major-solar-bess-project/</a>
Flyers (Factsheets)	Job vacancies and other project information will be posted at the governorate webpage and local labour offices, NGOs and social media
Face-to-face (one on one)	Could be arranged through the available NGOs, particularly the women NGOs. Face-to-face communication is usually a preferred method of communication with the communities. The project intends to assign a community liaison to facilitate more effective face-to-face community engagement.
Focus Group Discussions (FGDs) with vulnerable groups	The project will hold annual FGDs with vulnerable groups such as the elderly, women, illiterate people, people with special needs and any community members who may not be able to participate in formal meetings.

### 8.4 Stakeholder Engagement Resources

Table (12) below presents the roles and responsibilities for the SEP implementation.

**Table 12: Roles and responsibilities for SEP implementation**

Responsible Party	Roles and Responsibilities
Project Management	<ul style="list-style-type: none"> <li>– Oversee the overall implementation of SEP, including frequent interfacing with CLOs.</li> <li>– Ensure resources required (budgetary, human, and logistical resources) are available for the implementation of the SEP</li> <li>– Participate in implementation of the requirements of the stakeholder grievance mechanism as applicable to include signing grievance resolution forms.</li> </ul>
E&S manager	<ul style="list-style-type: none"> <li>– Regularly update the SEP and Grievance Mechanism</li> <li>– Implement and monitor stakeholder information exchange and</li> </ul>

Responsible Party	Roles and Responsibilities
	participation strategies. – Reporting to project management – Government and lenders liaison
Community Liaison Officer (CLO) (Male and Female)	– Participate in the update the SEP as required during the project's lifetime, to include planning, construction, operation, and decommissioning. – Overall responsibility for implementing the requirements of the SEP plan – Interaction with the community – Undertaking monthly internal audits and Reporting to E&S management – Coordinate with the EPC Contractor's team
EPC Contractor / Project Operator	The EPC Contractor and its subcontractors(s) have the role in addressing the community grievances related to their workforce and report to the CLO.

## 8.5 Stakeholder Engagement Communication Action Plan



Table 13: Stakeholders communication Action plan

Stakeholder	Potential issues/ concerns	Key messages	Communication mechanism	Frequency	Responsibility
<b>Primary Stakeholders</b>					
<b>Local Businesses &amp; Industry</b>	Assess the capacities of relevant local suppliers and urge contractors to increase local content	Disclose information on project updates and development needs	One-on-one meetings,	Once pre-construction, with relevant supplier and contractors Ad-hoc as needed during construction	Relevant developer team, CLO
<b>NGOs</b>	Community investment initiatives. Assistance with outreach to vulnerable groups	Project information and disclosures, <b>potential CSR activities</b> and Disclosure of (SEP) including grievance mechanism	One-on-one meetings, FGDs, Prepare leaflet in Arabic with updates on Project including environmental and social issues	As required	Relevant developer team, CLO
<b>Workers</b>	Occupational health and safety risks, code of conduct and workers grievance mechanism, economic benefits	Project information and health and safety requirements and Disclosure of grievance mechanism	– Induction trainings – Internal meetings /toolbox talks	– Upon employment – Continuous during construction and operation	Developer HSSE Team / EPC Team as applicable
<b>Local Communities residents/ community)</b>	Provision of workforce, may include key leadership figures of community stakeholders	Disclosure of Stakeholder Engagement Plan (SEP) including grievance mechanism, project labour needs, potential CSR activities and disclosure of (SEP) including grievance mechanism	One-on-one meetings, FGDs,	Once before construction (to be updated when required)	Relevant developer team, CLO
<b>Secondary Stakeholders</b>					
<b>Regional Government (Qena Governorate, Nagaa Hammadi city)</b>	Licensing renewal, security, employment and business opportunities, community investment initiatives	Disclose information on project updates and development	One-on- one meetings, written formal correspondence	Bi-annually or as required	Developer team as relevant

Stakeholder	Potential issues/ concerns	Key messages	Communication mechanism	Frequency	Responsibility
<b>NREA</b>	Issuance of operation permits	Disclose information on project updates and development	One-on- one meetings, written formal correspondence	<ul style="list-style-type: none"> <li>– During ESIA development</li> <li>– Issuance of operation permit and as required</li> </ul>	E&S manager and other Developer team as relevant
<b>EEAA</b>	ESIA approval , project follow up and ESMP inspection	Disclose information on project updates and development	One to one meetings, written formal correspondence,	<ul style="list-style-type: none"> <li>– At the scoping and ESIA preparation</li> <li>– Biannually or as required</li> </ul>	Developer E&S manager
<b>Local Labour office</b>	Employment & business opportunities, work permits.	Disclose information on project updates and development	One-on-one meetings, written correspondence	In advance of sub-contracting. Bi-annually or as required	E&S Manager, CLO & Project Human Resource representatives
<b>Healthcare service providers</b>	Handling of Site personnel emergency injuries & Corporate Social Responsibility activities for Community	Health related risks, impacts and mitigation plans.	One-on-one meetings, written correspondence.	As required	E&S Manager, & CLO
<b>Education providers (specifically technical /vocational training institutes)</b>	Project updates, opportunities available	Skill requirements, per project information and disclosures	One-on-one meetings	As required	E&S Manager, & Project Human Resource representatives & CLO
<b>Other Agencies relevant to utilities:</b> Ministry of Transport (roads and bridges Authority) Local Water and wastewater company	Project updates and utility requirements and planning	Disclose construction information and project and time schedule and needs	One-on-one meetings, written correspondence	As required	Relevant developer team as

## 8.6 Institutional Arrangements

The SEP will be managed by a Community Liaison Officer (CLO). Table ?? provides the institutional roles and responsibilities of implementing the SEP.

**Table 14: Roles and Responsibilities**

<b>Responsible Party</b>	<b>Roles and Responsibilities</b>
Project Management	<ul style="list-style-type: none"> <li>– Oversee the overall implementation of SEP, including frequent interfacing with CLOs.</li> <li>– Ensure resources required (budgetary, human, and logistical resources) are available for the implementation of the SEP</li> <li>– Participate in implementation of the requirements of the stakeholder grievance mechanism as applicable to include signing grievance resolution forms.</li> </ul>
E&S manager	<ul style="list-style-type: none"> <li>– Regularly update the SEP and Grievance Mechanism</li> <li>– Implement and monitor stakeholder information exchange and participation strategies.</li> <li>– Reporting to project management</li> <li>– Government and lenders liaison</li> </ul>
Community Liaison Officer (CLO) -(Male and Female	<ul style="list-style-type: none"> <li>– Participate in the update the SEP as required during the project's lifetime, to include planning, construction, operation, and decommissioning.</li> <li>– Overall responsibility for implementing the requirements of the SEP plan</li> <li>– Interaction with the community</li> <li>– Reporting to E&amp;S management</li> <li>– Coordinate with the EPC Contractor's team</li> </ul>
EPC Contractor / Project Operator	The EPC Contractor and its subcontractors(s) have the role in addressing the community grievances related to their workforce and report to the CLO.

## 1. Introduction

### 1.1 Project Overview

Dandra Solar Power Plant Project represents a strategic step in Egypt's efforts to transition to a low-carbon economy and promote the use of renewable energy in industrial sectors, in line with Egypt Vision 2030 and the Sustainable Development Goals.

Scatec company intends to establish a power plant 1000 Megawatt (AC) coupled with a Battery Energy Storage System (BESS) with a capacity of 200 Megawatt hour which will be built over 2 phases, through its affiliated Company Dandra Solar Power, S.A.E., the first phase will have a capacity of 500 Megawatt (AC) coupled with a Battery Energy Storage System (BESS) with a capacity of 100 Megawatt hour. The second phase will be a duplicate of the first phase. The current study focuses on the first phase only.

The project is located in Qena Governorate, east of the Nagaa Hammadi Industrial Zone, and near the Egypt Aluminium Company (EgyptAlum) complex, one of the largest and most energy-intensive industrial complexes in Egypt. The total usufruct area is approximately 2335 ha ( $\approx 23,350,000 \text{ m}^2$ ) has been allocated for phase 1 and 2, of which approximately 1130 ha ( $\approx 11,300,000 \text{ m}^2$ ) has been dedicated for the implementation of the first phase of the Dandra Solar Power Plant.

The project aims to supply EgyptAlum with a portion of its electricity needs by a clean, renewable source, contributing to a reduction of greenhouse gas emissions by up to 60% and improving energy efficiency in the industrial sector. It is expected to contribute to improving the carbon footprint of the Egyptian industry.

The project is among the first large-scale industrial decarbonization initiatives in the region, reinforcing Egypt's leadership in renewable energy and low-emission industries. Its proximity to the Nag Hammadi Industrial Zone substation enables a direct and efficient connection to the national grid.

The project is being implemented in collaboration with international financing institutions, including the European Bank for Reconstruction and Development (EBRD), the African Development Bank (AfDB), European Investment Bank (EIB) and Cassa depositi e prestiti S.p.A. (CDP). This demonstrates international partners' confidence in Egypt's sustainable investment climate and its capacity to deliver projects with lasting environmental and economic benefits.

Figure 1 below shows Dandra Solar Power Project and the surrounding activities in the study area. The figure also shows the proposed route of the overhead transmission line to connect the project to the national electricity grid, connecting it to the substation of the Nagaa Hammadi Industrial Zone.

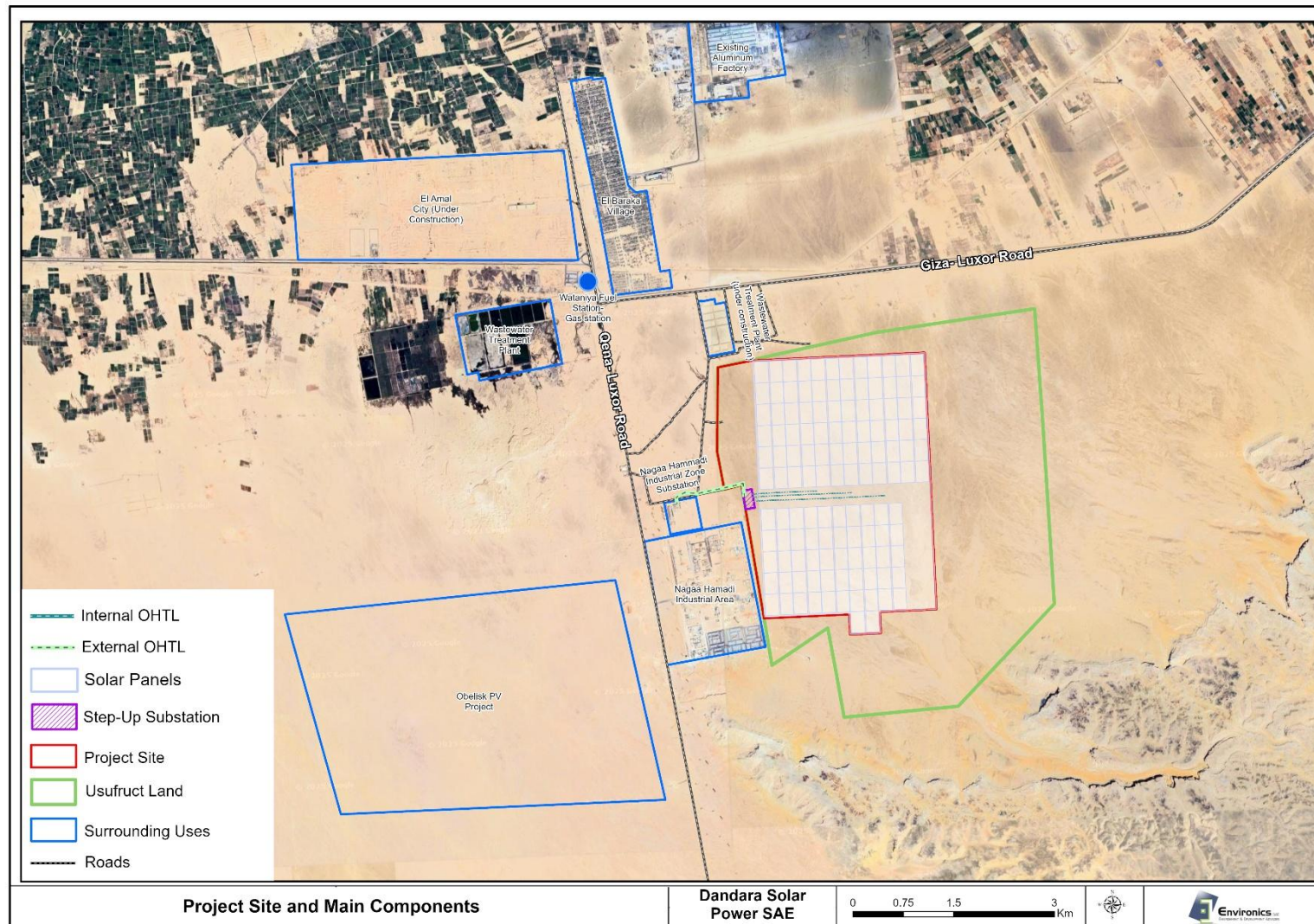


Figure 1: Proposed Project Location and the Surrounding Activities



In accordance with Environment Law 4/1994 (as amended by Laws 9/2009 and 105/2015) and its revised Executive Regulations, this Environmental Impact Assessment (EIA) study is prepared for the construction and operation of Dandra Solar Power Plant.

As per the project categorization lists issued by the EEAA in June 2023, the first phase of Dandra PV Plant (500MW, AC) and the BESS have been classified as Category Scoped-B projects.

However, according to the Lenders' categorization, the project is a Category A project (High E&S risk), requiring a full-scale ESIA including public disclosure activities.

## 1.2 Objective of the ESIA

The objective of the ESIA is to ensure that the project is environmentally sound and socially sustainable and that any potential negative environmental consequences are recognized early in the project cycle and taken into account before project implementation. It also aims to propose appropriate mitigation measures to prevent/reduce potential negative impacts during the construction and operation of the proposed project, to be within the limits of legal environmental and social requirements.

Moreover, the ESIA aims to satisfy the legal environmental requirements, addressed in the Environment Law No. 4 of 1994, amended by Law No. 9 of 2009 and Law No. 105/2015, and the up-to-date Executive Regulations.

Moreover, the ESIA is also intended to satisfy the environmental and social requirements of the international funding institutions, including specifically the European Bank for Reconstruction and Development (EBRD), the African Development Bank (AfDB), European Investment Bank (EIB), and Cassa depositi e prestiti S.p.A. (CDP), as well as the multilateral development banks.

## 1.3 Scope of Work

The ESIA of the proposed project would evaluate the project's potential environmental and social risks and impacts in its area of influence; identify ways of improving the project's environmental and social performance during its different stages by preventing, minimizing, or mitigating potential adverse environmental and social risks/impacts and enhancing positive impacts.

The scope of work covers the impacts of the PV power plant and BESS Project, which includes construction, operation, and decommissioning of the PV plant.

## 1.4 Structure of ESIA study

This ESIA report includes:

- **Chapter 1 (the current chapter):** Introduction and Background on the project for which the ESIA is developed as well as the scope and objectives of the ESIA study
- **Chapter 2:** Description of the intended PV plant construction and operation phases and the expected environmental and social aspects



- **Chapter 3:** Description of the local regulatory framework as well as the International E&S standards and requirements applicable to the project activities
- **Chapter 4:** Description of the environmental baseline and social context in the project area
- **Chapter 5:** Discussion of alternatives for different project components.
- **Chapter 6:** Assessment of the potential environmental and social risks and impacts and their mitigation measures.
- **Chapter 7:** The environmental and social management and monitoring plan for the PV plant
- **Chapter 8:** Stakeholders Consultation

## 2. Project Description

Scatec plans to develop a 500 MWac solar photovoltaic power plant 'Dandara Solar Power SAE' combined with a 100 MWh Battery Energy Storage System (BESS) in Qena Governorate, east of the Nagaa Hammadi Industrial Zone, as a first phase. The second phase will be a duplicate of the first phase. The current study focuses on the first phase only.

The project will supply renewable electricity to the Egypt Aluminium Company (EgyptAlum) under a long-term Power Purchase Agreement (PPA). Its primary objective is to support the decarbonization of aluminium production, ensure compliance with the European Union's forthcoming Carbon Border Adjustment Mechanism (CBAM), and reduce reliance on natural gas, while contributing to Egypt's renewable energy and climate targets.

### 2.1 Project Location

The usufruct land, allocated for phase 1 and 2, spans approximately 2335 ha ( $\approx 23,350,000$  m<sup>2</sup>) of which 1130 ha ( $\approx 11,300,000$  m<sup>2</sup>) are designated for the first phase for the development of the 500MWac solar power project. The site is located in a desert area to the east of the Nagaa Hammadi Industrial Zone within Qena Governorate. It lies south-east of the Nagaa Hammadi Aluminum Complex (EgyptAlum).

The Giza–Luxor Road lies approximately 1.2 kilometers north of the project site, providing convenient regional connectivity. The site can be accessed via an unpaved road extending westward for about 2.5 kilometers from the Giza–Luxor Road, or through another unpaved road extending approximately 2.5 kilometers westward from the Qena–Luxor Desert Road. Access is also available via the paved road serving the Nag Hammadi Industrial Zone, which extends westward for about 2 kilometers. Overall, the project area is well connected to both the main and regional transportation networks.

The site primarily consists of undeveloped desert land, while industrial and utility facilities are concentrated to the west within the Nag Hammadi Industrial Zone. The nearest residential settlement, El Baraka Village, is located approximately 4 kilometers northwest of the project boundary. Additionally, a few scattered reclaimed agricultural areas are found within the broader vicinity.

Figure 2 below shows the activities/land uses surrounding the proposed site.

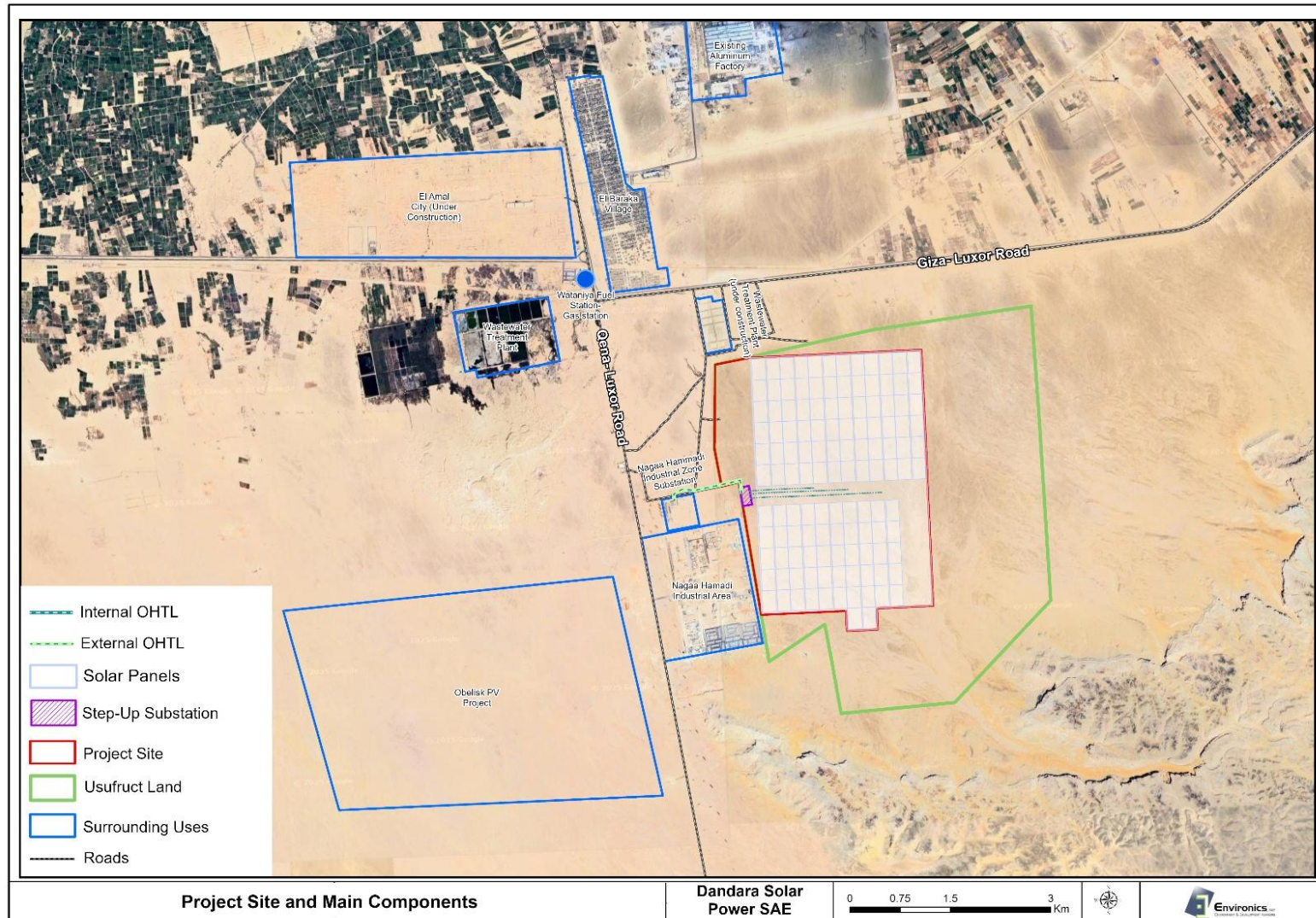


Figure 2: Activities/land uses surrounding the proposed site

## 2.2 Process Description

### 2.2.1 General Outline

The Photovoltaic Power Plant will utilize high-efficiency mono-crystalline silicon solar panels along with single-axis tracking systems (horizontal single axis tracker -1P) to maximize energy capture. Additionally, a BESS using lithium-ion battery modules will be integrated to store and manage the generated energy.

The project will be connected to the national grid through an overhead transmission line (OHTL) to be constructed by Dandra Solar Power, linking the project substation to the existing Nagaa Hamadi Industrial area Substation. This distance between the two substations is 1km. The generated electricity will then be wheeled to EgyptAlum through the existing electricity grid infrastructure.

A detailed description of the grid connection components will be provided in the subsequent sections.

### 2.2.2 Project Components

#### a) Component 1: Solar field Photovoltaic modules: High-efficiency mono-crystalline silicon solar panels

- **Solar Panels**

PV Plant using 903,960 photovoltaic modules, each with a typical peak power output of 630W totalling a plant DC capacity around 569.49 MW. These modules are known for their high efficiency and bifacial technology, which allows them to generate electricity from both sides, maximizing energy production.

Mono-crystalline silicon PV panels will be connected in series to produce DC output from incident irradiance. The Key design parameters include the orientation, row spacing, tilt angle.

- **Mounting structures**

For optimal performance, PV systems aim to maximize the time they face the sun.

PV modules will be installed at a single-axis horizontal tracking system that has a maximum height of approximately 2.8 meters and a tracking range of -55° to +55°. The following table describes some preliminary equipment quantities.

**Table 1: Preliminary Description (500 MWac)**

No	Item Description	Unit	Total Qty for 500MWac
1.	PV Modules (630Wp)	Nos	903960
2.	Substructure –Tracker	Tables	10044
3.	No. of PV Module per table	Module	90
4.	Inverter	Nos	496

No	Item Description	Unit	Total Qty for 500MWac
5.	No. of blocks/ MV transformer station	Nos	62
6.	Technology	----	Bifacial
7.	BESS Container	Nos	20

The PV arrays will be spaced appropriately, considering local topographic conditions. This spacing is designed to minimize shading effects and optimize solar exposure, ensuring maximum efficiency and environmental compatibility.

- **Inverter systems**

Inverter systems are used for converting the direct current (DC) generated by photovoltaic modules into alternating current (AC) and can be fed into the grid. The components of the inverter system are as follows:

- **Inverters**

The project will utilize 496 inverters to convert the DC generated by the photovoltaic modules into AC for use in the power grid. These inverters will handle the conversion process, ensuring efficient energy transmission. The project will employ PV inverters with a total capacity of 545.6 MVA, and 164.34 MVAR of reactive power will be supplied by both the BESS and PV Inverters together.

- **Switchgear**

The electrical equipment used to manage and protect the medium voltage (33kV) circuits before the voltage is stepped up to 220kV for transmission. This switchgear is crucial for ensuring the safe and efficient operation of the electrical system within the substation.

## b) **Component 2: BESS**

A Solid-State Battery consists of multiple battery cells assembled into modules. Each cell contains a positive electrode, a negative electrode, and an electrolyte. The lithium-ion BESS primarily use lithium nickel manganese cobalt oxide (NMC) or lithium iron phosphate (LFP) for their cathodes.

The BESS will comprise multiple battery units or modules housed in shipping containers or suitable housing structures, delivered pre-assembled to the project site. These containers are typically elevated slightly off the ground and arranged in rows.

Supplementary infrastructure and equipment include temperature control equipment, which may be positioned between the battery containers. The solid-state batteries under consideration are Lithium-ion systems. Figure 3 illustrates the BESS.

### **Key Components of the BESS**

#### 1. Battery Modules

- The core of the BESS, typically lithium-ion batteries with a nameplate capacity of 100 MWh and a dispatchable capacity of 50 MWac AC-coupled BESS, with no augmentation (degrades over the project lifetime)
- Connected in series and parallel to achieve the required capacity.

- Housed in weatherproof, insulated containers to protect from environmental conditions.
- BESS is designed to operate on only one full cycle per day. Once the BESS is charged to 100% State of Charge (SoC), it could accommodate Ancillary Services and load shifting if agreed by all parties. However, upon the first measurement of 0% SoC, all services will be suspended for the remainder of the day.
- The BESS can store energy and then release it during the specified time frame as agreed with the offtaker, depending on how much of its capacity is allocated for Ancillary Services. Ancillary Services are essential for maintaining the stability and reliability of the power grid.

## 2. Battery Management System (BMS)

The BMS is an essential component of the battery-based energy storage system. This system aims to monitor and manage the performance of batteries, ensuring they operate efficiently and safely. Some of the main tasks performed by the BMS include:

- Voltage and Current Monitoring: to ensure they operate within safe limits.
- Charge Balancing: ensures balanced charging among all cells in the battery, which helps improve performance and extend battery life.
- Temperature Monitoring: The BMS monitors the battery temperatures and activates cooling or heating systems as needed to maintain optimal temperatures.
- Protection system: It protects against abnormal conditions such as overcharging, over-discharging, and short circuits.
- Diagnostics and Maintenance: The BMS provides regular reports on the battery status and helps detect potential faults before they cause significant problems.

## 3. Cooling and Ventilation Systems

Batteries generate heat during charging and discharging. Cooling systems ensure that the temperature remains within safe limits to prevent overheating, which could degrade battery performance or even cause fires.

They use a liquid-cooled temperature control system to optimize the auxiliary power consumption for fans required to circulate air and to absorb heat from the batteries.

## 4. Control and Monitoring Systems

- Provides real-time data on the performance of the BESS.
- Components include SCADA systems, sensors, and communication interfaces.

## 5. Auxiliary Systems

- Includes lighting, emergency power supplies, and fire suppression systems.
- Supports the safe and reliable operation of the BESS.





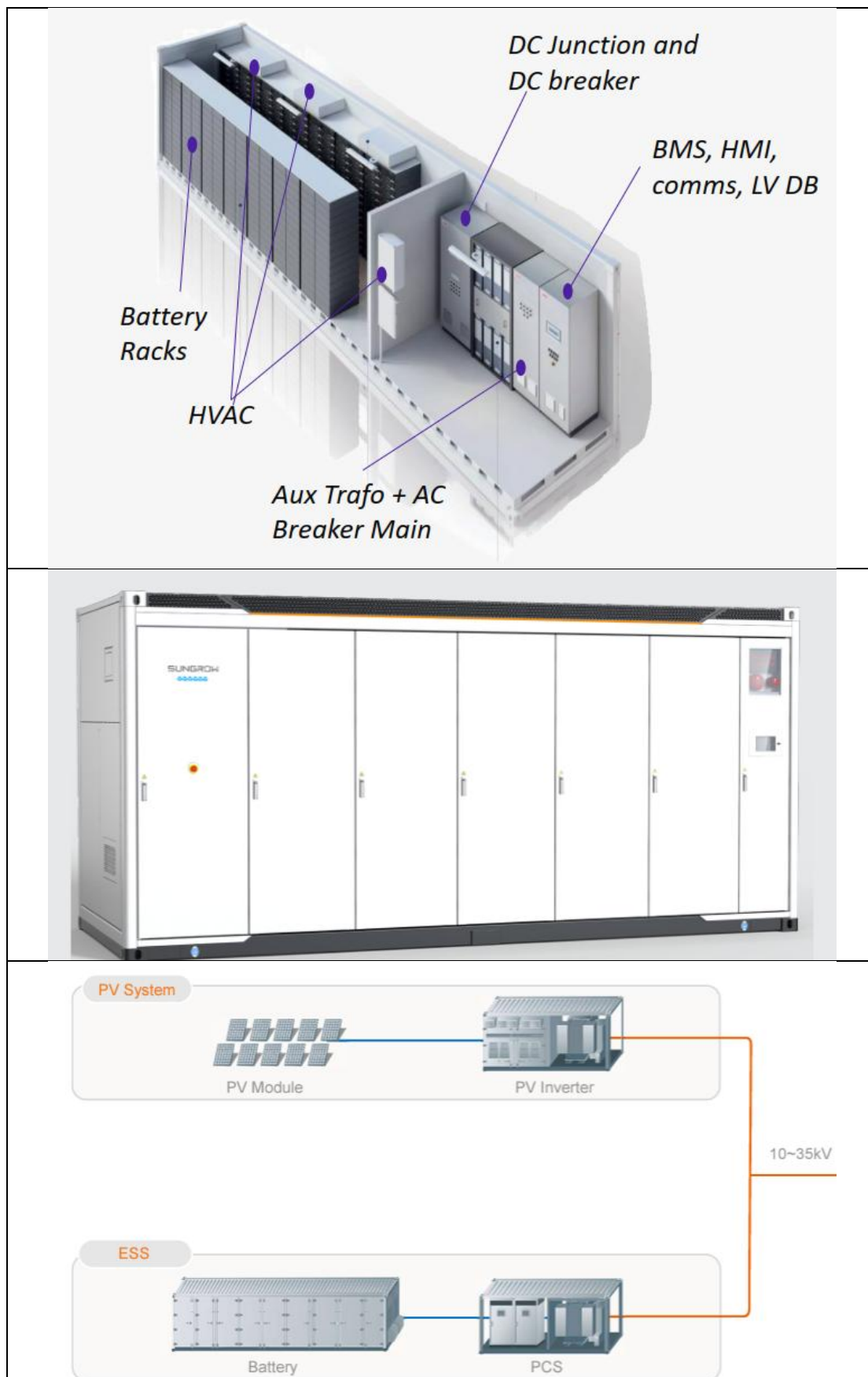


Figure 3: Battery Energy Storage System (BESS)

The installation of the BESS for the proposed project will adhere to the following standards and regulations:

- NFPA 855: Ensuring installations are performed appropriately with vital life safety considerations.
- ISO 45001: Emphasizing occupational health and safety management.
- EN 62485-2: Covering safety requirements for secondary batteries and battery installations.
- Local Building and Fire Codes: Complying with local regulations for safety and construction.

All these standards are mentioned in Chapters 5 and 6 of study.

### c) Component 3: Internal Medium Voltage Overhead Transmission Line (MV OHTL) Corridor

Within the boundaries of the project site, an internal 33 kV medium-voltage overhead transmission line (OHTL) corridor will be developed to collect and transmit the electrical power generated from the distributed solar photovoltaic (PV) arrays to the on-site substation.

This corridor forms the backbone of the internal power collection network, linking the MV inverter transformer stations through an intermediate MV collector unit to the 33/220 kV step-up substations located within the project area.

The internal 33 kV OHTL comprising about 12 towers network will extend over a span of 2.7 kilometers, running west to east across the central part of the project site. The lines will be supported on steel towers averaging 28 meters in height, with a potential maximum of up to 34 meters depending on the terrain and technical design requirements.

#### *Structural Design*

All structural components, including poles, towers, crossarms, foundations, insulators, conductors, earthing systems, and associated hardware, will be designed in accordance with IEC 60826 (Design of Overhead Lines) and IEC 61936 (Power Installations Exceeding 1 kV AC), in addition to relevant Egyptian national standards for structural integrity and safety.

Where feasible, standard tower designs already approved and utilized within Egypt will be adopted to ensure local compatibility, construction efficiency, and ease of maintenance.

#### *Electrical Design*

The electrical design of the MV OHTL will comply with IEC 60850 (Nominal Voltage Ratings) and other relevant IEC and Egyptian Grid Code standards, ensuring proper conductor selection, insulation coordination, and voltage regulation. The design will also integrate the Optical Ground Wire (OPGW) circuits, including all necessary junction boxes and splice enclosures, to facilitate secure communication and system protection.

All installations will adhere to Egyptian Electricity Transmission Company (EETC) standards and applicable international electrical safety and environmental codes.

**d) Component 4: Connection to the grid**

This component involves the development of one main step-up substation within the project boundaries. This facility will ensure the efficient transmission of generated power, enhance operational flexibility, and maintain stability and reliability across the national grid.

A 33/220 kV pooling substation will be constructed within the project site to step up the electrical output from the PV plant's 33 kV medium-voltage collection system to 220 kV for efficient long-distance transmission and integration into the national grid.

The substation will house two step-up transformers, each rated at 300 MVA, providing a total installed capacity of 600 MVA. This dual-transformer configuration ensures operational flexibility, redundancy, and reliability of power evacuation.

Each power transformer will be of the ONAF Type (Oil Natural Air Forced) featuring oil-filled tanks for insulation and cooling. Externally forced Air cooling, provided by multiple fans, will be employed to maintain optimal operating temperatures, thereby enhancing transformer efficiency and extending service life.

Core components will include switchgear, circuit breakers, and instrument transformers (CTs/VTs). The substation will be connected to the existing 220 kV Nagaa Hammadi Industrial Zone Substation via a newly constructed overhead transmission line (OHTL).

**e) Component 5: Overhead Transmission Line (OHTL)**

The proposed project includes the construction of a 220 kV overhead transmission line to evacuate the power from the solar PV plant to the national grid.

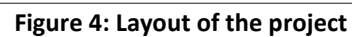
The OHTL will connect the 33/220 kV step-up substation located within the project site to the existing 220 kV Nagaa Hammadi Industrial Zone Substation, situated 1.0 kilometer to the west of the proposed new 33/220 kV substation.

*Project Site (33/220 kV Substation) → 220 kV OHTL → Existing 220 kV Nagaa Hammadi Industrial Zone Substation*

The OHTL will traverse a limited path along government-owned desert land, requiring the installation of transmission towers and the establishment of a right-of-way (ROW) corridor. Although the distance between the two substations is 1km, the OHTL route is not a direct line and thus will comprise six towers along the path.

The new OHTL will be routed along a very limited area, which will help minimize visual, land use, and ecological impacts.

It is worth mentioning that the new OHTL is part of the project components that will be constructed by the project and financed by the different development financial institutions (DFIs) participating in the proposed project.



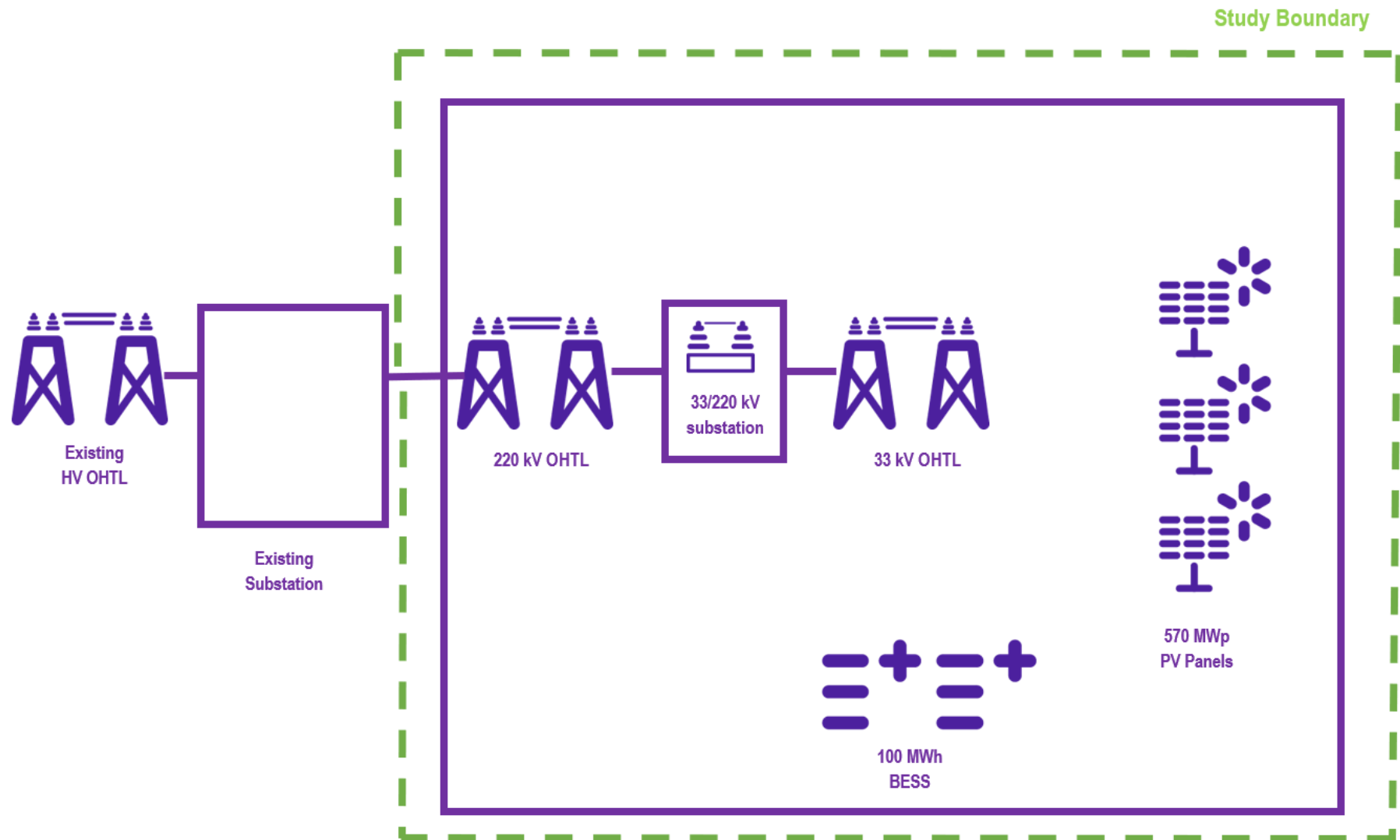


Figure 5: Project's first phase schematic of Study Boundary



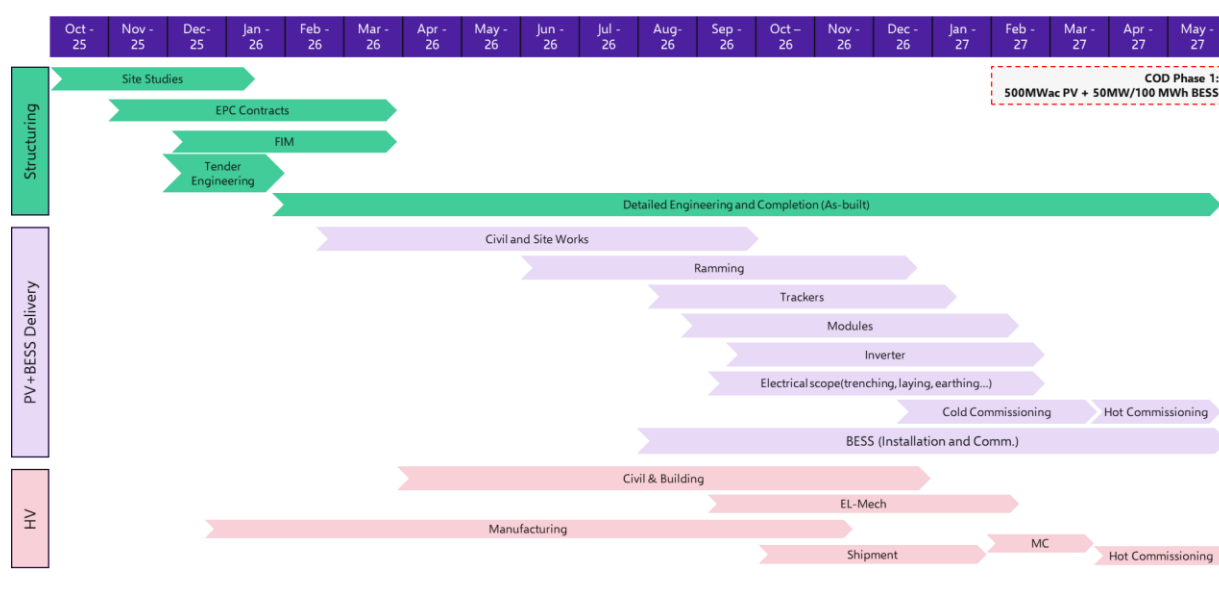
## 2.3 Construction Phase

### 2.3.1 Project Schedule

The Dandra Solar Power Project is planned to commence in the second quarter of 2026, following the receipt of all required permits and approvals. The total implementation period is estimated at approximately 15 months, from March 2026 to June 2027, covering all site establishment, civil, electrical, and mechanical works. The detailed construction timeline is presented in Table 2: Construction Schedule.

Table 2: Construction Schedule

### Egypt – Dandra – Structuring & Delivery Phase



### 2.3.2 Description of Construction Phase

Major on-site activities will include civil works, construction of buildings, installation of equipment and utilities, and testing and commissioning of equipment.

- Site preparation and clearing:
  - Site survey and geotechnical investigations are conducted to prepare the site for construction.
  - Clearing the site of rocks, levelling the ground
  - Warehouse and temporary storage area preparation
  - Concrete works
  - Water and sewage pipes
  - Establish laydown areas for equipment and materials
- Construction of panels and access road
  - It is anticipated that PV poles will be either directly rammed or predrilled in case of harder layers of soil/ gravel beneath to fix them on the ground. Based on the initial geotechnical studies the site, there would be a decent mix of both the cases in the project.

- Construction of access road connected to existing tarmac/asphalt road running from the highway to industrial/business area west of the PV plant area. The total length of this new gravel surface access road is estimated at 1,500 meters. Total width of this new access road is estimated at 6.0m wide with 0.5m shoulders either side.
  - Internal roads for handling construction equipment (construction material: gravel) and operation activities
  - Roads of the solar field will consist of compacted site material and gravel capable of support of the transit loads during construction and operation.
- Storm water and site drainage system
    - The preliminary channel is designed to cater for sub-basins 11 and 6, providing protection for both Phase 1 and Phase 2 against those watersheds. For Phase 2, a second channel will be implemented along the eastern fence of Phase 2 (the eastern boundary of the plot). This channel will protect against flows from sub-basin 4 and other inflows from the east. The second channel is not required at this stage for Phase 1 and is therefore not included in the current ESIA scope. The design will accommodate a 100YR event.
    - The open channel will largely maintain the natural stream path and not change the point of discharge. The outlet will be designed such that no change in the natural velocity occurs at the discharge point.
  - Fencing and gates
 

Perimeter fencing with main gates and emergency gates enclosing the entire project area. Also, the HV substation area and O&M building shall be separately fenced for improved security and safety reasons.

## 2.4 Service Units

### • Temporary structures (during construction phase)

#### **Workers Accommodation**

During the construction phase, workforce accommodation will be arranged through a combination of on-site and off-site facilities, depending on workers' roles and their permanent residence. The primary accommodation will be a dedicated camps within the project site, while subcontractors may arrange additional housing for non-local workers, if needed, in rented apartments within nearby villages and urban centres. However, all contractors will be encouraged to continuously increase percentage of local workforce.

All accommodation facilities will be designed and managed in accordance with Good International Industry Practice (GIIP) and consistent with EBRD Performance Requirement 2 (PR2), IFC Performance Standard 2 (PS2), and the IFC/EBRD "Workers' Accommodation: Processes and Standards" (2009) guidance. Compliance with Egyptian Labour Law No. 14/2025, its associated Occupational Safety and Health decrees (Nos. 126/2003, 134/2003, and 211/2003), and Civil Defense fire-safety approvals will also be ensured.

For the cases of on-site accommodation, these will consist of prefabricated modular units manufactured off-site and assembled on-site to allow efficient installation, operation, and dismantling once construction is completed. Key design features will include:

- Walls: Galvanized steel frames with insulated sandwich panels (mineral wool or polystyrene).
- Roofs: Lightweight corrugated metal sheets providing thermal protection.
- Floors: Raised concrete or timber platforms with non-slip, water-resistant finishes.
- Windows: Aluminum or uPVC frames with insect screens.
- Doors: Solid wood or metal with secure locking mechanisms.

Accommodation camps will be designed to provide safe, hygienic, and comfortable living conditions for all residents. Core amenities will include:

- Adequate living space per person in line with international benchmarks.
- Separate sanitary facilities for male and female workers, equipped with sufficient toilets, showers, and handwashing stations.
- Dining and catering facilities with potable water and hygienic food preparation areas.
- Ventilation, air conditioning, and adequate lighting to ensure comfort and safety.
- Fire detection, firefighting systems, and emergency exits meeting Civil Defense standards.
- First-aid and medical facilities, including a fully stocked kit at the contractor's office.
- Prayer areas and culturally appropriate amenities, including meal schedules adapted to Ramadan fasting hours.
- Communication and recreation facilities to support worker wellbeing.
- Waste management systems, including segregation, collection, and septic tank–soak pit systems for domestic sewage.

All Requirements will be embedded in the ESMS/ESMP and contracts with contractors/subcontractors that house workers, with regular inspections, corrective actions, and engagement with local authorities and nearby communities

### **Labor and Working Conditions**

The project will strictly adhere to the Egyptian Labor Law 14/2025 and international standards, including the ILO's "Minimum Age Convention, 1973 (No. 138)" and the "Forced Labor Convention, 1930 (No. 29)," to ensure the prevention of child labour and forced labour. The project is also committed to abiding by the national minimum wage rate.

Additionally, the project will respect the workers' right to freedom of association and collective bargaining as per the ILO's "Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87)" and the "Right to Organise and Collective Bargaining Convention, 1949 (No. 98)".

- **Temporary structures (during construction phase)**

During the construction phase, the following facilities are required on site to service employees, contractors, and employer's representatives (laydown areas).

- Offices for the employers (air-conditioned)
- Mess / eating facilities
- Sanitary facilities

When the construction work is completed, most of the temporary structures and facilities will be dismantled.

- **Permanent buildings (during Operation phase)**

For the operation phase, permanent buildings will be constructed at the site to house employees and operation and maintenance (O&M) activities.

The buildings will either be prefabricated or brick constructed. Some facilities set up within the construction phase will be used in the operation phase as well. The following facilities will be constructed;

- Warehouse facilities.
- Secured control room.
- Secured server room.
- Facilities at security gates.
- Meeting room facilities.
- Offices (air-conditioned)
- Kitchen/mess area
- Segregated sanitary facilities with provisions for disabled persons
- Prayer room.

## 2.5 Utilities

### 2.5.1 Water and Wastewater Tanks

#### A. Water Supply and Storage

*Construction Phase:*

- Water for construction activities and sanitary purposes will be primarily supplied through water tankers from the closest water source (water treatment plant) and stored in constructed or prefabricated tanks on site, located near sanitary and catering facilities. As per the meeting with Qena governor, the nearest water plant has the capacity to provide the required quantity of water during construction and operation.
- Daily consumption is expected to be 4 m<sup>3</sup>/ day for drinking water (bottled water), about 97 m<sup>3</sup>/ day for sanitary municipal water, and about 76 m<sup>3</sup>/ day for construction water during peak construction.

*Operation & maintenance Phase:*

- O&M consumption is expected to be 75-100 m<sup>3</sup>/month only for office sanitary purposes and will be trucked to the site through water tankers, as required. Water could also be fed to the site through a water pipeline connection to the nearest public network connection point at about 2km from the site perimeter. The water pipelines will be constructed within the utility corridors within the right-of-way of the road. The project will not require water for cleaning purposes since only dry cleaning is anticipated for the PV modules.
- Bottled drinking water will be provided for workers.

#### B. Wastewater

*Construction Phase:*

- Wastewater volumes are estimated at 50-60 m<sup>3</sup>/day. This includes water from sanitation facilities, welfare facilities as kitchens, and other amenities provided for construction workers.
- Sewage tanks will be used for collection and will be located near the O&M building and catering facilities.  
External contractors authorized by the governorate will handle wastewater disposal, as wastewater shall be collected from the sewage tanks at the site, trucked for discharge at an authorized wastewater treatment facility (the nearest Wastewater treatment evaporation ponds at 2.8 km to the north-west).

#### *Operation Phase:*

- Wastewater volumes are expected to be 8-12 m<sup>3</sup>/day.
- Wastewater is planned to be pumped out of the septic tanks and trucked for discharge by authorized contractors at the appropriate wastewater treatment plant near the site.
- There will be no discharge from the PV cleaning process

### **2.5.2 Electricity supply**

- During construction, electricity will be supplied through direct connection (underground cable) from the nearby substation. It supplies caravans and the operation of equipment.
- Transmission towers will be constructed within the site for electricity provision during the operation phase.

### **2.5.3 Fuel supply**

- Diesel will be used for power generators as a backup during construction works, as well as equipment operation. It will be provided through a contractor.
- During Operation, fuel required for the emergency generator during operation will be sourced from the nearest fuel station, located approximately 4 km northwest of the project site, within the surrounding area.
- Moreover, a portion of the generated energy will be allocated to the lighting system, buildings, and the tracking system.

### **2.5.4 Labour**

The direct labour force required for the project construction could reach 5000 workers at peak construction months, including skilled and unskilled labour. The company will encourage contractors to maximize hiring workers from the local communities to above the 50 % threshold set by the project.

During the construction period, the construction subcontractors will provide the food & transportation to workers as per the IFC Standard.

Permanent employees during operation are expected to be up to 100 workers. According to the company's employment policy, preference will be given to workers from neighboring areas, depending on the availability of suitable qualifications.

## **2.6 Decommissioning Phase**

- A. Solar Panel and Mounting Structure Deactivation:
  - Careful detachment of solar panels from their mounting structures.
  - Systematic disassembly of single-axis tracking systems.
- B. Inverter and Electrical Component Deactivation:
  - Safe isolation and deactivation of inverters, transformers, and switchgear.
  - Comprehensive testing and assessment of electrical components to determine suitability for reuse or recycling.
  - Environmentally responsible disposal of any hazardous materials contained within electrical equipment.
- C. BESS Deactivation:
  - Controlled discharge and isolation of battery modules.
  - Methodical disassembly and separation of battery components.
  - Recycling or proper disposal of battery materials (e.g., lithium-ion) in compliance with environmental regulations and best practice/international and/or EU guidelines.
  - Proactive management of any potential electrolyte leakage or contamination.
  - Follow the standard decommission procedure provided by the BESS equipment supplier, where applicable and available.

## 2.7 Expected Environmental Outputs and Emissions of Construction, Operation, and Decommissioning Phases

### A. Construction Phase

- **Air Emissions**
  - Emissions from construction equipment exhaust, such as nitrogen oxides, sulphur oxides, and carbon monoxide.
  - Greenhouse gas (GHG) from construction vehicles and machinery.
  - Emissions from the use of power generators.
  - Dust/particulate matter, and emissions from soil leveling, construction equipment, and transport vehicles.
- **Noise**
  - The primary sources of noise during construction are transport vehicles, ramming machines, heavy equipment/machinery, cutting machines, and vehicle movement.
- **Wastes**
  - Construction Debris: Includes concrete, metals, plastics, and packaging materials.
  - Hazardous Wastes: Potentially includes solvents, paints, and other chemicals used during construction.
  - Soil and Vegetation: Excavation and land clearing can result in soil and (potential) vegetation waste.
  - Wastewater: mainly domestic wastewater from the workforce.

### B. Operation Phase

- **Emissions**
  - Emissions resulting from the use of backup generators during emergency power outages.



- **Noise at the workplace**
  - Continuous operation of inverters and transformers.
  - Noise from backup diesel generators used during power outages
- **Wastes**
  - End-of-Life Panels and Batteries: At the end of their lifecycle.
  - Maintenance Wastes: Include used lubricants, cleaning agents, and replaced components
  - Wastewater: mainly domestic wastewater from the workforce

### **C. Decommissioning phase**

The decommissioning process, while expected to have a minimal environmental footprint, will generate some waste streams. These include materials from solar panels, mounting structures, inverters, electrical components, and battery modules. Dust emissions and noise pollution are expected to be temporary and localized during the dismantling and removal of infrastructure, similar to those employed during construction.



Figure 6: Characteristics of the surrounding area

## 2.8 Environmental and Social Aspects

The construction and operation of PV systems have specific environmental and social aspects resulting from specific project activities and associated facilities. These aspects may lead to potential risks and impacts, that need to be identified, assessed, and managed effectively through appropriate mitigation measures to minimize adverse effects and enhance positive outcomes.

Based on the project components described in chapter 2, the key environmental and social aspects of the PV project are summarized in Table 3 for both construction and operation phases:

**Table 3: Project E&S aspects**

Environmental & Social Aspects		Source(s)	
		Construction phase	Operation phase
Land Uptake	Land Access Restriction	<ul style="list-style-type: none"> <li>- Project infrastructure and assets (e.g., laydown areas, temporary facilities, and site security)</li> </ul>	<ul style="list-style-type: none"> <li>- Project infrastructure and asset (e.g., fenced PV field, substations, BESS) security</li> </ul>
	Land Transformation	<ul style="list-style-type: none"> <li>- Site clearing, leveling, grading</li> <li>- Excavation for foundation construction</li> <li>- Lay down area</li> <li>- Substation construction</li> <li>- Construction of temporary facilities (e.g., construction workforce camps)</li> </ul>	Permanent transformation of the project footprint, fully stripped of its natural state.
	Land Acquisition	<ul style="list-style-type: none"> <li>- The route of the external OHTL is located in a publicly owned desert land</li> <li>- The project site itself is state-owned desert land</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>
Transportation Demand		<ul style="list-style-type: none"> <li>- Transportation of project components</li> <li>- Transportation of machinery &amp; equipment</li> <li>- Transportation of water, fuel, and other materials for construction activities</li> <li>- Transportation of workers to and from project sites and accommodation camps</li> </ul>	<ul style="list-style-type: none"> <li>- Limited transportation needs for O&amp;M workforce, spare parts, and maintenance equipment.</li> </ul>
Workers Influx		<ul style="list-style-type: none"> <li>- Skilled and non-skilled construction workers (site preparation activities, assembly, technical installations, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>- Limited workforce</li> </ul>
Worker welfare		<ul style="list-style-type: none"> <li>- In the work environment</li> <li>- In the workers' camp</li> </ul>	<ul style="list-style-type: none"> <li>- In the work environment</li> <li>- In the workers' camp, if any</li> </ul>
Water Demand		<ul style="list-style-type: none"> <li>- Construction activities (preparation of concrete)</li> <li>- Potable (drinking) water</li> <li>- workers (workforce accommodation, sanitation, catering &amp; other facilities)</li> <li>- Dust suppression</li> </ul>	<ul style="list-style-type: none"> <li>- Limited O&amp;M workforce, sanitation, and other facilities.</li> <li>- Panel cleaning.</li> </ul>
Noise & Vibration		<ul style="list-style-type: none"> <li>- Site preparation grading, leveling, clearing, concrete mixing, trucks, deliveries, piling/ramming works.</li> <li>- moving machines (mixers, tippers, communicating workers)</li> <li>- Incoming vehicles to deliver construction materials, components, and workers to the site</li> </ul>	<ul style="list-style-type: none"> <li>- Limited activities from O&amp;M (inverters, transformers, cooling fans, and trackers)</li> <li>- Limited Worker's transportation and maintenance activities</li> </ul>

Environmental & Social Aspects	Source(s)	
	Construction phase	Operation phase
	<ul style="list-style-type: none"> <li>- Installation of the components (especially ramming machines)</li> </ul>	
<b>Dust/Particulate Matter/Gaseous Emissions</b>	<ul style="list-style-type: none"> <li>- Site preparation (site clearance, excavation, and spreading of the topsoil)</li> <li>- Movement of vehicles across dirt/unpaved roads, topsoil, and excavated soil handling</li> <li>- Increased traffic flows (vehicle emissions)</li> <li>- Emissions from onsite diesel power generators</li> </ul>	<ul style="list-style-type: none"> <li>- Negligible – only workforce transport and minor maintenance vehicles.</li> </ul>
<b>Wastewater Generation</b>	<ul style="list-style-type: none"> <li>- Domestic waste from a large number of workers</li> </ul>	<ul style="list-style-type: none"> <li>- Limited generation from sanitation facilities</li> </ul>
<b>Waste Generation (Hazardous and non-hazardous)</b>	<p><b>Non-hazardous</b></p> <ul style="list-style-type: none"> <li>- Construction material packaging, debris, and waste</li> <li>- Non-hazardous off-cuts</li> <li>- Domestic waste from workforce (e.g., food waste, plastic bottles &amp; cans, Paper, and Glass)</li> </ul> <p><b>Hazardous</b></p> <ul style="list-style-type: none"> <li>- Empty containers of hazardous substances</li> <li>- waste paints, coatings, adhesives, cleaning solvents</li> <li>- Spent lubricating oils and hydraulic fluid</li> </ul>	<p><b>Non-hazardous:</b></p> <p>Limited quantities of</p> <ul style="list-style-type: none"> <li>- O&amp;M material packaging (e.g., spare parts)</li> <li>- Domestic waste from workforce (e.g., food waste, plastic bottles &amp; cans, glass, and mud)</li> <li>- Paper &amp; other office supplies</li> <li>- Cardboard.</li> </ul> <p><b>Hazardous</b></p> <ul style="list-style-type: none"> <li>- Absorbent material, waste oil from machinery lubricants</li> <li>- Empty containers of hazardous substances</li> <li>- Waste cleaning solvents</li> <li>- End-of-life lithium batteries</li> </ul>
<b>Visual Aspects</b>	<ul style="list-style-type: none"> <li>- Heavy construction machinery, equipment, and vehicles</li> </ul>	<ul style="list-style-type: none"> <li>- PV panels are alien to the desert landscape</li> </ul>
<b>Glare</b>	N/A	<ul style="list-style-type: none"> <li>- Sunlight reflected off the modules and the metal mounting structure</li> </ul>
<b>Electromagnetic waves</b>	N/A	<ul style="list-style-type: none"> <li>- Substation and Transformer</li> <li>- Switch gears</li> <li>- Transmission Lines (associated facility)</li> </ul>
<b>Lake effect</b>	N/A	<ul style="list-style-type: none"> <li>- Smooth and uniform appearance of PV solar plants, similar to a sheet of water, as they reflect light just as a lake or a pond is said to attract birds</li> <li>- For PV panels with a tracking system, this will happen only during a short portion of the day</li> </ul>

## 2.9 Area of Influence

The area of influence (Aoi) includes regions likely to be affected by the project and its directly managed activities and facilities. It also encompasses areas impacted by unplanned but predictable developments caused by the project, which may occur later or at different locations. Additionally, it covers areas where the project indirectly affects biodiversity or ecosystem services that are crucial to the livelihoods of local communities. The identified project E&S aspects within the project's direct area of influence are described in the tables below. Impacts within the potential indirect area of influence, if any, would be addressed in the impact assessment section.

**Table 4: Environmental and Social Aspects Aoi during the construction phase**

Environmental & Social Aspects		Area of Influence (Aoi)
		Construction phase
Land uptake	Land Access Restriction	the project footprint
	Land Transformation	the project footprint
	Land Acquisition (for the transmission line)	The project area and the transmission line are on government-owned desert land (1km to the substation)
Transportation Demand		<p>The project site can be accessed through the national and regional road network linking the Red Sea ports with Upper Egypt. The following main corridors and right-of-way (ROW) options are relevant for the transportation of imported equipment and materials:</p> <ul style="list-style-type: none"> <li>From Red Sea Ports (Ain Sokhna / Adabeya): Cargo can be transported westward via the Red Sea coastal highways towards Safaga Port and then inland.</li> <li>Safaga – Qena Corridor: The Safaga–Qena Road provides a direct inland route across the Eastern Desert, leading to the Qena Bridge over the Nile, offering access into Upper Egypt.</li> <li>Eastern Desert Road – Luxor Bridge Option: Alternatively, the Eastern Desert Highway can be used to reach the Luxor Bridge, providing another Nile crossing point south of Qena.</li> <li>Connection to Giza–Luxor Road: Both Nile crossings (Qena Bridge or Luxor Bridge) link to the Giza–Luxor (Western Desert) Road, which serves as the principal north–south arterial route along the west bank of the Nile.</li> <li>Site Access: From the Giza–Luxor Road, access to the project site is gained through the industrial area access road, located east of the corridor, leading directly to the designated project location.</li> </ul>
Workers Influx		The nearest communities are located in Baraka village, approximately 4 km from the project site.
Water Demand		To be trucked from the nearest water supply plant.
Wastewater		To be trucked from the nearest wastewater plant
Waste Generation		To be trucked from the nearest waste management facility

Environmental & Social Aspects	Area of Influence (Aoi)
	Construction phase
Noise & Vibration	The immediate project footprint and construction areas
Dust/Particulate Matter/Gaseous Emissions	The immediate vicinity of the project area (A general default distance of 350 m to be considered for dust effects, (IAQM, 2012)
Biodiversity Disturbance	Desert habitat along the site footprint and OHTL alignments
Community Health & Safety	Baraka Village (nearest settlement), roadside communities along transport routes.



Table 5: Environmental and Social Aspects AoI during the operation phase

Environmental & Social Aspects		Area of Influence (AoI)
		Operation phase
Land Uptake	Land Access Restriction	Project footprint
	Land Transformation	Project Footprint
	Land Acquisition	N/A - no new land anticipated during O&M.
Transportation Demand		Limited needs for the same roads as for construction for transportation during O&M
Workers Influx		N/A .
Water Demand		Limited needs during O&M; supply to be secured either through trucking or a dedicated water connection.
Noise & Vibration		Limited to the workplace - Localized within the project footprint, primarily from inverters, transformers, and occasional vehicle movements.
Dust/Particulate Matter/Gaseous Emissions		N/A
Visual Aspects		The project site boundaries
Glare		<p>Potential glare impacts on nearby receptors are considered minimal.</p> <ul style="list-style-type: none"> <li>- The nearest airport is Luxor Airport (~50 km away), with a NNE–SSW runway orientation; no significant glare risk is expected.</li> <li>- Potential glare toward the Giza–Luxor Road is expected to be limited, as this corridor lies about 3 km north of the site and is partially shielded by on-site infrastructure, including the substations, BESS complex, and O&amp;M facilities located along the western and southwestern boundaries. These structures effectively block potential reflected sunlight from the PV modules toward the road user.</li> </ul> <p>Overall, based on the above, the glare potential to off-site receptors—such as airports, roads, and nearby communities—is considered negligible.</p>
Electromagnetic waves		<ul style="list-style-type: none"> <li>- Project footprint.</li> <li>- Along the OHTL corridor: within a Right of Way (RoW) of 25 m on each side of the transmission line.</li> </ul>

Based on the two tables above, the AoI during the construction phase includes the project site and its immediate surroundings. During operation, although the IFC standards do not define a specific extent of the AoI for solar panels' projects, previous studies proposed best practices that consider a buffer area of 1 km from the project site boundaries (ERM, 2018; Masdar, 2022). Accordingly, the AoI considered for the project extends for 1 km from the project site boundaries.

### 3. Policy, Legal, and Administrative Framework

This section summarizes the environmental and social legislation and regulations of relevance to the project. They were identified according to the type of the proposed activity (described in detail in chapter 2), its geographic location, and the expected risks and impacts. Consideration is first given to the national legislation pertaining to the execution of the ESIA, followed by a review of guidelines of international financing institutions for environmental requirements relevant to the project, as well as the Company's sustainability, environmental, health, and safety framework requirements.

#### 3.1 National Legislation Pertaining to EIA

In accordance with Article 29 of the Law of the Environment No. 4/1994, as amended by Laws No. 9/2009 and No. 105/2015, and its Executive Regulations (ERs), the project proponent is required to prepare an EIA for new projects and expansions or modifications within existing facilities.

Pursuant to Law No. 4/1994 and its ERs, the proponent is required to submit an EIA study to the Competent Administrative Authority (CAA) or the licensing authority prior to the commencement of the project. The CAA or the licensing authority is responsible for verifying all required data, before forwarding the study to EEAA for review.

For the PV project, the CAA is the New and Renewable Energy Authority (NREA).

EEAA may request the proponent to provide additional data, or clarifications, only once, and if the required data isn't provided within 15 working days, the EEAA will return the study to the CAA for completion and resubmission.

EEAA will provide its opinion within 30 working days from the date of receipt of all required data.

The CAA shall notify the project proponent of the results of EEAA assessment.

The project proponent has the right to appeal in writing the result of the assessment within 30 days from the date of his notification following which non-response constitutes implicit approval.

Based on the EEAA projects categorization lists issued in June 2023, projects are classified into four categories according to their environmental impacts:

- **Category A:** Projects with minor or limited environmental impacts.
- **Category B:** Projects that may result in moderate environmental impacts.
- **Category Scoped B:** Projects with potentially significant environmental impacts due to certain components, but not the project type itself. An EIA study is required, focusing on the major component, but without public consultation.

- **Category C:** Projects with potentially significant environmental impacts This category requires a full-scale EIA study, including public consultation and disclosure as a main component.

According to the project categorization lists issued by the Egyptian Environmental Affairs Agency (EEAA) in June 2023, the Dandra PV Plant (500 MW, AC) and BESS have been classified as a Category Scope B project. Consequently, a public stakeholder consultation meeting is not required for these projects.

However, according to the lenders' categorization, the project is a Category A (High E&S risks) project, requiring a full-scale ESIA report including public disclosure.

## 3.2 Applicable Egyptian and International Environmental Regulations pertaining to the project

### 3.2.1 Air Quality

Article 36 of Law 4/1994 and Article 37 of ER 1095/2011 set the maximum permissible limits for exhaust gases from engines and vehicles.

Article 35 of Law 4/1994, Article 34 of its modified ER 1741/2005, and Annex (5) of modified ER 710/2012 provide the maximum limits for ambient air pollutants. The applicable limits are summarized in the Table below.

**Table 6: Maximum Limits of Ambient Air Pollutants according to Annex (5) of the Modified ERs of Law 4/1994 as well as the EU Maximum Limits**

Pollutant	Area	Maximum Allowable limits			
		1 hr	8 hrs	24 hrs	1 year
Sulfur Dioxide ( $\mu\text{g}/\text{m}^3$ )	Urban Areas	300	-	125	50
<i>EU</i> <sup>1</sup>		350	-	125	20
<i>WHO</i>		-	-	125	-
Carbon Monoxide ( $\text{mg}/\text{m}^3$ )	Urban Areas	30	10	-	-
<i>EU</i>		-	10	-	-
<i>WHO</i>		-	-	7	-
Nitrogen Dioxide ( $\mu\text{g}/\text{m}^3$ )	Urban Areas	300	-	150	60
<i>EU</i>		200	-	-	40
<i>WHO</i>		-	-	120	40
Total Suspended Particles ( $\mu\text{g}/\text{m}^3$ )	Urban Areas	-	-	230	125
<i>EU</i>		-	-	-	-

<sup>1</sup> <https://www.europarl.europa.eu/factsheets/en/section/193/environment-policy>

Pollutant	Area	Maximum Allowable limits			
		1 hr	8 hrs	24 hrs	1 year
WHO		-	-	-	-
PM <sub>10</sub> (µg/m <sup>3</sup> )	Urban Areas	-	-	150	70
EU		-	-	50	40
WHO		-	-	150	70

\* The specified maximum limits of ambient air pollutants outlined above apply mainly to the construction phase of the proposed project.

\* In cases where discrepancies exist between the national regulations and the EU Maximum Limits, projects are required to adhere to the more stringent standards.

### 3.2.2 Noise

Article 42 of Law 9/2009 and Article 44 of its modified ER (1095/2011), provide the maximum permissible limits for noise levels. Table 7 below provides the maximum permissible limits for noise intensity in different areas according to Annex 7 of the ER replaced by Decree 2466/2024, and the EU Environmental Noise Directive 2002/49/EC.

**Table 7: Maximum Limit Permissible for Noise Level in the Different Zones according to Annex (7) of the Modified ERs of Law 4/1994 as well as EU Maximum Limits**

Type of zone	The permissible limit for noise level, dB (A)		
	Day time 7 am – 10 pm	Night 10 pm – 7 am	
Areas on roads whose width is 12 m or more, or industrial areas which comprise light industries and other activities	70	60	
EU (Mixed commercial and industrial areas)	Day-time	Evening-time	Night-time
	68	63	58
	During Construction Activities: Up to 70 dBA during the day.		

\* The specified maximum limits outlined above apply to the construction phase of the Proposed Project.

\* In cases where discrepancies exist between the national regulations and the EU Maximum Limits, projects are required to adhere to the more stringent standards.

### 3.2.3 Non-Hazardous Solid Wastes

Chapter 4 of Egypt's Waste Management Law 202/2020 and its Executive Regulations (ERs) 722/2022 and 1113/2024 address the requirements for the solid waste management framework, including collection, transportation, storage, and disposal:

- Article 15: Waste generators must minimize waste, promote reuse, ensure recycling and safe disposal, and manage waste without harming public health or the environment.
- Article 16: Waste generators bear the cost of integrated, safe waste management.
- Article 20: Open burning of waste is prohibited.

Article 36 of the executive regulation addresses construction waste management through contracting licensed contractors and proper storage of construction material/waste.

Additionally, Law 9/2009 and its executive regulations (Articles 39 and 41) address precautionary measures, ensuring proper waste handling and environmental protection.

*Non-hazardous waste management requirements apply throughout the project lifecycle, from construction through operation and decommissioning phases.*

### **3.2.4 Hazardous Materials and Wastes**

Law No. 202/2020 and its executive regulations, Nos. 722/2022 and 1113/2024, introduced specific requirements for hazardous waste management.

Chapter Five of Law No. 202/2020, in conjunction with Articles 50 to 54 of Executive Regulations No. 722/2022, delineates the protocols for hazardous waste management process, including comprehensive record-keeping and disposal methodologies.

*Hazardous material management apply throughout the construction and operation phases of the proposed project.*

*Hazardous waste management requirements apply throughout the lifecycle of the proposed project. Yet, larger quantities of hazardous waste are expected to be generated during construction phase compared to the operation phase.*

### **3.2.5 Registers/ Records**

#### ***Environmental Register:***

According to Article 22 of Law No. 9 of 2009, amending Law No. 4 of 1994, and Article 17 of its modified Executive Regulation 2466/2024, all establishments are mandated to maintain comprehensive environmental registers. The specific content of these registers is outlined in Article 17 and Annex 3 of the Executive Regulation.

#### ***Hazardous Materials & Waste Register:***

According to Article 56 of Law No. 202 of 2020, establishments that generate hazardous waste must maintain a register of such materials and waste, including details on its disposal and the entities contracted for any waste management operations.

In addition, in accordance Appendix (3) of the ERs of Law No. 4/1994, and Article 50 and Appendix (7) of the ER of Law No. 202/2020 on waste management and its executive regulations (654/2021), establishments generating hazardous waste shall maintain a register of this type of waste that explains the method of disposal and the companies responsible for waste management.

### **3.2.6 Biodiversity Protection**

Article 28 of the Environmental Law No. 4 of 1994 is a crucial provision for wildlife protection. It explicitly prohibits the hunting, killing, or capturing of specific wild animals and plants, particularly those that are endangered or essential for maintaining the natural ecological balance.

This article aims to safeguard biodiversity by preventing the depletion of species at risk of extinction or those playing a critical role in their ecosystems.

The protection measures extend to habitats and ecosystems, ensuring the preservation of both flora and fauna that contribute to environmental stability. Additionally, this article empowers authorities to enforce these prohibitions and take necessary actions to protect wildlife from illegal activities.

Furthermore, Annex 4, as amended by ERs 1095 of 2011 of the Environmental Law No. 4 of 1994, lists the specific species of wild animals and plants protected under the law. These species are prohibited from being hunted, killed, or captured due to their ecological importance and the need for their conservation.

▪ **First:**

Wild birds, animals, and other terrestrial or aquatic creatures, or any parts or derivatives thereof, are prohibited from being hunted, killed, traded, bred, possessed, transported, exported, or imported, whether alive or dead prohibition specifically includes:

- All wild birds, except those that are permitted under clause (1) of article 28 to be hunted in accordance with their designated seasons and within the allowed quantities.
- The Prohibited Animal Species (Mammals) under clause (1) of Article 28
- The Prohibited Animal Species (Amphibians and Reptiles) under clause (1) of Article 28:

Additionally, it is prohibited to kill or capture wild birds, animals, and aquatic creatures in areas where such actions would result in the destruction or alteration of their natural habitats. This includes areas of significant importance for resident and migratory wild birds, such as wetlands, natural lakes, the Nile River system, migration routes, and movement corridors of resident birds. The prohibition also applies to areas designated under the Ramsar Convention, to which the Arab Republic of Egypt is a party, as well as currently declared nature reserves and those that may be declared in the future by a decision from the Prime Minister under Law No. 102 of 1983.

- **Second:** Flora is forbidden to be collected, imported, exported, cultivated, or commercialized. This includes wild plant species related to trade, specifically those listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), to which the Arab Republic of Egypt is a party, according to Article 28.
- **Third:** Endangered Animal or Plant Species or Those Cultivated Outside Their Natural Habitats Without a License:

According to Article 28 of the law, it is prohibited to cultivate or breed endangered animal or plant species, or those that are grown or raised outside their natural habitats, without obtaining a license from the Environmental Affairs Agency. This provision ensures that such activities are regulated to prevent potential harm to the species and their ecosystems.



Furthermore, in accordance with Article 3 of Law 102 of 1983 Concerning Natural Protected Areas, it is strictly prohibited to undertake any activities, actions, practices, or experiments in the zones surrounding a protected area. These zones are designated by a decision from the competent minister, following a proposal from the Environmental Affairs Agency at the Council of Ministers. Such activities are only permissible if a permit has been granted by the relevant administrative authority, particularly if they have the potential to impact the environment of the protected area or its natural features.

In addition, Law 53 of 1966 (the Law of Agriculture) is also concerned with biodiversity. Article 117 prohibits the hunting of birds and other wild animals useful to agriculture. It also bans the trading, killing, and destruction of their nests. Minister of Agriculture Decree 28 of 1967 (amended by Decree 1227 of 1988) specifies the species of birds and other wild animals under protection covered by Article 117 of Law 53/1966.

*These requirements apply to the proposed project, although, as described in Chapter 4, the proposed project area does not include a significant biodiversity.*

### **3.2.7 Cultural Heritage**

Law 117 of 1983 promulgating the Antiquities' Protection Law, as amended by Law 3/2010, 61/2010, 91/2018, and 20/2020, serves as the cornerstone for safeguarding archaeological and historical sites.

The Ministry of Tourism and Antiquities (MOTA) is the primary authority responsible for overseeing all archaeological activities.

This legislation provides the primary legal framework for the preservation of archaeological and historical sites.

According to Article 5 of the law, MOTA is the designated authority responsible for supervising all archaeological activities and sites within the country.

Additionally, Article 23 assigns the MOTA the responsibility for the discovery and exploration of antiquities across Egyptian territory. It mandates that any person who discovers an unregistered archaeological artifact is obligated to notify the MOTA. The artifact shall be considered state property, and the MOTA must take the necessary measures to preserve it. Within three months, the MOTA must either remove the artifact found on private property, or take the necessary procedures to expropriate the land on which it was found, or leave it in place and register it following the provisions of this law.

*These requirements do not apply to the proposed project. No cultural heritage components are expected. Moreover, there are no registered archeological sites within or in close proximity to the proposed project location. However, chance finds plan would be developed for the construction activities.*

### 3.2.8 Work Environment

#### A. Workplace emissions

The new Egyptian Labor Law 14/2025<sup>2</sup>, alongside Minister of Manpower and Immigration's Decisions 134/2003 and 211/2003, establish comprehensive guidelines in Egypt for occupational safety, health, and a secure work environment.

The Ministerial Decree 134/2003 requires that facilities hiring more than 50 employees to establish an occupational health and safety department to be responsible for the workplace and employees' safety and provide the necessary equipment for measuring and monitoring pollution in the work environment.

Besides, Ministerial Decree 211/2003 of the Ministry of Manpower addresses the requirements to prevent adverse physical, chemical, and mechanical hazards and dynamic electricity hazards in the workplace and requires keeping medical surveillance records for the employees.

#### B. Workplace Noise

Table 8 provides the maximum noise levels in the workplace, as indicated in Table 1 in Annex 7 of the ER 710/2012 of Law 4/1994.

**Table 8: Maximum Noise Levels within Workplace (dB (LAeq))**

Type of Place and Activity	Exposure Period (hours)	Maximum Noise Level dB (LAeq)
Workplace (workshops and factories) (licensed starting from 2014)	8	85
Administrative offices - Workrooms for computers, typewriters, and similar equipment	--	65
Workrooms for activities requiring routine mental concentration - control rooms	--	60

#### C. Occupational health and safety

Based on the Ministerial Decree 134/2003, facilities with more than 50 workers should establish an occupational health and safety structure/department, which is responsible for health and safety issues and will undertake all related responsibilities, and should undertake daily inspections to detect hazards and risks.

#### D. Work Environment Health and Safety

The Egyptian Labour Law number 14/2025 organizes working conditions and management of worker relationships. The law in its different articles; addresses the individual labour contracts, terms of employment, wages and leaves, collective negotiations and collective labour agreements, and litigations as well as vocational training are addressed in sections one to four.

<sup>2</sup> The new labor law 14/2025 is entered into force by 1 September 2025, replacing the previous Law No. 12 of 2003. The updated executive decrees of the law are not issued yet.

The occupational health and safety requirements are addressed in Book Four of the Labour Law.

#### **E. Noise in the workplace**

Law 4 /1994 (amended by Law 105/2015) sets the maximum permissible noise levels within the workplace (in dB) in Annex 7 of the Executive Regulation (amended by decrees 710/2012, 964/2015, and 2466/2024).

If the noise level is more than 85 dB in workplaces with up to 8 working hours, the facility is obliged to reduce the exposure time by half with each increase in noise level by 3 dB with appropriate earplugs.

#### **F. Employment organization**

The Egyptian Labour Law 14/2025 organizes employment terms, working conditions, and management in Book 2 and Book 3 of the Labour Law, as follows:

##### *Book 2 – Employment Organization:*

- Definition and classification of employment contracts (fixed-term, unlimited-term)
- Conditions for employment and required contract formalities
- Work patterns including emerging/non-traditional forms (e.g., part-time, remote, job-sharing)
- Employer and employee registration obligations, data submission, and record-keeping
- Equal opportunity, non-discrimination, and prohibition of forced labour
- Employee file maintenance, electronic format recognition, retention periods
- Working hours, overtime arrangements, rest periods
- Leave entitlements (annual leave, maternity, paternity, casual)
- Health, safety, and welfare obligations of the employer toward employees
- Provisions concerning persons with disabilities or “people of determination”

##### *Book 3 – Termination, Disputes & Special Employment Cases:*

- Termination of employment contracts: notice periods, severance, end-of-service benefits
- Grounds for summary dismissal (gross misconduct) and procedural safeguards
- Resignation procedures and right of withdrawal
- Treatment of absence without justification (voluntary resignation concept)
- Recognition of work arrangements in the context of termination and rights
- Labour dispute resolution: specialized labour courts, timelines, and processes
- Employment of foreign workers: permits, terms, regulations
- Special employment categories and protections (women, minors, workers with disabilities)
- Employer obligations in organizational changes (downsizing, restructuring)
- Transitional provisions and application of the law to existing contracts

#### **G. Child labour**

According to Articles 62, 63, 64, and 65 of the Labor Law 14/2024, Chapter 4 of Book 2: Rules for the Employment and Training of Children, it is prohibited to employ children before the age of 15. However, they may be trained once they reach the age of 14, provided that this does not prevent them from continuing their education. The employment or training of

children must be in accordance with a decree issued by the competent minister in coordination with the National Council for Childhood and Motherhood.

It is also prohibited to employ or train children in jobs, professions, and industries that may endanger their physical or psychological health, safety, or morals. These jobs, professions, and industries, according to different age groups, will be issued by the decree of the competent minister, in coordination with the National Council for Childhood and Motherhood. Until the updated decree is issued, Decree 215/2021 regarding the child employment and training system is implemented.

According to Article 66 of Labour Law 14/2025, It is the responsibility of the employer who employs one or more children to consider the following:

1. To post a copy of the provisions of this chapter in a visible place at the workplace.
2. To prepare a record indicating working hours and rest periods, approved by the relevant administrative authority (labour office).
3. To inform the relevant administrative authority of the names of the working children, the tasks assigned to them, and the names of the individuals responsible for monitoring their work.
4. To provide separate accommodation for children away from adults, in accordance with the regulations and provisions issued by the competent minister, and it is strictly prohibited for the child to stay overnight at the workplace.

#### **H. Persons with Disabilities**

Egyptian Law No. 10 of 2018 amended by Law 156/2021 on the Rights of Persons with Disabilities aims to ensure the rights and inclusion of persons with disabilities in society. The law mandates non-discrimination, equal opportunities equal employment opportunities based on their qualifications, and accessibility in various aspects of life, including education, employment, and public services. Key provisions of articles 21,22, and 23 from Law No. 10 of 2018, include:

- Job Placement: The Ministry of Manpower is responsible for creating a registry of job-seeking individuals with disabilities and assisting them in finding suitable employment.
- Employer Quotas: Employers with 20 or more employees must hire at least 5% of their workforce from people with disabilities.
- Tax Incentives: it includes a 50% increase in the personal exemption for persons with disabilities or their caregivers. Employers who hire beyond the 5% quota receive additional tax benefits.

In addition, Article 37 of Labour Law 14/2025 requires facilities to keep a special register of persons with disabilities and dwarfism and report on their employment and wages. The facility must also notify the authority with a statement that includes the total number of employees, the number of jobs occupied by people with disabilities and dwarfism, and the wages they receive, following a template and schedule set by the minister.

#### **I. Equal opportunities**

Article 9 of the Egyptian Constitution stipulates that the country is committed to achieving

equal opportunities for all citizens, without any form of discrimination.

Article 35 of Labour law 14/2025 states that it is prohibited to cluster wages based on cultural, religious, or gender.

Law 10/2018 related to the rights of people with disabilities is concerned with provision of equal rights to this group. It includes their rights to have a life insurance, social insurance, freedom in choices, chances of work opportunities that do not surpass their physical disability limit.

#### **J. Women's Workplace Safety and Night Shifts**

According to the Labour Law 14/2025:

Article 53: Applies all employment provisions to women without discrimination; mandates equal pay for equal value of work among men and women.

Article 59: Requires employers who employ one or more female workers to post the "Women's Employment Regulations" in the workplace, which must address flexible working hours or remote work for women caring for children with disabilities or dwarfism.

In addition, Decree No. 44 of 2021 issued by Egypt's Ministry of Manpower permits women, upon their request, to work night shifts in any establishment, provided that employers implement appropriate health, safety and transportation measures.

#### **K. Protection from Harassment**

Article 254 of Labour Law 14/2025 stipulates that facilities and their branches shall be obligated to provide a safe and non-hostile work environment, free from harassment, bullying, and violence, and to ensure the availability of effective means for prevention against such behaviours.

Anti-harassment Law No. 141/2021: This law, which modifies the 58/1937 Penal Law, strengthens legal protections against sexual harassment. It provides comprehensive safeguards for women against various forms of harassment, including unwanted sexual advances, physical or verbal conduct, online and electronic harassment, stalking behaviours, workplace harassment, and public transportation harassment. It also imposes stricter penalties on perpetrators, reflecting a growing recognition of the seriousness of this issue in Egypt.

#### **L. Grievance**

##### **Article 103 of the Environmental law 4/1994**

Grants every citizen and organization concerned with environmental protection the right to report any violations of the provisions of this law.

##### **Article 85 of the Egyptian Constitution**

All citizens have the right to address public authorities in writing and signed, but should not address it on behalf of groups, only as juridical persons.

#### **M. Community Investment:**

According to the Egyptian Investment Law 72/2017 indicated that towards achieving the goals of the sustainable development, investors may dedicate a percentage of their annual

profits for social developments in one or more of the following fields:

- Environmental protection
- Areas of healthcare, social care, or cultural care;
- Support the technical education or the funding of research, studies in cooperation with any of the universities or scientific research institutions; and
- Training and scientific research.

Where investors have undertaken/implemented any community development investments, investors are required to submit to the General Authority for Investment and Free Zones an annual report supported by documents on community development activities.

### 3.3 Strategic National Initiatives

#### ▪ ***Egypt National Climate Change Strategy (NCCS) 2050***

Egypt launched on 19/5/2022 the National Climate Change Strategy 2050. NCCS is a comprehensive roadmap designed to guide Egypt's efforts in addressing climate change. The strategy lays out five overarching goals, encompassing mitigation, adaptation, governance, financing, and scientific research. These goals are further divided into objectives and specific directions, each with corresponding performance indicators to track progress.

The contribution of the PV and BESS projects to the Egypt's National NCCS 2050 include:

- Contribution to Renewable Energy Goals: PV and BESS projects are expected to significantly contribute to the national goal of increasing the share of renewable energy in the energy mix. The strategy aims to increase the contribution of renewable energy sources to 42% of the total electrical energy produced by 2035.
- Enhancing Climate Resilience: These projects are to integrate climate resilience into their design and operations. These would include measures to withstand extreme weather conditions, such as high temperatures and flash floods, which are common in regions like Qena governorate.
- Reducing GHG Emissions: By transitioning to renewable energy sources, PV and BESS projects contribute to reducing GHG emissions associated with fossil fuel consumption if the same amount of energy were generated from conventional power plants.
- Supporting Sustainable Development Goals: PV and BESS projects should align with Egypt's Vision 2030 and support sustainable economic growth with low-emission development.

#### ▪ ***Nationally Determined Contribution (NDC)***

After Egypt signed the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement on the 22nd of April 2016 and ratified it on the 29th of June 2017, the Intended Nationally Determined Contribution (INDC) was considered Egypt's first NDC.

Egypt's updated NDC to the UNFCCC. It outlines Egypt's commitments to reducing GHG emissions and adapting to the effects of climate change between 2020 and 2030.



The NDC highlights Egypt's national circumstances, including its vulnerability to climate change impacts, especially in the Nile Delta, and its ambitious economic development goals. It presents a series of mitigation actions, focused on energy, oil and gas, transport, industry, buildings and urban cities, waste management, and tourism, with projected emission reductions for each sector.

In June 2023, Egypt revised its NDC. As part of its second revised NDC, Egypt has committed to reducing GHG emissions in the oil and gas sector by 2030 from 2,575 GgCO<sub>2</sub>-eq under a business-as-usual (BAU) scenario to 0,89 GgCO<sub>2</sub>-eq under a mitigation scenario. Egypt intends to reach this target through improving access to clean fuel in households and increasing the production and use of alternative green fuels (such as biofuels).

▪ ***Egypt's National Strategy for the Empowerment of Egyptian Women 2030:***

Launched in 2017, this comprehensive strategy aims to advance women's empowerment across political, economic, and social domains, aligning with national and international development goals. Key pillars include:

Political Empowerment: Increasing women's representation in leadership and decision-making positions.

Economic Empowerment: Expanding economic opportunities for women through improved employment prospects and support for female entrepreneurship.

Social Empowerment: Enhancing women's access to quality education, healthcare, and social services.

Protection and Response: Preventing and addressing violence against women through multi-stakeholder efforts.

### 3.4 International Conventions

Egypt has been among the first countries to take an active interest in conserving biodiversity and preserving natural resources and heritage. In 1936, Egypt became a participant in the "Convention Relative to the Preservation of Fauna and Flora in their Natural State", London 1933. This was later followed by signing and ratifying conventions and agreements pertaining to the various aspects of biodiversity conservation. Those potentially relevant to the site include:

#### 3.4.1 Biodiversity

- **Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA), 1995**

The convention emphasizes the importance of migratory birds on the global biological diversity and that they highly depend on wetlands. Parties of this convention are expected to minimize disturbances as much as possible that can negatively impact migratory water birds when planning and constructing. Egypt ratified the convention on the 1st of January 1999.

- **United Nations Convention on Biological Diversity (UNCBD), Rio de Janeiro, 1992**

It recognizes the importance of biological diversity in offering ecosystem services such as recreational, ecological, economic, educational services, etc., and its importance in

maintaining life. The convention emphasizes that countries and States are responsible for preserving their biological diversity and that specific human activities negatively affect their presence. Parties are expected to sustainably manage the surroundings of protected areas. Egypt signed this convention on the 9th of June 1992, ratified it on the 2nd of June 1994, and it entered into force on the 31st of August 1994.

- **Convention on the Conservation of Migratory Species of Wild Animals (CMS), Bonn Convention. 1979**

Globally conserve aquatic, terrestrial, and avian migratory animals and it recognize their crucial role in the stability of the ecosystem. It also recognizes that all boundaries where the species occur or pass through need to be managed. Egypt ratified it on the 2nd of November 1982, and it entered into force on the 11th of January 1983.

- **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973**

It is an international agreement between states that aims to ensure that international species trade does not affect their survival. It recognizes the importance of international cooperation in controlling animal trade to avoid over-exploitation. It was put in effect on 1 July 1975. Egypt ratified the convention on 4 January 1978 and was put into force on 4 April 1978.

- **African Convention on the Conservation of Nature and Natural Resources, Algiers, 1968**

The convention recognizes the economic, social, cultural and environmental importance of natural resources including renewable and non-renewable resources as well as the soil, water, flora and fauna. It aims to promote and enhance environmental protection and to encourage sustainable use of natural resources and to synchronize policies in the different fields. It requires all parties to adopt measures to reach these aims. It requires all parties to implement preventative measure to avoid land degradation and soil deterioration. It also requires parties to sustainably manage their water resources and to prevent pollution and excessive abstraction of the water. In addition, it requires that parties maintain and enhance genetic diversity and floral cover. Egypt signed this convention on the 15th of September 1968, ratified it on the 12th of April 1972 and it entered into force on the 12th of May 1972.

### 3.4.2 Climate change

- **Paris Agreement for strengthening global response to climate change threats, 2016**

Brings together nations to fight climate change and adapt to it while helping developing countries to do so without ignoring their national objectives. It globally aims to keep an overall temperature rise of less than 2° C this year and to pursue more efforts to lower the increase of rise even further by 1.5 ° C. Although the agriculture sector is not mentioned explicitly in the agreement, it does mention efforts to adapt to climate change and resilience in a manner that do not hinder food production. Egypt signed the agreement on the 22nd of April 2016 and ratified it on the 29th of June 2017.

- **United Nations Framework Convention on Climate Change, 1992**

It provides an intergovernmental framework to face climate change issues. Recognizing that the climate is a common shared resource affected by anthropogenic human emissions. It recognizes the importance of marine environments as well as terrestrial ones in acting as reservoirs for Carbon and GHG. It also emphasizes the importance of scientific, economic and practical sectors in tackling climate change problems and the importance of continuous monitoring and assessment. In addition, it promotes the diffusion and transfer of technologies that reduce anthropogenic emissions of GHG in sectors including agriculture and industry. Egypt signed this convention on the 9th of June 1992 and ratified it on the 5th of December 1994. It entered into force on the 5th of March 1995.

- **Kyoto Protocol setting internationally binding emission reduction targets, 1997**

The protocol aims to commit its joined parties to specific international emission targets and aims to strengthen the global response to the temperature rise. It recognizes that currently developed countries are the main cause of the presently high emissions of GHG in the atmosphere, a result of 150 years. It provides flexibility on how the countries reach their target (e.g., increase in forests to compensate for their emissions). In addition, the protocol requires parties to promote sustainable agriculture practices while taking into consideration the climate change factor. Egypt signed this protocol on the 15th of March 1999 and ratified it on the 12th of January 2005. It entered into force on the 12th of April 2005 as an agreement to the UNFCCC convention.

### 3.4.3 Cultural Heritage

- **Convention for the Safeguarding of the Intangible Cultural Heritage, 2003**

The Convention for the Safeguarding of the Intangible Cultural Heritage is a UNESCO treaty adopted by the UNESCO General Conference on 17 October 2003, which entered into force in 2006. The “intangible cultural heritage” means the practices, representations, expressions, knowledge, skills – as well as the instruments, objects, artifacts, and cultural spaces associated therewith – that communities, groups, and in some cases, individuals recognize as part of their cultural heritage. The purposes of the convention are: (a) to safeguard the intangible cultural heritage; (b) to ensure respect for the intangible cultural heritage of the communities, groups, and individuals concerned; (c) to raise awareness at the local, national, and international levels of the importance of the intangible cultural heritage, and of ensuring mutual appreciation thereof; and (d) to provide for international cooperation and assistance. Egypt ratified the convention on 3 August 2005. Article 13 of the convention states that “to ensure the safeguarding, development, and promotion of the intangible cultural heritage present in its territory, each State Party shall endeavor to adopt a general policy aimed at promoting the function of the intangible cultural heritage in society, and at integrating the safeguarding of such heritage into planning programs”.

- **Convention for the Protection of the World Cultural and Natural Heritage, 1972**

The General Conference of the UNESCO meeting was held in Paris from 17 October to 21 November 1972, at its seventeenth session.

- Egypt ratified the convention on the 7<sup>th</sup> of February 1974.

- The convention sets guidelines for parties to help them identify locations that can be world heritage sites and means to conserve them.
- The convention provides management guidelines and possibly financial assistance.
- Moreover, raising awareness and education is also encouraged to improve the protection of those sites.

#### **3.4.4 Work Environment**

The ILO conventions are international standards that complement national labor laws. The following international standards are crucial in creating a safe, fair, and non-discriminatory work environment that respects and protects the rights of all workers.

##### **Freedom of Association and Protection of the Right to Organize Convention, 1948 (No. 87):**

This convention guarantees workers and employers the right to form and join organizations of their choosing without prior authorization.

##### **Right to Organise and Collective Bargaining Convention, 1949 (No. 98):**

This convention provides protection against anti-union discrimination and promotes voluntary negotiations between employers and workers to determine wages and working conditions through collective bargaining.

##### **Forced Labour Convention, 1930 (No. 29) and its 2014 Protocol:**

This convention aims to suppress all forms of forced or compulsory labour. The 2014 Protocol strengthens the measures to prevent forced labour and provides protection and remedies for victims.

##### **Abolition of Forced Labour Convention, 1957 (No. 105):**

This convention calls for the immediate and complete abolition of forced or compulsory labour in all its forms, particularly for political coercion, economic development, labour discipline, or racial, social, national, or religious discrimination.

##### **Minimum Age Convention, 1973 (No. 138):**

This convention sets the minimum age for admission to employment and work, ensuring that children are not exposed to work environments that can harm their health, safety, or morals.

##### **Worst Forms of Child Labour Convention, 1999 (No. 182):**

This convention focuses on eliminating the worst forms of child labour, including slavery, forced labour, trafficking, prostitution, and any work that is likely to harm the health, safety, or morals of children.

##### **Equal Remuneration Convention, 1951 (No. 100):**

This convention mandates equal remuneration for men and women workers for work of equal value, aiming to reduce gender pay gaps and promote economic justice.

##### **Discrimination (Employment and Occupation) Convention, 1958 (No. 111):**

This convention seeks to eliminate discrimination in employment and occupation based on race, color, sex, religion, political opinion, national extraction, or social origin.

**Occupational Safety and Health Convention, 1981 (No. 155):**

This convention aims to ensure that occupational safety and health measures are in place to protect workers from workplace hazards and promote safe working environments.

**Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187):**

This convention provides a framework for continuously improving occupational safety and health systems to prevent workplace accidents and diseases, fostering a culture of prevention.

### 3.5 International Standards and Guidelines

In addition to complying with Law 4/1994, the ESIA study has been prepared in accordance with the requirements of international financial institutions, particularly the EBRD and the AfDB for projects seeking funding.

The sections below provide a summary of the International E&S Requirements.

#### 3.5.1 African Development Bank Group's Operational Safeguards (AFDB OS)

The Bank has defined the E&S Operational Safeguards (OSs), as part of its Integrated Safeguards System (ISS 2023), which are designed to maximize positive impacts and to avoid, minimize, reduce, mitigate or compensate for the adverse E&S risks and impacts of projects, including those related to climate change.

**OS1: Assessment and Management of Environmental and Social Risks and Impacts**

It addresses how the borrower will address the environmental and social risks and impacts of the project throughout the project life cycle to meet the requirements of the Environmental and Social Safeguards (ESSs) in a manner and within a time frame acceptable to the Bank.

*This safeguard is applicable to most projects and applies to the current one.*

**OS2: Labor and Working Conditions**

It recognizes the importance of employment creation and income generation in the pursuit of poverty reduction and inclusive economic growth. Also, the importance of treating workers in the project fairly and providing safe and healthy working conditions and respect of workers' rights to promote sound worker-management relationships and enhance the development benefits of a project.

*This safeguard is applicable to the proposed project during the construction and operation phases.*

**OS3: Resources Efficiency and Pollution Prevention and Management**

It recognizes that economic activities often cause air, water, and land pollution and consume finite resources that may threaten people, ecosystem services, and the environment at the local, regional, and global levels. It sets out the requirements to address resource efficiency and

pollution prevention and management throughout the project life cycle in a manner consistent with GIIP.

*This safeguard is applicable on the construction and operation phases of the project.*

**OS4: Community Health, Safety and Security**

It recognizes that projects, activities, equipment, and infrastructure can increase community exposure to risks and impacts. In addition, communities that are already subjected to impacts from climate change may also experience an acceleration or intensification of impacts due to a project or activities. It addresses the health, safety, and security risks to and impacts on project-affected communities and the corresponding responsibility of the Borrower to avoid or minimize them.

*This safeguard is applicable on the construction and operation phases of the project.*

**OS5: Land Acquisition, Restrictions on Access to Land and Land Use, and Involuntary Resettlement**

It recognizes that involuntary resettlement should be avoided, and where involuntary resettlement is unavoidable, it will be minimized, and appropriate measures to mitigate adverse impacts on displaced persons (and on host communities receiving displaced persons) will be carefully planned and implemented.

*This safeguard does not apply to the proposed project since the activities will not involve any involuntary resettlement or change in the land use.*

**OS6: Habitat and Biodiversity Conservation, and Sustainable Management of Living Natural Resources**

It recognizes that protecting and conserving biodiversity and sustainably managing living natural resources are fundamental to sustainable development. Also, recognizes the importance of maintaining core ecological functions of habitats, including forests, and the biodiversity they support in a changing climate, and the need to consider the livelihoods of project-affected parties. Also, addresses the sustainable management of primary production and harvesting.

*This safeguard is applicable to the construction of most project components as they are located within a natural desert environment.*

**OS7: Vulnerable Groups**

OS7 requires assessment and mitigation of impacts on vulnerable groups, including women, children, the elderly, and indigenous peoples. It contributes to poverty reduction and sustainable development by ensuring that projects supported by the Bank enhance opportunities for vulnerable groups to participate in, and benefit from, the development process in ways that do not threaten their unique cultural identities and well-being.

*This safeguard is applicable on the construction and operation phases of the project.*

**OS8: Cultural Heritage**

It sets out measures designed to protect cultural heritage throughout the project life cycle.

*In case of chance finds, the procedures outlined in the Egyptian Antiquities Law No. 117 of 1983 will be followed.*

*Although no cultural heritage components are anticipated within the project site, the archaeological sites near the proposed project location will be addressed in the ESIA.*

**OS9: Financial Intermediaries**

It recognizes that strong domestic capital and financial markets, and access to finance are important for economic development, growth, and poverty reduction. Also, it addresses the environmental and social (E&S) requirements associated with intermediated financing through financial and nonfinancial institutions.

*This safeguard is not applicable to the present project.*

**OS10: Stakeholder Engagement and Information Disclosure**

It recognizes the importance of open and transparent engagement between the Borrower and project stakeholders as an essential element of good international practice.

*This safeguard is applicable on the construction and operation phases of the project.*

**3.5.2 EBRD Performance Requirements**

The Project will comply with the European Bank for Reconstruction and Development (EBRD) Environmental and Social Policy (2024). The project is anticipated to be classified as a Category A undertaking, due to the potential for significant environmental and social risks. Accordingly, a full Environmental and Social Impact Assessment (ESIA), robust stakeholder engagement process, and public disclosure are required.

Below summarizes the relevance and applicability of each EBRD Environmental and Social Requirement (ESR) to the proposed project.

***ESR 1: Assessment and Management of Environmental and Social Risks and Impacts***

This requirement establishes the overarching framework for identifying, evaluating, and managing environmental and social risks. It mandates the development of an Environmental and Social Management System (ESMS), supported by an ESIA and Environmental and Social Management Plan (ESMP). Stakeholder engagement and application of the mitigation hierarchy are fundamental components.

*This requirement is relevant to most projects and applies to the current one.*

***ESR 2: Labour and Working Conditions***



This ESR emphasizes the relation between the economic growth and the well-being of a company in one side and establishing a relationship with the workers as a valuable asset that requires a healthy and safe work environment as well as protection for basic rights of workers. It also recognizes the need for employment creation and income generation as an approach for economic growth. It pertains to issues around labour and working conditions, occupational health and safety, migrant labour, etc.

*This ESR applies to the proposed project during the different phases; more specifically regarding employment opportunities as well as ensuring the safe environment of the workplace. The PR also addresses suppliers and contractors monitoring<sup>3</sup>. In this respect, companies should identify the roles, impacts, and risks associated with their supply chain concerning labour issues (child and forced labour and significant occupational health and safety risks)*

### **ESR 3: Resource Efficiency and Pollution Prevention and Control**

This ESR promotes pollution prevention, efficient resource use, and adherence to Good International Industry Practice (GIIP). It addresses air and water emissions, waste management, and greenhouse gas mitigation.

*The requirement applies to the potential emissions and wastes (solid and liquid) from different sources during the construction and operation phases and their potential impacts.*

### **ESR 4: Health, Safety, and Security**

This ESR recognizes that the project activities and infrastructure can increase the potential for community exposure to risks and impacts arising from equipment accidents, structural failure, and releases of hazardous materials. Impacts may also occur from exposure to diseases and the use of safety and security personnel. Additionally, the EBRD mandates a risk assessment for gender-based violence and harassment (GBVH), recognizing its severe impact on women's health and wellbeing. This includes identifying and mitigating risks related to physical, mental, or sexual harm and ensuring safe, inclusive working conditions.

*The proposed project is a PV Power Plant (500 MW, AC) and BESS and is located at a distance of about 1.5 km from the nearest community (Baraka Village) and about 1.5 Km from the Giza - Luxor Road. North of the proposed project site.*

*Therefore, the likelihood of the surrounding community and nearby road users being affected by construction activities is considered minimal and localized. Additionally, the potential impacts on the community during the operational phase are expected to be insignificant. However, the current ESIA study will address these potential impacts.*

### **ESR5: Land Acquisition, Restrictions on Land Use, and Involuntary Resettlement**

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<sup>3</sup> Where the companies can reasonably exercise control, the client should collaborate with its primary suppliers to propose mitigation measures proportionate to identified risks on a case-by-case basis, while recognizing that assessing and addressing supply chain implications beyond the first or the second-tier suppliers may not be practical or meaningful to the client or the supplier. IFC Guidance Note 1, 2012

This ESR ensures that any displacement is minimized and that affected individuals are compensated fairly. It mandates meaningful consultation and livelihood restoration where applicable.

*The provisions of this requirement do not apply to the proposed project, as the activities will not involve any involuntary resettlement or changes in land use.*

#### **ESR6: Biodiversity Conservation and Sustainable Management of Living Natural Resources**

This performance requirements addresses how projects<sup>4</sup> can avoid or mitigate threats to biodiversity arising from their operations as well as sustainably manage renewable natural resources.

*As a significant part of the ESIA, the biological baseline in the project area is to be described. Preliminary information about the proposed project area indicates the absence of significant ecological diversity. Yet, the ESIA will describe the different habitats and biodiversity surrounding the area and investigate the potential project impact on them, where/if applicable.*

#### **ESR 7: Indigenous Peoples**

This performance requirement aims at preventing adverse impacts of the projects on communities of Indigenous Peoples and to provide opportunities for development benefits.

*Provisions of this ESR do not apply to the proposed project since there are no indigenous communities in the area.*

#### **ESR8: Cultural Heritage**

The objective of this performance standard is to protect the cultural heritage from the adverse impacts of the project activities and support its preservation.

There are no registered antiquities or cultural heritage sites within the Project Site. However, the archaeological sites and monuments located in close proximity to the Project Site will be addressed in the ESIA.

#### **ESR10: Information Disclosure and Stakeholder Engagement**

Sets out the principles and requirements for meaningful stakeholder engagement throughout the lifecycle of a project. It aims to ensure transparency, inclusivity, and responsiveness by requiring the early disclosure of relevant project information, ongoing consultation with affected communities and stakeholders, and the establishment of accessible grievance mechanisms.

*ESR-10 is applicable to the Project*

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<sup>4</sup> Where a client is purchasing primary production (especially but not exclusively food and fiber commodities) that is known to be produced in regions where there is a risk of significant conversion of natural and/or critical habitats, systems and verification practices will be adopted as part of the client's ESMS to evaluate its primary suppliers.<sup>21</sup>

### 3.5.3 European Investment Bank (EIB)

The European Investment Bank (EIB) applies eleven Environmental and Social Standards (2023) to ensure that projects it finances are environmentally sound, socially responsible, and aligned with EU and international commitments

#### ***Standard 1: Environmental and Social Impacts and Risks***

This Standard promotes an integrated approach to impact assessment and risk management, ensuring environmental, climate, social, and human rights considerations are addressed in decision-making. It mandates the establishment of an Environmental and Social Management System (ESMS) by the promoter. The process involves: Identifying and assessing likely significant effects, including direct, indirect, secondary, cumulative, and transboundary effects. Applying the mitigation hierarchy (avoid, prevent, reduce, and, if necessary, remedy/compensate) to manage adverse effects. Integrating human rights risks into the assessment. Ensuring consistency with the "Do Not Significant Harm" (DNSH) and "Minimum Safeguards" (MS) principles. Projects likely to have significant impacts must undergo an EIA (in the EU) or ESIA (in the rest of the world).

*This standard is relevant to most projects and applies to the current one.*

#### ***Standard 2: Stakeholder Engagement***

This Standard recognizes the importance of stakeholder engagement for effective assessment, management, and monitoring of risks, enhancing project sustainability. It outlines the promoter's responsibility for transparent and continuous engagement. The core objectives are: Adopting an inclusive and systematic approach to engaging constructively with affected persons and communities. Ensuring stakeholders have timely access to information about project risks/impacts in a culturally appropriate and understandable manner. Promoting meaningful and free participation in decision-making. Providing rights-holders with effective grievance and remedy mechanisms. The nature and extent of engagement must be commensurate with the project's likely impacts and risks.

*This standard is relevant to the current one*

#### ***Standard 3: Resource Efficiency and Pollution Prevention***

This Standard promotes the goal of zero pollution and transitioning to a circular economy. The primary responsibility is ensuring an integrated approach to resource efficiency and control of emissions (air, water, land, noise). Key areas of focus include: Assessing the effectiveness and efficiency of resource use (materials, land, soil, water, energy). Promoting waste prevention, reuse, and recycling in accordance with the waste hierarchy. Using Best Available Techniques (BAT). Establishing management systems for Emergency Prevention, Preparedness and Response to major accidents (e.g., related to dangerous substances). Ensuring the sound management of hazardous substances and materials.

*The standard applies to the potential emissions and wastes (solid and liquid) from different sources during the construction and operation phases and their potential impacts.*

#### ***Standard 4: Biodiversity and Ecosystems***

This Standard focuses on protecting and conserving biodiversity and maintaining ecological functions. It recognizes the link between ecosystem degradation and disproportionate impacts

on vulnerable communities. The objectives are: Applying the precautionary approach to avoid irreversible impacts. Applying the mitigation hierarchy (avoid, minimize, restore, compensate) to achieve No Net Loss or a Net Positive Impact (NPI) on biodiversity where required. Promoting the use of an ecosystem-based approach. Prohibiting project-related activities in areas of critical habitat unless rigorous conditions are met, ensuring no measurable adverse impacts or net reduction in vulnerable species population.

**Standard 5: Climate Change**

This Standard addresses the urgency of combating climate change through mitigation (reducing GHG emissions) and adaptation (building resilience). It promotes alignment with the Paris Agreement goals. Promoter responsibilities include: Assessing project-related GHG emissions and alignment with low-carbon pathways. Assessing the project's resilience to physical climate risks (acute and chronic hazards). Where a project is at risk, carrying out a Climate Risk and Vulnerability Assessment (CRVA) to identify commensurate adaptation measures. Ensuring consistency with the "Do No Significant Harm" (DNSH) principle to climate objectives.

**Standard 6: Involuntary Resettlement**

This Standard applies to displacement—both physical displacement (loss of residence) and economic displacement (loss of income/livelihood)—resulting from involuntary land acquisition or use restriction. The primary goals are: To avoid or minimize involuntary resettlement. To avoid any forced evictions (which are considered a gross violation of human rights). To improve or at least restore displaced persons' livelihoods and living standards to pre-project levels. Mandating timely compensation for loss of assets at the full replacement cost. Planning documents must be prepared, such as a Resettlement Action Plan (RAP) or Livelihood Restoration Plan (LRP).

*The standard of this requirement do not apply to the proposed project.*

**Standard 7: Vulnerable Groups, Indigenous Peoples and Gender**

This Standard addresses individuals and groups who may be disproportionately affected by risks due to systematic discrimination, marginalisation, and/or exclusion based on socioeconomic characteristics (e.g., gender, age, disability, ethnicity). The objectives are: To address inequalities and facilitate equitable access to mitigation and benefits. Requiring promoters to adopt a gender-responsive approach to identifying, managing, and monitoring impacts. For Indigenous Peoples: Ensuring respect for their rights, identity, culture, and livelihoods. In required cases (e.g., impacts on customary lands or cultural resources), promoters must obtain Free, Prior and Informed Consent (FPIC).

*Provisions of this standard do not apply to the proposed project since there are no indigenous communities in the area*

**Standard 8: Labour Rights**

This Standard establishes minimum requirements aligned with the principles of the ILO Fundamental Conventions and the European Pillar of Social Rights. It applies to direct workers, third-party workers (contractors/intermediaries), and supply chain workers. Key requirements include: Ensuring non-discrimination and equal opportunity in employment decisions. Implementing zero tolerance for forced labor and child labor. Respecting the rights to freedom

of association and collective bargaining. Establishing a written employment contract for all workers. Setting up an effective, gender-responsive grievance mechanism for workplace concerns.

This standard applies to the proposed project during the different phases; more specifically regarding employment opportunities as well as ensuring the safe environment of the workplace.

#### ***Standard 9: Health, Safety and Security***

This Standard covers occupational and public health, safety, and security risks arising from project activities. It requires promoters to put in place a Health and Safety Management System (HSMS). The objectives focus on: Protecting the health, safety, and security of project workers (including third parties and considering gender-specific risks). Managing risks to project-affected people and communities (including sexual harassment, exploitation, and abuse). Ensuring the use of public or private security forces is consistent with international human rights standards (e.g., the UN Voluntary Principles on Security and Human Rights)

*This standard is relevant to the current one*

#### ***Standard 10: Cultural Heritage***

This Standard emphasizes the protection and conservation of both tangible and intangible cultural heritage. The core objective is the application of a precautionary approach to managing and protecting cultural heritage. Key actions include: Avoiding significant adverse impacts on cultural heritage; if unavoidable, minimizing them and providing compensation as a last resort. Engaging professionals to compile a baseline inventory and assess cultural significance. Establishing chance finding procedures for unexpected discoveries during implementation. Ensuring equitable sharing of benefits when commercializing cultural resources used by local communities

There are no registered antiquities or cultural heritage sites within the Project Site. However, the archaeological sites and monuments located in close proximity to the Project Site will be addressed in the ESIA.

#### ***Standard 11: Intermediated Finance***

This Standard applies when EIB financing is channeled through Financial Intermediaries (FIs) to support smaller sub-projects. The FI's process for assessing, managing, and monitoring ECS risks must be commensurate with the sub-project's risk level. General requirements for FIs include: Respecting their own employees' labour rights and providing a safe working environment. Requiring final beneficiaries to comply with applicable national and EU legislation (or EIB ESS outside the EU). Operating processes to screen sub-projects against the EIB's excluded activities list. Ensuring rights-holders have access to stakeholder engagement and grievance mechanisms.

*This standard is not applicable to the present project.*

### **3.5.4 Cassa Depositi e Prestiti S.p.A. (CDP) Sustainability Framework (2020)**

The Cassa Depositi e Prestiti S.p.A. (CDP) Sustainability Framework (Version 1.0, 2020) establishes a comprehensive environmental, social, and governance (ESG) system that applies to all projects and entities benefiting from CDP financing.

The Framework aligns with international sustainability principles and ensures that all CDP-supported activities respect human rights, prevent adverse environmental and social impacts, and contribute positively to sustainable development objectives

### **A. Environmental Commitments**

In accordance with Sections 6.1 and 6.4 of the CDP Sustainability Framework, every financed project is subject to a Sustainable Development Assessment (SDA), which evaluates ex-ante the potential positive and negative environmental impacts across key dimensions such as climate change, resource efficiency, biodiversity, pollution prevention, and waste management.

An ex-post assessment is then conducted to verify the actual environmental and social performance of financed activities, based on annual reporting and the aggregation of new lending data across CDP's operational lines. **Funded projects are required to:**

- Comply with internationally recognized environmental standards, including:
  - IFC Performance Standards on Environmental and Social Sustainability.
  - World Bank Group Environmental, Health and Safety (EHS) Guidelines.
  - European Union environmental directives, where applicable.
- Avoid, minimize, or mitigate adverse impacts and implement corrective actions when required. CDP expects beneficiaries to manage environmental risks proactively and report any identified non-compliance or incidents.
- Promote positive environmental outcomes through initiatives that enhance sustainability performance, such as renewable energy adoption, energy efficiency improvement, low-carbon transition, climate adaptation, and conservation of natural ecosystems.
- Monitor and disclose environmental results periodically through sustainability reporting mechanisms defined under Sections 6.5 and 7 of the Framework.

### **B. Social Commitments**

CDP's social standards are grounded in internationally recognized human rights and labor conventions and apply to all operations and relationships arising from CDP-financed projects. As stated in Section 6.4, CDP periodically evaluates the human rights implications and social risks associated with its activities, considering external contexts such as country risk, regulatory developments, and stakeholder feedback. Funded entities are expected to:

- Respect and uphold international human rights standards, in line with:
  - The Universal Declaration of Human Rights;
  - The International Covenant on Civil and Political Rights;
  - The International Covenant on Economic, Social, and Cultural Rights;
  - The ILO Fundamental Conventions (Nos. 29, 87, 98, 100, 105, 111, 138, 182).
- Engage stakeholders effectively, maintaining transparent dialogue and consultation throughout the project life cycle, consistent with the requirements of Section 7 – Disclosure and Transparency.

### **C. Health and Safety Commitments**

As outlined in Sections 6.4 and 6.5, CDP requires that all financed projects maintain high standards of occupational health and safety (OHS) and community protection, consistent with the World Bank Group Environmental, Health and Safety Guidelines and relevant EU Directives.

### **3.5.5 IFC E&S Performance Standards**

#### ***PS1: Social and Environmental Assessment and Management System***

This performance standard establishes the importance of:

- i. Integrated assessment to identify the social and environmental impacts, risks, and opportunities of projects;
- ii. Effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them;
- iii. The client's management of social and environmental performance throughout the life of the project.

*This PS is relevant to the current project. The current ESIA report is prepared satisfying PS 1.*

#### ***PS2: Labor and Working Conditions***

This performance standard emphasizes the relation between the economic growth and the well-being of a company in one side, and establishing a relationship with the workers as a valuable asset that requires a healthy and safe work environment as well as protection for basic rights of workers. It also recognizes the need for employment creation and income generation as an approach for economic growth.

*This PS applies to the current project; more specifically related to the creation of job opportunities as well as ensuring the safe environment of the workplace.*

#### ***PS3: Pollution Prevention and Abatement***

This performance standard recognizes that industrial activities often generate increased levels of pollution to air, water, and land, which can have a potential adverse impact on the surrounding environment.

*This PS applies to the potential generation of wastewater from different sources of this project and their potential impacts.*

#### ***PS4: Community Health, Safety, and Security***

This performance standard recognizes that the project activities and infrastructure can increase the potential for community exposure to risks and impacts arising from equipment accidents, structural failure, and releases of hazardous materials. Impacts may also arise from exposure to diseases and the use of safety and security personnel.

*This PS applies to the proposed project during the construction and operation phase of the project.*

#### ***PS5: Land Acquisition and Involuntary Resettlement***



This performance standard recognizes that the project design minimizes economic and physical displacement, balancing social, environmental, and financial costs and benefits.

*This PS does not apply to the proposed project since the activities will not involve any involuntary resettlement.*

**PS6: Biodiversity Conservation and Sustainable Natural Resource Management**

This performance standard addresses how projects can avoid or mitigate threats to biodiversity arising from their operations as well as sustainably manage renewable natural resources.

*This PS applies to the proposed project, as the substation component is located outside the industrial area. Chapter 6 of this study discusses the mitigation measures needed for the biodiversity environment concerning the proposed project.*

**PS7: Indigenous Peoples**

This performance standard aims at preventing adverse impacts of the projects on communities of Indigenous peoples and to provide opportunities for development benefits.

*This PS does not apply to the proposed project since there are no indigenous communities in Egypt.*

**PS8: Cultural Heritage**

The objective of this performance standard is to protect the cultural heritage from the adverse impacts of the project activities and support its preservation.

*This PS does not apply to the proposed project as there are no recorded archaeological sites within the Project site.*

### **3.5.6 World Bank EHS Guidelines**

The World Bank Group members are committed to abiding by the general EHS Guidelines for different projects where they are involved. These are complemented by industry-specific guidelines for complex projects.

The EHS Guidelines are technical reference documents with general and industry-specific examples of GIIP. These industry sector EHS guidelines are designed to be used together with the General EHS Guidelines document, which provides guidance to users on common EHS issues potentially applicable to all industry sectors.

The EHS Guidelines include performance measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an

environmental assessment in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account.

## 4. Environmental and Social Baseline

### 4.1 Project Site Location

The project site is administratively located in the Qena Governorate, specifically, within the desert hinterland of the city and Markaz of Nagaa Hammadi, and is located around 14 km southeast of the town of Nagaa Hammadi. The nearest settlement to the Project Site is located approximately 1.5 km northwest of the Project Site (Baraka Village). Other notable areas surrounding the Project Site include the Obelisk PV Project located approximately 2 km west of the Project Site, the Nile Valley, located 8 km north of the Project Site, and the capital of the Qena governorate, Qena City, situated 42.5 km northeast of the Project Site. The coordinates of the boundaries of the usufruct area and the included project site, along with the locations of the nearest roads and residential settlements, are provided below (Figure 7).

**Table 9: Coordinates of the Project Site**

Corner No.	Latitude	Longitude
1	32° 19' 39.83" E	25° 56' 40.63" N
2	32° 19' 58.42" E	25° 56' 43.62" N
3	32° 21' 30.43" E	25° 56' 44.04" N
4	32° 21' 31.11" E	25° 54' 40.0" N
5	32° 21' 0.92" E	25° 54' 39.31" N
6	32° 21' 0.97" E	25° 54' 29.59" N
7	32° 20' 44.46" E	25° 54' 29.51" N
8	32° 20' 44.41" E	25° 54' 39.24" N
9	32° 19' 59.11" E	25° 54' 39.59" N
10	32° 19' 50.01" E	25° 55' 43.93" N
11	32° 19' 40.6" E	25° 55' 42.12" N
12	32° 19' 37.62" E	25° 56' 0.4" N

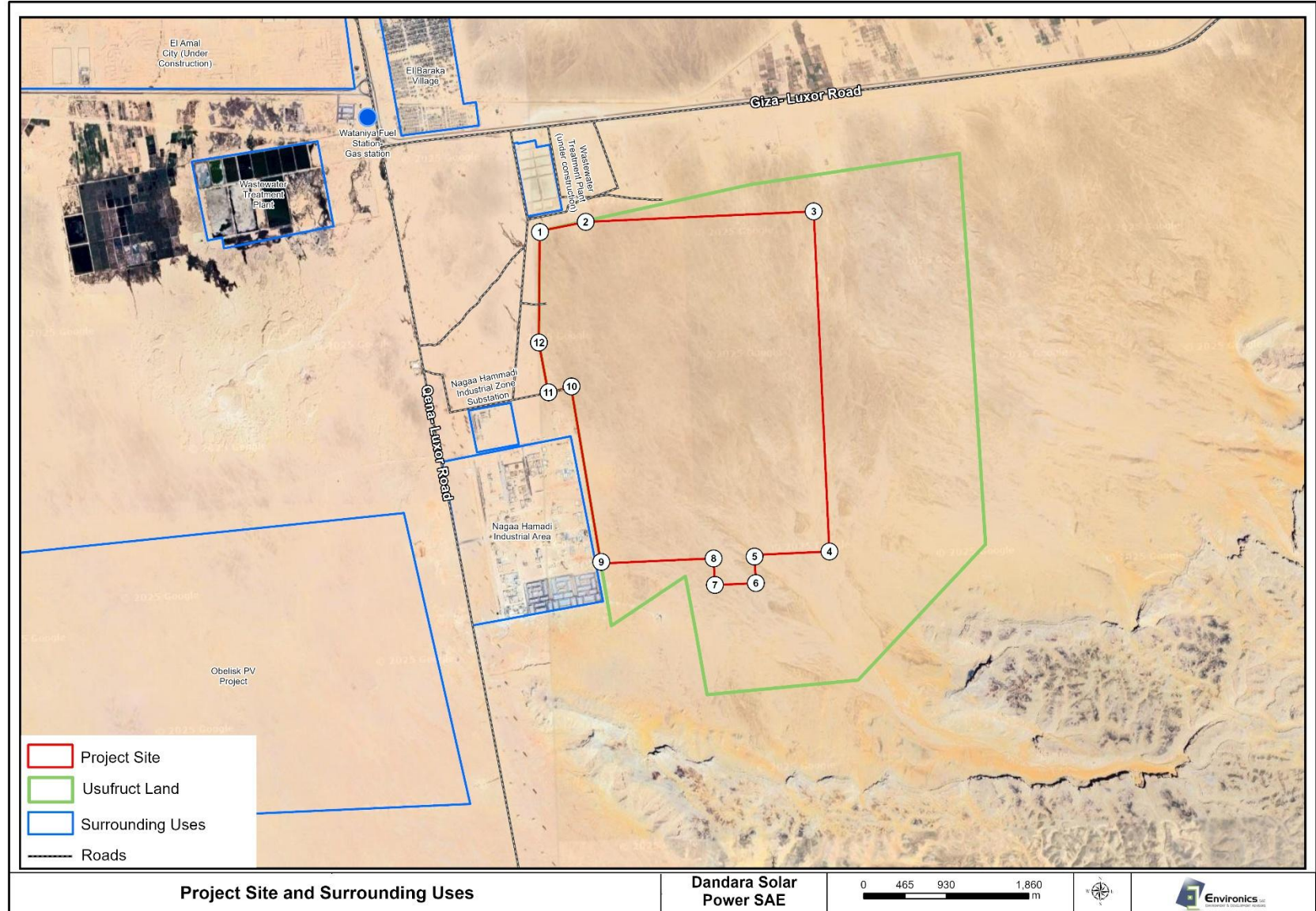


Figure 7: Map showing the Project Site within Scatec's usufruct land

## 4.2 Methodology

A thorough desktop review of reports and studies has been carried out. Information has been refined through analysis of satellite images. The status of the bio-physical features and socio-economic characteristics of the Project Site and surroundings have been described.

Desktop information was refined through the integration of the results of two field visits carried out in August and October 2025, as well as meetings with local stakeholders.

### 4.2.1 Physical Environment

Information was gathered from published material, previous reports, online meteorological data such as Meteoblue and Weatherbase, interpretation of geological and hydrogeological maps, analysis of satellite images, and application of GIS analysis tools. Topographic maps are based on the Digital Elevation Model extracted from Global Mapper.

### 4.2.2 Biological Environment

Information and data on the species/features of the wider area<sup>5</sup> that could also be present in the project area were gathered from direct observations, published material and previous reports, analysis of satellite images, and from recent studies performed by Environics and other entities.

Accordingly, data and information on the biodiversity of the Project Site and surroundings were mainly obtained through:

- Published material and previous reports, analysis of satellite images, and recent studies performed by Environics and other entities;
- References with maps showing empirical records and projected species' range, such as Baha El Din (2006) for herpetofauna, BirdLife International (2025) for avifauna, and Basuony *et al.* (2010) and Hoath (2009) for mammals;
- BirdLife International database;
- The IUCN Red List of Threatened Species;
- Integrated Biodiversity Assessment Tool (IBAT)<sup>6</sup>;
- Global Biodiversity Information Facility (GBIF);
- Migratory Soaring Birds Tool (MSBT); and
- Professional judgment based on analysis of information obtained from literature on the wider area.

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<sup>5</sup> The wider area includes the area surrounding the project site which encompasses the same habitat and features of the project site and having a reasonable geographical extent to include all environmental and social aspects/receptors that might interact with project activities.

<sup>6</sup> IBAT is a web-based map and reporting tool developed as partnership among BirdLife International, Conservation International, IUCN, and UN Environment World Conservation Monitoring Centre. The tool provides a metric of "biodiversity significance", namely, Rarity-weighted species richness. It is visualized through a map that shows the relative importance of each ~10km (30 arc-seconds) grid cell in terms of its aggregate contribution to the global distribution of species of mammals, birds, amphibians, crabs, crayfishes and shrimps.

Gathered information was confirmed and/or refined through two field visits to the Project Site and its surroundings carried out by the Scatec team in August 2025 and by Environics' team in October 2025.

Given the extent of the wider area, Environics carried out an initial assessment based on analysis of satellite images before undertaking the field survey. This step resulted in the preliminary identification of the land use sets and habitat types of the entire study area and provided an initial identification of the area features and landmarks. Accordingly, a number of locations were preliminarily selected for field investigations, representing the different habitat types of the area.

Moreover, as Scatec's field visit preceded Environics' survey, the field visit report developed by Scatec was used to plan Environics' field survey, which focused on confirming Scatec's findings, as well as on the main areas of interest not covered by Scatec's visit. Accordingly, a survey of the project site and its close surroundings was undertaken on the 7<sup>th</sup> of October 2025.

Accordingly, the entire project site, along with the usufruct area, the area of influence (Aoi), and an Ecologically Appropriate Area of Analysis (EAAA; see Section 4.4.8), was covered by the two complementary surveys. Environics' survey included 10 points, numbered from 1 to 10 (see Figure 28 in Section 4.4.2). The survey covered a radius of 500-750 meters around the selected points, as well as the route connecting the different points.

Figure 8 shows the surveyed locations and survey tracks during the August and October 2025 surveys.



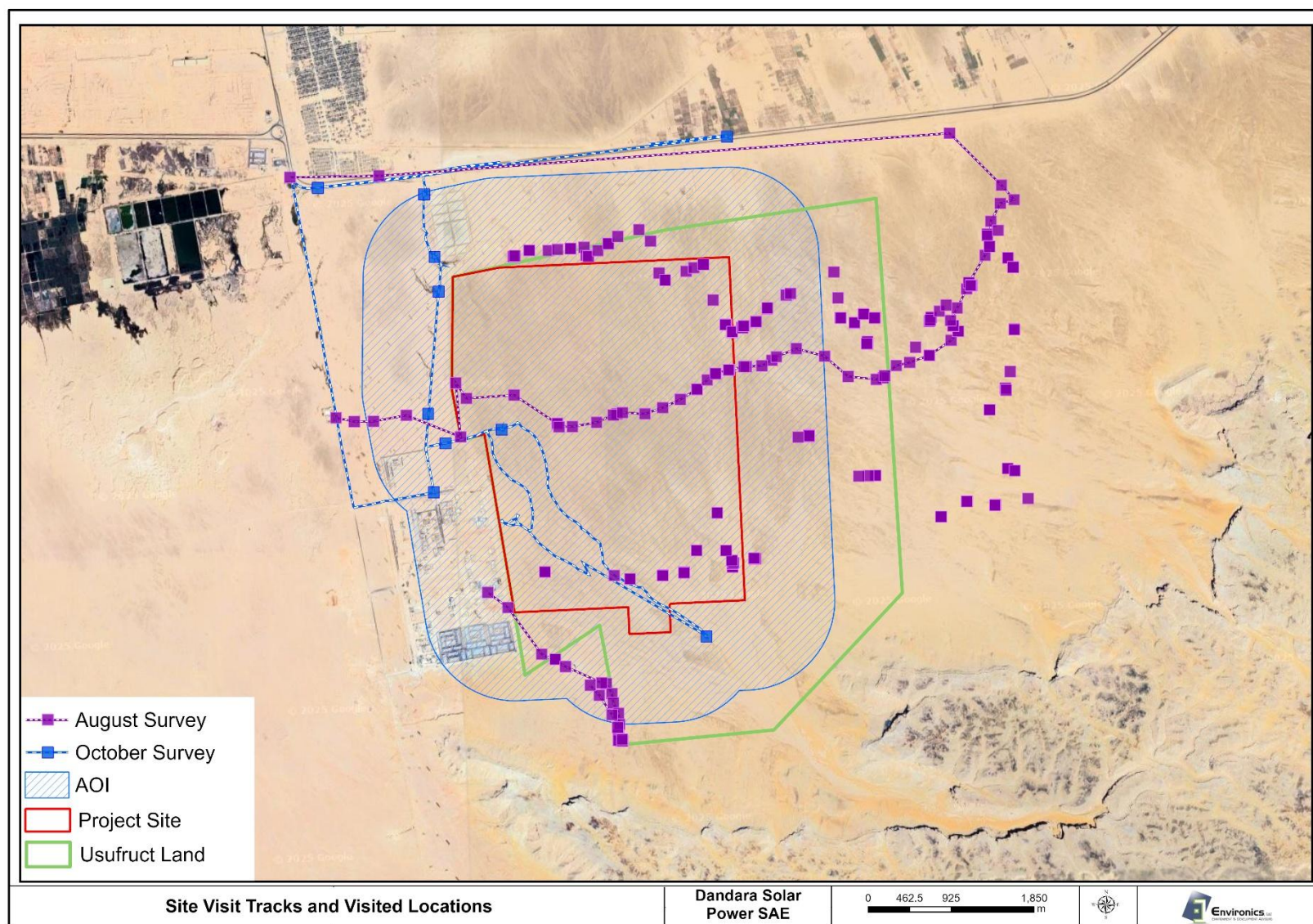


Figure 8: Surveyed locations within the Project Site and surroundings in August and October 2025



The location of each visited place was recorded using a GPS. At each point, a quick assessment methodology, covering a radius of 500-750 meters around each point, was used to assess the main ecological features of the site. Moreover, the route connecting the different points was also visually inspected from the car to identify potential variations or other points of interest. The survey included an active search to record the main species of flora and signs indicating the presence of fauna (markings, urine, scats, tracks, trails, burrows and dens, carcasses, remains of prey or direct observation of the animal). Field notes were taken, and photographic records of flora and fauna were obtained, whenever possible.

Based on the collected information, valuable habitats, sensitive areas as well as species of concern have been highlighted, to include threatened and/or protected species as well as species of ecological and/or economic importance. The Red List issued by the International Union for the Conservation of Nature (IUCN) is used to determine the international status of species. The national status, whenever available, has been obtained from local literature on the Egyptian biodiversity. As many of these references are not very recent and require updates, the local status obtained from literature has sometimes been modified to reflect the actual status of animals, based on professional judgment. Moreover, if the status differs from one source to another, the more stringent classification is applied. The status of species is determined following the IUCN Red List categories<sup>7</sup>.

#### **4.2.3 Socio-economic Environment**

The socio-economic data collection of the Project Sites and immediate surroundings relied on secondary data sources which included, but were not limited to:

- Maps and satellite images of the Project Sites and surroundings;
- Former technical reports in nearby areas and localities;
- CAPMAS data on the area;
- Information available on the relevant governorate web portal; and
- Land use data acquired from Sentinel-2 10 m land use/land cover dataset obtained from ESRI.

Socio-economic data were also complemented through stakeholders' meetings carried out in October 2025.

Moreover, the wider area was screened for the presence of archaeological and cultural heritage sites using the following sources:

- Archaeological Atlas of Published Excavations; and
- The Archaeological Map of Egypt<sup>8</sup>.

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<sup>7</sup> EX: Extinct; EW: Extinct in the Wild; CR: Critically Endangered; EN: Endangered; VU: Vulnerable; NT: Near Threatened; LC: Least Concern; DD: Data Deficient; NE: Not Evaluated; NA: Not Applicable

<sup>8</sup> <https://archmap.cultnat.org/>

## 4.3 Physical Environment

### 4.3.1 Climate and Meteorology

The Qena governorate is characterized by its substantial temperature variability, manifested in very hot summers, very cold winters, and a highly variable diurnal air temperature range (i.e., the difference between the daily maximum and daily minimum air temperature) (Katavoutas et al., 2023). In addition, the governorate is characterized by its year-long aridity and negligible precipitation events, and the large quantities of solar radiation the governorate receives, particularly during the summer seasons.

Detailed climatic features of the Qena governorate are provided in the following sections based on historical data recorded from the Qena meteorological station. Pertinently, the Qena meteorological station is the closest meteorological station to the Project Site (the station is located approximately 53 km east of the Project Site).

- **Temperature**

Air temperature data collected over a monitoring period of 112 years from the Qena meteorological station (Table 10) indicate that the annual average air temperature in the Qena governorate is 23.9°C. In terms of monthly air temperature data, air temperature peaks during the months of July and August, reaching 37.9°C and 37.6°C, respectively. Conversely, the lowest monthly average temperatures occur in January and February, where average minimum temperatures reach 5.3°C and 6.7°C respectively. This temperature variation throughout the year underscores the seasonal temperature variability experienced by the Qena governorate (Weatherbase, 2025).

**Table 10: Air temperature recorded from the Qena meteorological station over a period of 112 years**

Qena Meteorological Station														
Annual Avg. Temp. (°C)	23.9	Monthly Avg. Temp. (°C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			14.4	16.1	19.7	24.6	28.3	30.9	31.2	30.8	29	25.6	20.3	16
Annual Avg. High (°C)	30.8	Monthly Avg. High (°C)	21.1	23.3	27	31.8	35.5	37.9	37.6	37.3	35.7	32.6	27.4	22.5
Annual Avg. Low (°C)	14.9	Monthly Avg. Low (°C)	5.3	6.7	10.3	15	18.9	21.5	22.7	22.3	20.4	16.8	11.5	6.9

- **Solar Radiation**

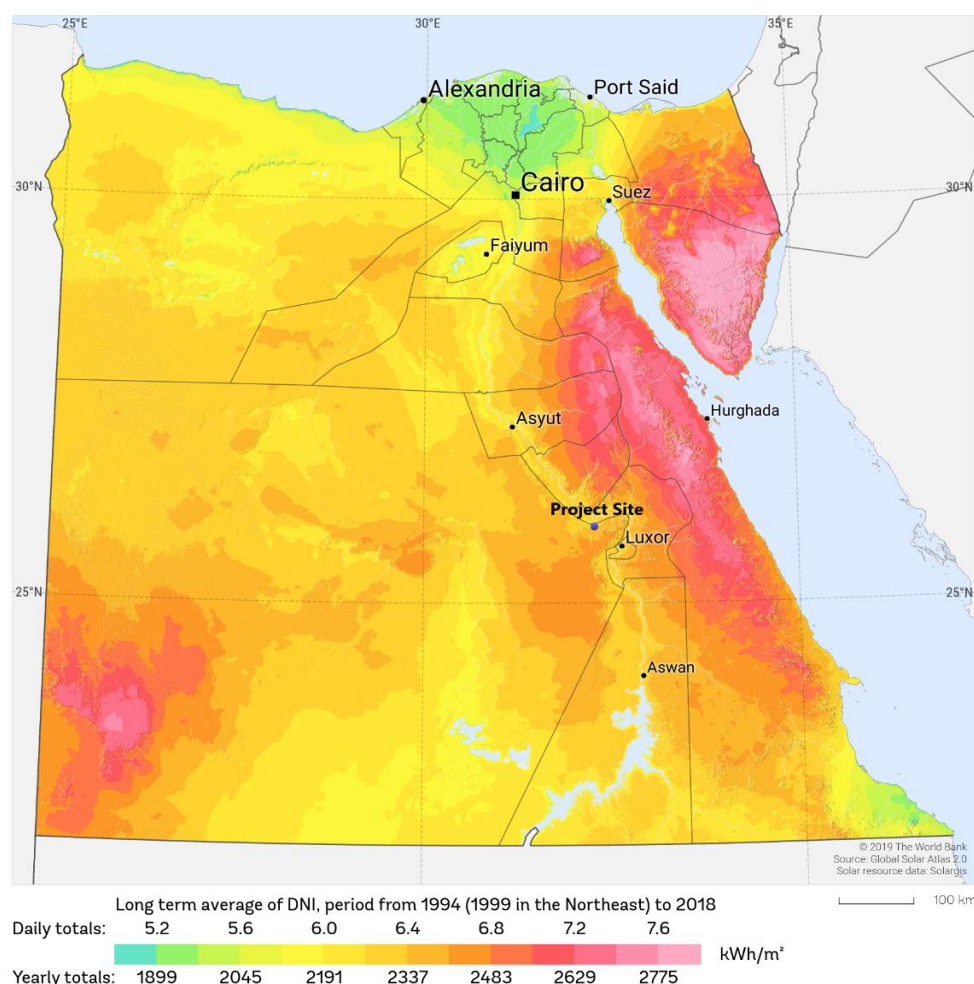
The monthly average Solar Radiation (SR) in megajoules per meter squared per day (MJ/m<sup>2</sup>/day) received in the Qena governorate between 2012 and 2016 reveals that the maximum solar radiation was consistently recorded in the month of July. In addition, the highest levels of solar radiation were reached over the four years (27 MJ/m<sup>2</sup>/day) in July of 2012. On the other hand, the lowest SR values were recorded in December, where the minimum SR level (12 MJ/m<sup>2</sup>/day) was reached in December in multiple years (Khalafallah, 2020).

More comprehensive data on the quantities of solar radiation received in the Qena governorate is provided below (Table 11) (Khalafallah, 2020).

Table 11: Monthly average levels of SR MJ/m<sup>2</sup>/day between 2012 and 2016 in the Qena Governorate

Year	Monthly Average SR (MJ/m <sup>2</sup> /day)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Max	Min
2012	15	15	22	25	26	25	27	26	22	18	15	13	27	13
2013	14	18	21	25	26	24	24	22	20	17	13	12	26	12
2014	12	14	19	22	24	24	24	22	20	17	14	12	24	12
2015	13	14	17	20	20	21	21	19	18	16	13	12	21	12
2016	13	16	17	21	22	23	23	21	18	15	12	12	23	12

According to the solar map of Egypt, the Project Site lies in an area with a high intensity of direct solar radiation, where solar radiation ranges between 2,191 kWh/m<sup>2</sup>/ year and 2,264 kWh/m<sup>2</sup>/ year and 6.0 kWh/m<sup>2</sup>/ day to 6.2 kWh/m<sup>2</sup>/ day (Figure 9) (Solargis, 2025).



- **Day Length**

The average length of day in the Qena governorate ranges between 11 hours and 14.2 hours. The average minimum day length of 11 hours is reached in December, whilst the average maximum of 14.2 hours is reached in June. More comprehensive data on the annual and

monthly average day lengths as recorded by Qena meteorological station over a monitoring period of 30 years is summarized below (Table 12) (Weatherbase, 2025).

**Table 12: Average day lengths as recorded by the Qena meteorological station over 30 years**

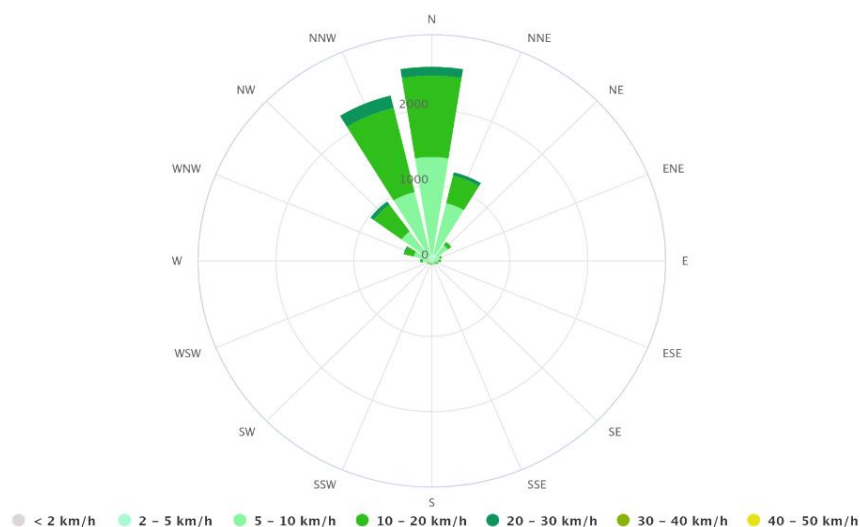
Annual Average Day Length (Hr)	Monthly Average length of day (Hr)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
12.6	11.1	11.7	12.4	12.4	13.9	14.2	14	13.4	12.7	11.9	11.3	11

- Wind Speed and Direction**

The Qena governorate experiences slight variations in wind speeds throughout the year. The annual average wind speed as recorded by the Qena meteorological station over a period of 112 years is 12 km/h, the maximum monthly wind speed recorded over the same period does not deviate much from this value, with windspeeds peaking at 13.7 km/h during April. Similarly, the minimum windspeed values drop to 9.7 km/h between October and November, again, only a slight deviation from the annual average. In terms of wind direction, northerly and north-northwesterly winds are the dominant wind directions at the Qena governorate throughout the year. Following these are northwesterly and north-northeasterly winds (Figure 10) (Meteoblue, 2025).

**Table 13: Average wind speeds as measured by the Qena meteorological station over 112 years**

Annual Average Wind Speed (km/h)	Monthly Average Wind Speed (km/h)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
12	12.6	12.6	13	13.7	13	13	12.6	12.2	12.6	9.7	9.7	9.7



**Figure 10: Wind Rose for the Qena governorate showing the dominant windspeeds and directions**

- Precipitation**

The Qena governorate is located in a dry climatic region characterized by warm temperatures, aridity, and drought during the summers, and negligible amounts of rainfall during the

winters. The peak monthly average amount of rainfall is reached in May (0.4 mm), whilst the lowest monthly average drops to 0.1 mm in December and January. The annual and monthly average values recorded by the Qena meteorological station over a period of 112 years are detailed below (Table 14) (Weatherbase, 2025).

**Table 14: Rainfall (in millimeters) recorded by the Qena meteorological station over 112 year**

Annual Avg. rainfall (mm)	Monthly Average Rainfall (mm)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.6	0.1	0.3	0.2	0.3	0.4	0	0	0	0	0.2	0	0.1

- **Relative Humidity**

The average relative humidity is highly variable in the Qena governorate, with the annual average humidity measuring 41%, and the maximum average humidity reaching 54.2% (in December), and the minimum value dropping to 30% (in May) (Table 15) (Weatherbase, 2025).

**Table 15: Average Relative Humidity recorded from Qena over 112 years**

Annual Average Humidity (%)	Monthly Average Humidity (%)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
41	52.8	46.1	39.7	33.9	30	30.8	34.4	37	40.2	43.5	49.9	54.2

- **Dust and Sandstorms**

According to a dust, sandstorm, and haze assessment conducted for the project as part of the baseline investigations, the Project Site is subject to the dust and sand dynamics to which the narrow land strip of the Nile Valley in Upper Egypt is normally exposed. The assessment was conducted using data extracted from Luxor Airport meteorological station, due to its location within the vicinity of the Project Site (located around 50 km away), and its abundance of relevant data collected over a lengthy monitoring period of 22 years.

- **Haze**

Haze is an extreme meteorological phenomenon with negative health implications for humans. Haze is caused by the increase and accumulation of polluting aerosol emissions, such as fossil fuel combustion from automobile exhaust. In recent years, haze events have progressively increased in frequency across North Africa (Zhang et al., 2021). According to the results of the haze assessment conducted, over 22 hours, the total number of observed hours of haze events in the vicinity of the Project Site was 2,864 hours (1.5% of total hours). Haze events peaked in February, with the average maximum number of hours of observed haze events occurring during February, whilst the summer months had the minimum average number of hours of haze. The 2,864 hours of observed haze occurred across a period 804 days, and were correlated with very slow windspeeds (less than 1 m/s) and light winds less than 3.5m/s.

- **Dust Storms**

Over the same 22-year period, the total number of observed hours of dust storming was 544 hours, accounting for 0.29% of the total observed hours. These events occurred across 105 days and were characterized by moderate windspeeds (2 - 5 m/s). Dust storming events peaked in March, where the maximum number of hours of observed dust storms occurred, and as above, the summer months were when the lowest frequencies of dust storms occurred.

- **Sand Rising**

The total number of observed hours of Rising Sand events is 446 hours, accounting for 0.23% of the total hours. These events occurred across 122 days characterized by high windspeeds (greater than 5 m/s). The number of hours of observed rising sand events peaked in March, and again, the minimum rate of rising sand events occurred during the summer.

- **Sandstorms**

The total number of observed hours of Sandstorm events is 34 hours, accounting for 0.02% of the total hours. These events occurred across 16 days, characterized by high wind speed of more than 5 m/s. Westerly winds were deduced to be the predominant winds causing sandstorms, followed by northwesterly and easterly winds, to a lesser extent. Again, sand storm events peaked in March, where the maximum number of hours of observed, however, the frequency of sand storming decreased during April and May.

#### 4.3.2 Air Quality

According to data from the Qena meteorological station recorded in December of 2023, the air at the governorate was found to have a relatively high average monthly concentration of PM<sub>10</sub> (particulate matter where particles have a diameter of 10 micrometers or less) of 166 µg/m<sup>3</sup>. This is higher than the regulatory threshold of 70 µg/m<sup>3</sup>, as expected in a location surrounded by desert. The average monthly concentrations measured during the same period (December 2023) of Sulphur dioxide, Nitrogen dioxide and Ammonia are outlined below and are lower than the regulatory thresholds (Table 16) (EEAA, 2023).

**Table 16: Monthly average concentration of air pollutants at Qena, and Luxor monitoring stations during December 2023 (µg/m<sup>3</sup>)**

Air Pollutant	PM <sub>10</sub>	SO <sub>2</sub>	NO <sub>2</sub>	NH <sub>3</sub>
Monthly Average Concentration (µg/m <sup>3</sup> )	166	18	29	17

Annual average concentrations of common pollutants were also recorded and collated from the Qena meteorological station over the year 2022. The records indicated that, as above, the air at Qena was found to have a high annual average concentration of PM<sub>10</sub> (149 µg/m<sup>3</sup>), which is again, higher than the regulatory threshold of 70 µg/m<sup>3</sup> and WHO threshold of 70 µg/m (interim target 1)<sup>9</sup>. The annual average concentrations Sulphur dioxide and nitrogen dioxide are also provided below (Table 17) (EEAA, 2022).

<sup>9</sup> WHO global air quality guidelines (2021) <https://iris.who.int/bitstream/handle/10665/345329/9789240034228-eng.pdf>

**Table 17: Annual average concentration of air pollutants in Qena and Luxor monitoring stations during the year 2022 ( $\mu\text{g}/\text{m}^3$ )**

Air Pollutant	PM <sub>10</sub>	SO <sub>2</sub>	NO <sub>2</sub>
Annual Average Concentration ( $\mu\text{g}/\text{m}^3$ )	149	15	22

### 4.3.3 Air Quality and Noise Measurements

Baseline measurements of ambient air quality and noise levels were undertaken at the proposed Dandra Solar Power Plant site, Nag Hammadi, Qena Governorate, during morning and afternoon periods to characterize existing environmental conditions prior to construction.

These measurements provide essential baseline data to support impact assessment and guide mitigation planning in line with Egyptian Law No. 4/1994 for Environmental Protection (as amended by Law No. 9/2009) and its Executive Regulations (latest amendment Decree No. 2466/2024), as well as relevant international standards.

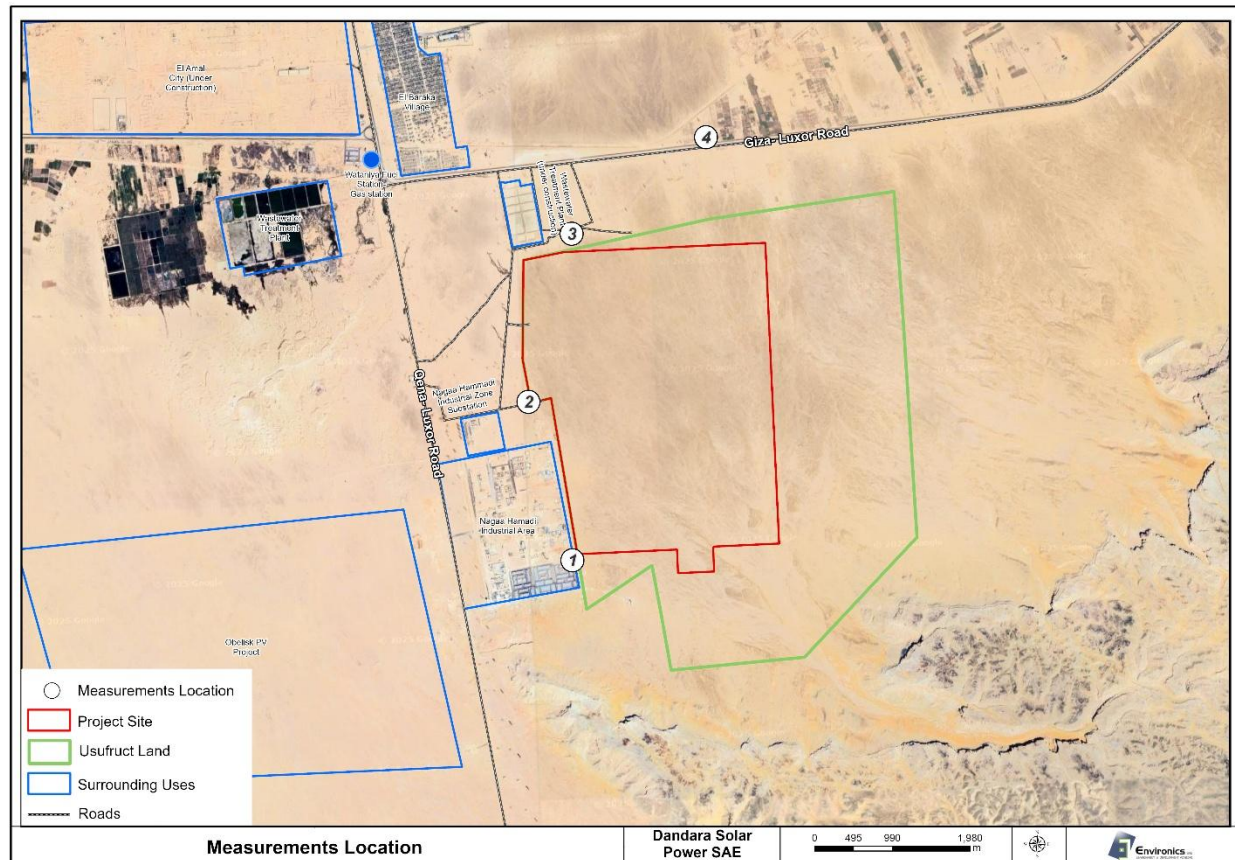
The monitoring program was implemented by QMS Institute, an ISO-certified environmental monitoring firm (ISO 9001:2015, ISO 14001:2015, ISO 45001:2018), on 30 October 2025.

Four representative sampling points were selected across the project footprint based on land cover, accessibility, and proximity to site boundaries. Their geographic coordinates are presented in Table 10 below.

**Table 18: Coordinates of Ambient Air and Noise Monitoring Locations**

Point ID	Latitude (N)	Longitude (E)
Point 1	25°54'36.60"N	32°19'56.55"E
Point 2	25°55'42.63"N	32°19'39.39"E
Point 3	25°56'51.04"N	32°20'2.29"E
Point 4	25°57'28.54"N	32°21'5.38"E





**Figure 11: illustrates the exact locations of all monitoring points.**

## Air Quality Monitoring

Air quality monitoring included Total Suspended Particulates (TSP), Respirable Particulate Matter (PM<sub>10</sub>), and the major gaseous pollutants SO<sub>2</sub>, NO<sub>2</sub>, CO, and CO<sub>2</sub>, measured during both morning and afternoon periods to capture diurnal variations.

Tables 19 and 20 summarize the recorded concentrations of air quality parameters.

### Table 19: Morning Air Quality Measurements

Location	SO <sub>2</sub> (µg/m <sup>3</sup> )	NO <sub>2</sub> (µg/m <sup>3</sup> )	CO (mg/m <sup>3</sup> )	CO <sub>2</sub> (µg/m <sup>3</sup> )	TSP (µg/m <sup>3</sup> )	PM <sub>10</sub> (µg/m <sup>3</sup> )
1	157	169	<b>0.80</b>	811,800	310	260
2	210	132	<b>0.92</b>	835,200	260	260
3	184	188	<b>0.34</b>	826,200	300	250
4	210	226	<b>0.46</b>	838,800	430	380
	350	300	<b>30</b>	-		-

Table 20: Afternoon Air Quality Measurements

Location	SO <sub>2</sub> (µg/m <sup>3</sup> )	NO <sub>2</sub> (µg/m <sup>3</sup> )	CO (mg/m <sup>3</sup> )	CO <sub>2</sub> (µg/m <sup>3</sup> )	TSP (µg/m <sup>3</sup> )	PM <sub>10</sub> (µg/m <sup>3</sup> )
1	157	169	<b>0.80</b>	811,800	440	370
2	210	132	<b>0.92</b>	835,200	390	340
3	184	188	<b>0.34</b>	826,200	510	360
4	210	226	<b>0.46</b>	838,800	480	400
<b>Permissible Limits</b>	350	300	<b>30</b>	—	—	—

All measured air quality parameters were well below the national permissible limits, confirming that the site experiences excellent ambient air quality with minimal pollutant concentrations. SO<sub>2</sub> and NO<sub>2</sub> ranged between 157–210 µg/m<sup>3</sup> and 132–226 µg/m<sup>3</sup>, respectively—significantly below their respective limits (350 and 300 µg/m<sup>3</sup>).

CO levels (0.34–0.92 mg/m<sup>3</sup>) were negligible compared to the 30 mg/m<sup>3</sup> limit, while CO<sub>2</sub> concentrations represented typical background levels.

TSP and PM<sub>10</sub> (260–510 µg/m<sup>3</sup> and 250–400 µg/m<sup>3</sup>) indicated clean atmospheric conditions with minor dust resuspension observed in the afternoon period.

#### Noise Level Monitoring

Noise monitoring was conducted concurrently at the same locations during morning and afternoon periods using a calibrated sound level meter.

Table 21: Ambient Noise Levels (Morning and Afternoon)

Location	Morning LAeq (dB(A))	Afternoon LAeq (dB(A))	Permissible Limit (dB(A))
1	45.1	47.5	70 (daytime)
2	46.4	47.0	70 (daytime)
3	45.9	46.0	70 (daytime)
4	46.6	47.0	70 (daytime)

Measured noise levels in both periods were below national allowable thresholds.

#### Conclusion

The monitoring confirms that both air quality and noise levels at the Dandra Solar Power Plant site are within Egyptian environmental standards. The site currently experiences low background noise and excellent air quality, suitable for project development.

#### 4.3.4 Geology, Geomorphology, and Topography

- Geology**

According to the Geological Map of Egypt (1981), the project site is located within the Quaternary undivided wadi and playa deposits, situated between the cultivated Nile deposits and the thick Eocene marine limestone formations (see Figure 12). The sandy and sandstone deposits at the project site may have originated from the wadi deposits derived from the adjacent Eocene limestone hills.

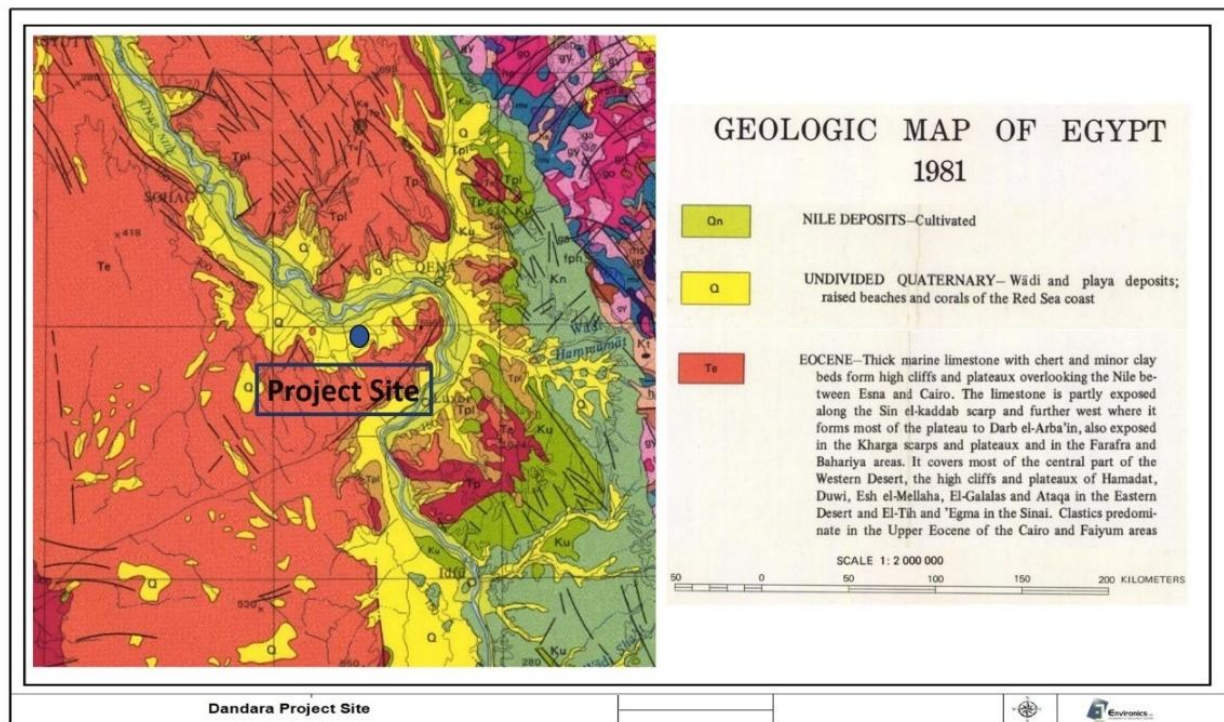
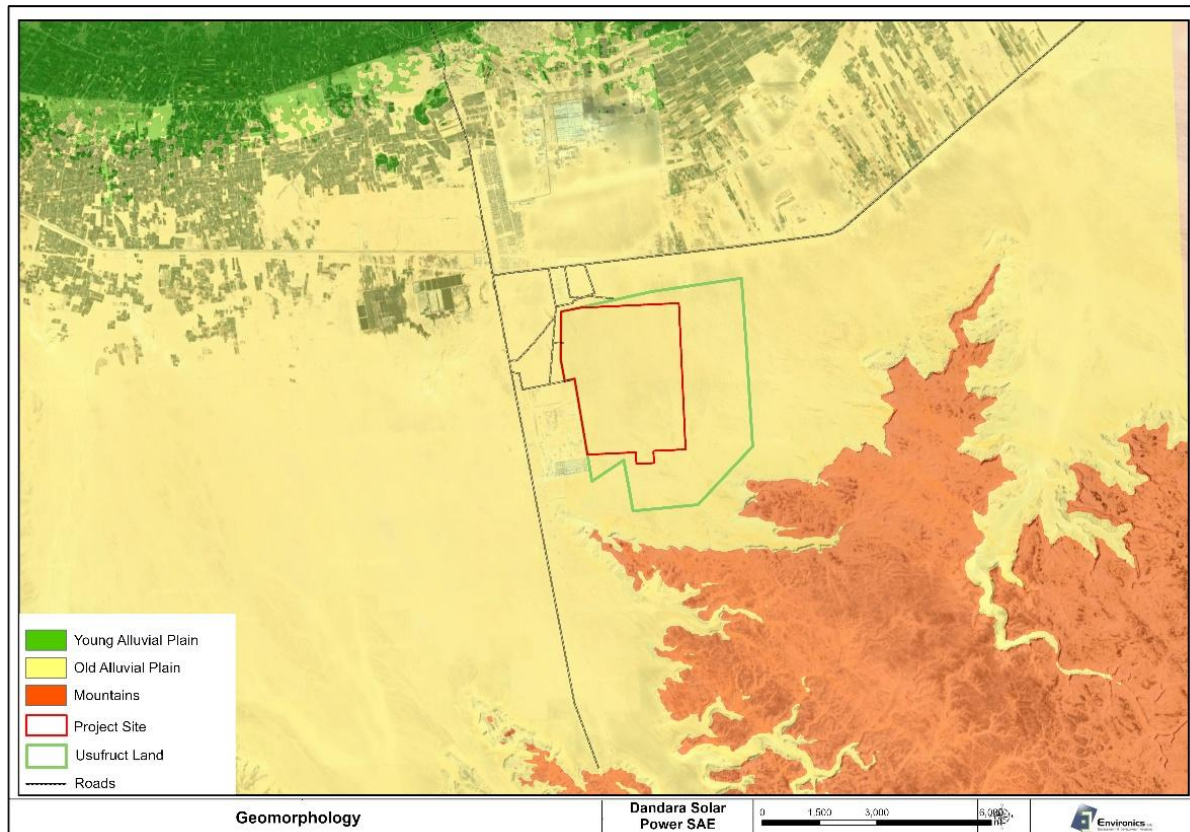


Figure 12: Geologic Map of the Project Site

- Geomorphology and Soil**

The Project Site lies in the ancient alluvial plains between the rugged terrain and the limestone plateau to the south, and the young alluvial plains along the valley to the north. The old alluvial plains are located in the form of terraces at different heights above the level of the young alluvial plains (Figure 13) (GAEB, 2003).





**Figure 13: Geomorphological features of the Project Site**

According to the soil map of Egypt, the soils of the entire Project Site are sandy loam soil that is particularly shallow or stoney and developed mainly from limestone (El-Ramady et al., 2019).

- **Topography**

Elevations at the project site and its surroundings increase towards the south, reaching a maximum of approximately 450–500 m above mean sea level (MSL). Within the project site and the usufruct area, elevations generally range between 130 and 170 m above MSL, except in the southern part, where the elevation rises to a peak of about 220 m above MSL. (Figure 14).

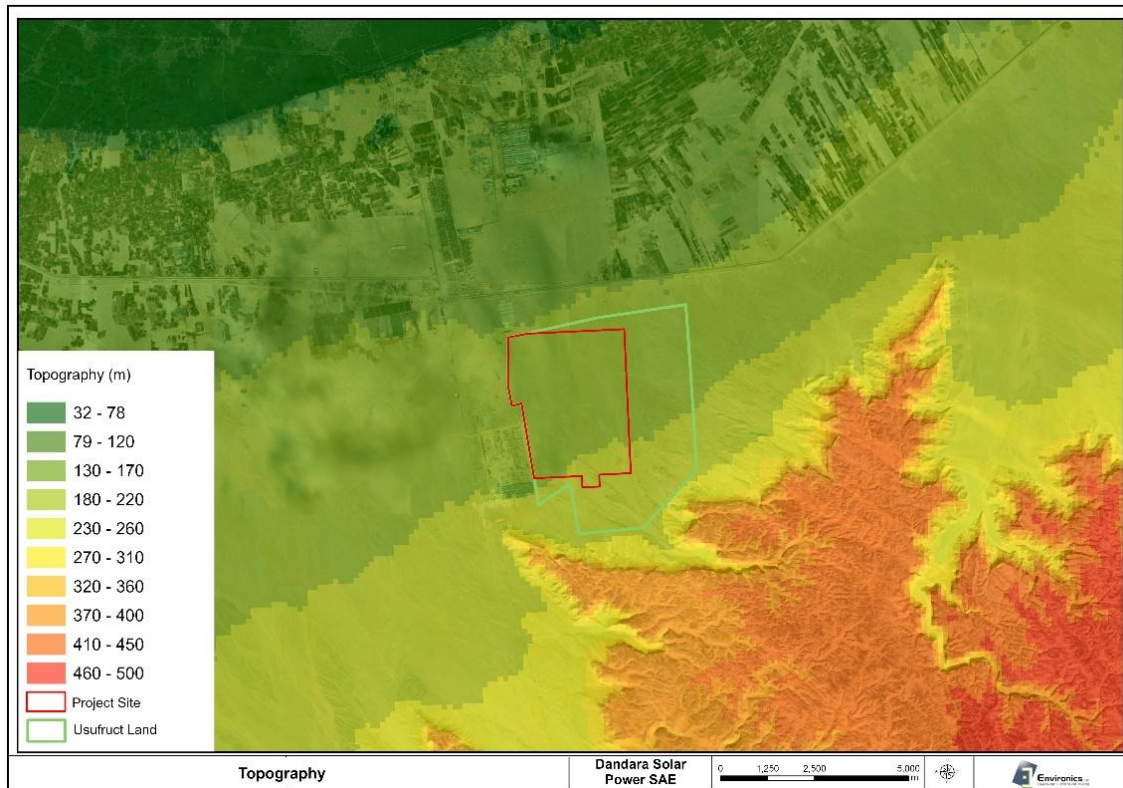


Figure 14: Topography of the Project Site (indicated in red)

#### 4.3.5 Hydrology and Hydrogeology

##### • Surface Waters

As previously mentioned, the Project Site is situated in the desert hinterland of Markaz Nagaa Hammadi. As such, the Project Site is devoid of any surface water bodies or surface canals within its boundaries. There are three water bodies near the Project Site. These are the Alranan Canal, Almarashda Canal, and the river Nile, all of which are located north of the Project Site. The Alranan Canal is the closest water body to the Project Site and is located 8.5 km north of it, the Almarashda Canal (9 km away from the project site). (Figure 15).

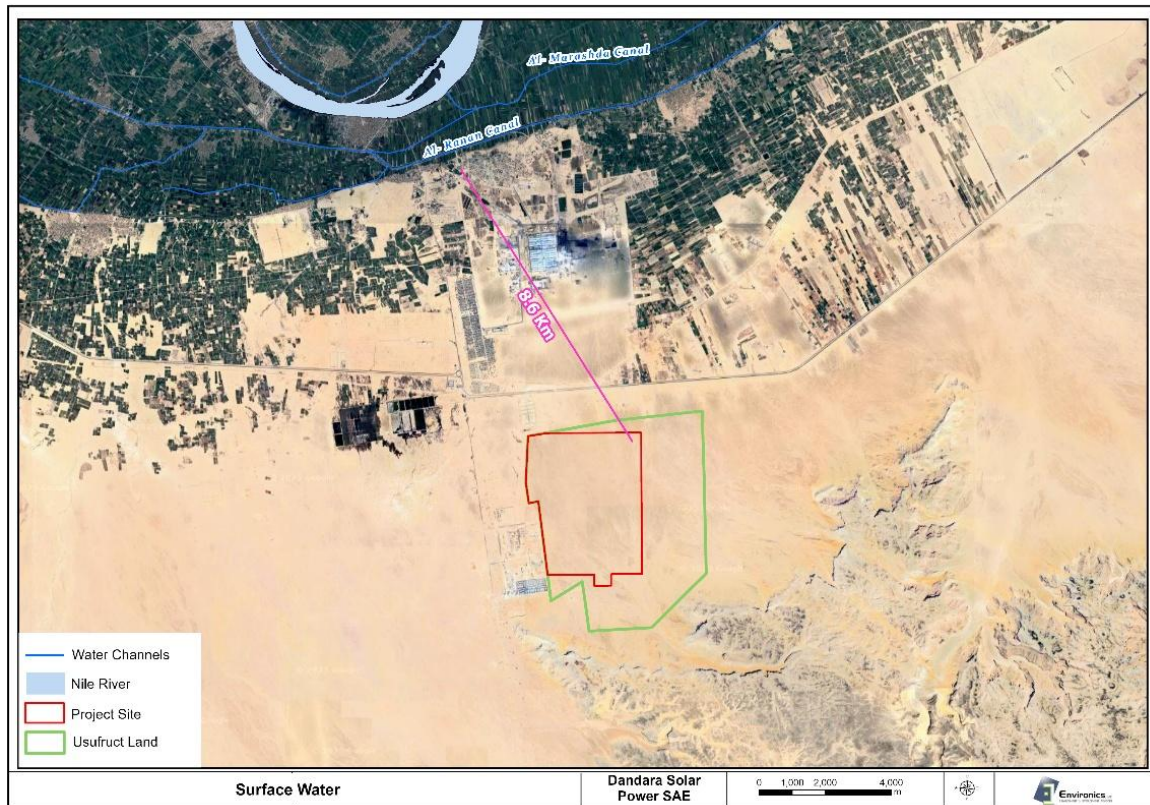


Figure 15: Surface water bodies and canals in close proximity to the Project Site

- Groundwater**

The Quaternary aquifer is the principal aquifer underlying the Project Site. This aquifer represents the main groundwater resource in the Nile Valley. It consists mainly of the Pleistocene graded sand and gravel intercalated with clay lenses and is underlain by an impermeable layer of Pliocene clays that prevents its connection with the deeper aquifers. It is covered by a permeable layer of Wadi deposits at the old alluvial floodplain, which means that groundwater occurs under unconfined conditions. The thickness of the aquifer varies from about 200 m at the center of the cultivated floodplain to about 80 m at the desert fringes. It is recharged continuously from the excess irrigation water and occasionally from infrequent rainfalls. The old alluvial floodplain is characterized by moderate to very high recharge potentialities. The Project Site is located in an area of moderate recharge groundwater potentiality (Figure 16) (Gaber *et al.*, 2020).



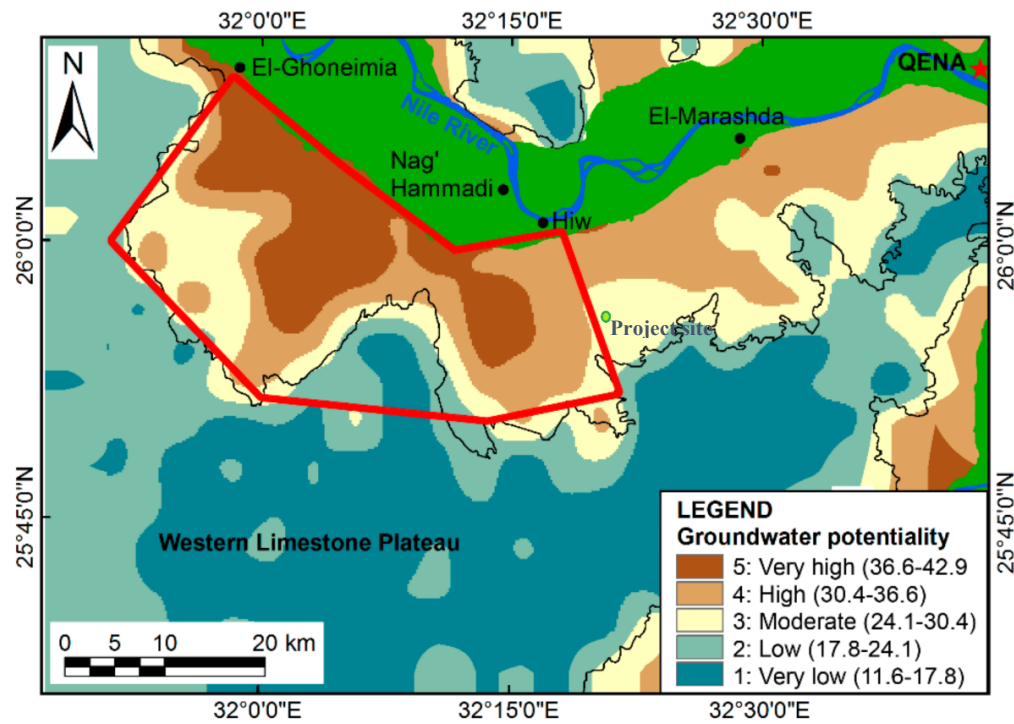


Figure 16: Groundwater recharge potentiality map including the Project Site, indicated by a green circle

The groundwater in the Project Site occurs at moderate depth that ranges between 36 meters to 41 meters (Figure 17) (Gaber et al., 2020).

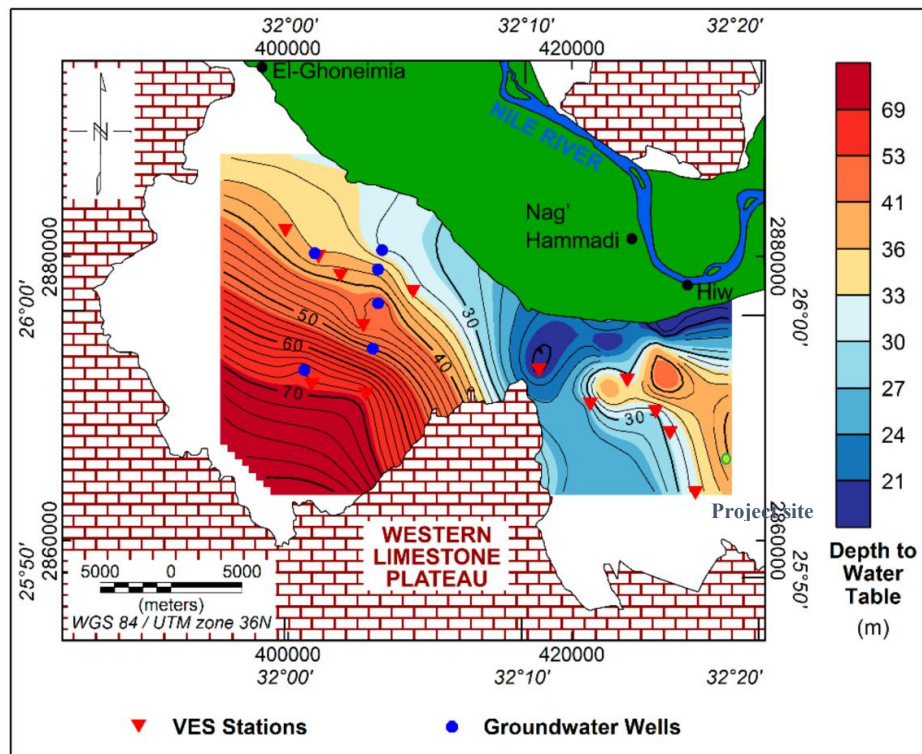


Figure 17: Depth to water contour map in relation to the Project Site



- Flash Flood Hazards**

Although the Project Site receives negligible rainfall throughout the year, extreme rainfall events potentially take place in the Qena governorate, where the Project Site is located. The Qena governorate is one of the most susceptible regions in the Nile Valley to flash flooding, particularly during the winter seasons (between October and February). This is a historical phenomenon, with numerous flash flood events having been documented in Qena since 1938 (Mohamed, 2019). The maximum recorded daily rainfall depth at Qena Station (44 km away from the project site) is 55.3 mm, which occurred in 1949.

Morphological studies and identification of streams and drainage basins affecting the boundaries of the study area were performed using SRTM within ArcGIS using satellite images.

The 1: 50,000 topographic map of the study area was obtained from the Egypt Geological Survey and used to confirm the STRM results. Satellite images were further used to verify the results of morphological analysis of drainage basins as well as to determine the quality of land cover and land use for areas within the boundaries of drainage basins affecting the study area. The site drains form the higher grounds in the south towards the lower grounds in the north.

Based on the above, the natural wadis are delineated in Figure 18 below. The flood paths potentially affecting the project site are located to the south and southeast of it.

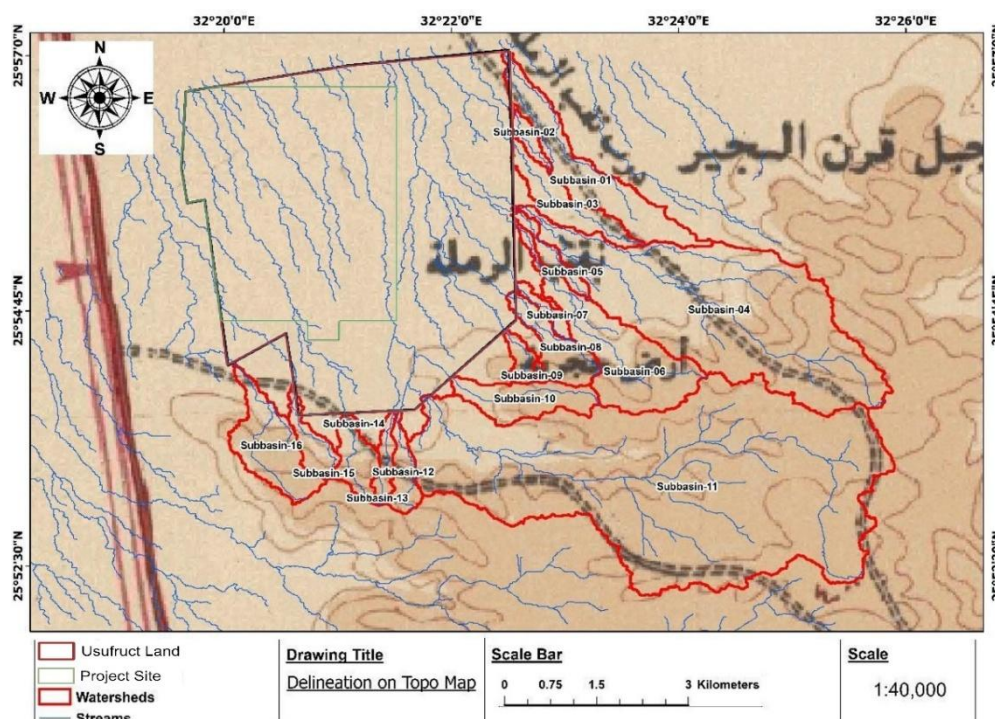


Figure 18: Natural Wadis in the project area

Results of the field visit indicated that the site is generally flat and composed of a sandy soil mostly covered with small stones, with some scattered boulders. Accordingly, its sandy nature limits water accumulation and facilitates drainage.

A wadi located close to the southern borders of the Project Site and within Scatec's usufruct land was inspected for signs of vegetation or vegetation remains, that might indicate the presence of water and the occurrence of flash floods. However, the site was found to be dry and totally devoid of vegetation, like the rest of the site.

Moreover, a hydrological study to identify potential risks of the floods from outside the Project Site has been developed. The study is attached as Annex 1.

- **Climate Change**

The project is located in Qena Governorate, an area characterized by extreme temperatures, variable rainfall, and a history of flash floods, as well as the presence of old flood drainage paths to the south and southeast of the project site. This necessitates careful consideration of potential climate change impacts.

The AfDB categorizes projects based on their vulnerability to climate change through its Climate Safeguards System (CSS). The CSS includes a climate screening process that assesses the vulnerability of a project to climate change and assigns a categorization ranging from 1 (most vulnerable) to 3 (least vulnerable). This categorization helps in identifying appropriate adaptation measures to reduce vulnerability and ensure the project's resilience to climate impacts.

The project is classified as Category 2<sup>10</sup> under the AfDB's CSS, acknowledging its potential vulnerability to these climatic factors and the need for targeted adaptation measures to enhance its resilience.

## 4.4 Biological Environment

The Project Site is located in the vast Egyptian Western Desert (WD), which covers about two-thirds of the total area of Egypt. This desert extends from the Mediterranean coast in the north, to the Egyptian–Sudanese border in the south, the Nile Valley and Delta in the east, and to the Egyptian–Libyan border in the west.

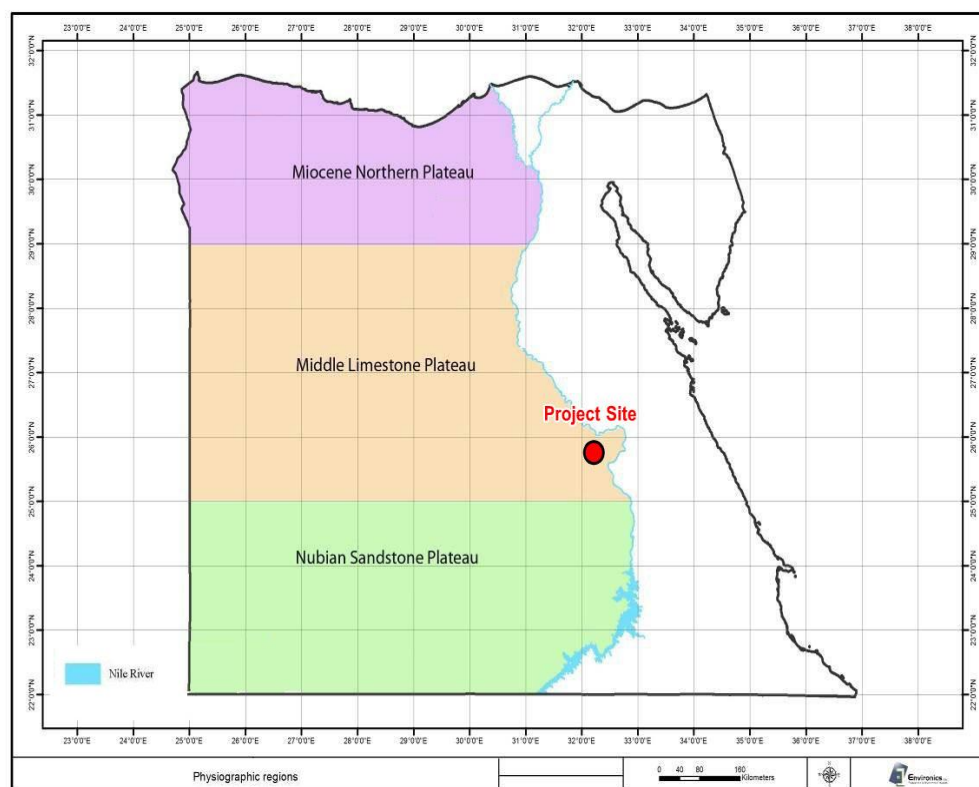
The WD is generally conceived as a barren plain with an apparently internal drainage system (interior basins that are characteristic of depressions and not wadi systems that are typical of the Eastern Desert) and widespread sand bodies.

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<sup>10</sup> What [Category 2] means for the project is that it has to be aligned both in terms of mitigation (i.e. GHG emissions reductions) and adaptation considerations. In this case, and given the nature of the project, there is no issue with mitigation alignment; however, being category 2 according to the Climate Safeguards System (CSS) of the Bank, there are certain climate risks that have to be further assessed and mitigated (i.e. incorporate relevant adaptation solutions in the design of the project)"

The WD can be divided from north to south into three principal physiographic regions (Figure 19):

- The Miocene Northern Plateau that slopes towards the Mediterranean coast. This plateau embraces the inhabited Siwa Oasis and the Qattara Depression.
- The Middle Limestone Plateau (MLP) extends from about latitude 25° N to about 29° N. This plateau embraces a number of oases, depressions, including the inhabited Kharga, Dakhla, Farafra, Bahariya, and Fayoum. The latter is connected with the Nile by the Bahr Youssef irrigation canal; the other oases depend on groundwater resources from the Nubia Sandstone aquifers. The Project Site is located within the southeastern part of the MLP.
- The Nubian Sandstone Plateau sloping gradually toward the north from Gebel Uweinat and the Gifl Plateau to the fringe of the oases' depressions (EEAA, 1993).



**Figure 19: Physiographic regions of the Western Desert and location of the Project Site**

#### 4.4.1 Project Wider Area

As explained in Section 4.2.2, a field visit to the project area was carried out by Scatec in August 2025, and the results were submitted to Environics. Accordingly, Environics team undertook a site visit on the 7<sup>th</sup> of October 2025, which targeted specific locations selected through the analysis of satellite images and based on the report submitted by Scatec (which included a large set of geo-referenced photos). In this respect, the visit was not limited to the Project Site, but included other habitat types within the wider area, in order to document the ecological difference and variation between other habitat types (such as the nearby reclaimed agricultural lands and other man-made habitats) versus the arid desert habitat characterizing the Project Site.

A description of the four main habitats of the wider area and their characteristic biodiversity is provided herein.

The habitat topologies of the ecosystems in close proximity to (i.e., localities situated 15 km or less away from the Project Site) can be broken down into four main habitat types:

### ***Middle Limestone Plateau***

The Qena Governorate encompasses a large area of the Middle Limestone Plateau of the Western Desert. The Middle Limestone Plateau is a substantially dry sand plateau with very little or no precipitation, and outside of its depressions and oases, the only other habitats available are bare ground habitats (EEAA, 1993). Due to the plateau's aridity, the majority of it is totally devoid of flora, save for a few desert-adapted floral species distributed as scattered, isolated shrubs throughout the plateau. This scattered distribution of flora is commensurate with the scattered distribution of fauna, which tends to be composed of species adapted to such harsh desert environs. The Project Site is located within the southeastern part of the Middle Limestone Plateau.

### **Nile Valley Farmlands**

The Nile Valley is located at a distance of 8.5 km, and as mentioned above, there are numerous farmlands north of the Project Site, separated from the site by the Giza – Luxor Road<sup>11</sup>. These are essentially nearly completely modified habitats; nevertheless, these farmlands provide habitat for a variety of weeds and ruderal plants in the fields, canals, and drain banks.

### **Reclaimed Agricultural Lands**

There are several desert lands reclaimed for agriculture near the Project Site, the closest of which (Point 10) is located 1 km north of the Project Site. The land was fenced with *Conocarpus lancifolius*, an introduced tree native to the coastal and riverine areas of Somalia, Djibouti, and Yemen (Figure 20).

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<sup>11</sup> The part of the road facing the Project Site is also called "Nagaa Hammadi – Qena Road".



**Figure 20: Reclaimed agricultural land fenced with *Conocarpus lancifolius* located at about 1 km north of the project site**

Other reclaimed agricultural lands, visited during the ESIA preparation for another Scatec PV project, are found north and northwest of the project site.

The presence of water and vegetation cover at these reclaimed agricultural lands is likely to attract species from the Nile Valley that would otherwise avoid the harsh desert habitat. Accordingly, reclaimed agricultural lands host a biodiversity similar to that of the Nile Valley. Recorded avifauna included House Sparrow (*Passer domesticus*), Cattle Egret (*Bubulcus ibis*) (Figure 21), and Common Hoopoe (*Upupa epops*) (Figure 22).





Figure 21: Cattle Egrets (*Bubulcus ibis*) in a reclaimed agricultural land



Figure 22: A Common Hoopoe (*Upupa epops*) in a reclaimed agricultural land

### Wastelands

Extensive flora forming a vegetated wasteland is present on the Giza – Luxor roadside, probably due to the presence of irrigation water from the nearby reclaimed agricultural lands.



Figure 23: Vegetated wasteland on the Giza – Luxor roadside close to Point 10

### Urban Habitats

There are urban habitats scattered throughout the Nile Valley farmlands and reclaimed agricultural lands, such as banks of canals and drains, roadsides, railways and wastelands. These habitats are mainly home to exotic plants and trees introduced for ornamental purposes, as well



as opportunistic fauna associated with human activities (e.g., feral dogs and cats, rats, mice, and several species of birds).

Baraka Village (Point 1) is the closest human settlement and is located about 1.5 km northeast of the Project Site. The village also includes an ambulance station.



**Figure 24: Baraka Village, located about 1.5 km northeast of the Project Site**



**Figure 25: Ambulance station, Baraka Village**

Moreover, there is a wastewater treatment plant located close to the northwestern borders of the Project Site (Points 2 and 3), which falls within the project's AoI. This location provides a good example of habitat modification of a hyper-arid desert environment due to anthropogenic activities.

Man-made structures also include:

- A power sub-station close to the western borders of the Project Site (Point 5); and
- An industrial area located on the southwestern borders of the Project Site (Point 6). The area is not fenced and includes paved roads.



**Figure 26: Power sub-station**



**Figure 27: View of the industrial area**

#### **4.4.2 Project Site and Close Surroundings**

There is a marked and significant difference between the desert habitat and the other regional habitat types. Moreover, most of the previous biodiversity monitoring activities within the region had focused on areas of expected biodiversity value rather than the harsh desert environment characterizing the Project Site.

Therefore, the environmental team was keen to conduct a field survey *in situ* to complement and/or discard regional information acquired from literature and obtain a realistic vision of the Project Site. The survey was carried out on the 7<sup>th</sup> of October 2025.

As previously mentioned, the field survey was preceded by an analysis of satellite images in order to select the most suitable locations representing the different habitat types of the project area and its close surroundings. On the other hand, both the analysis of satellite images, as well as the August site visit report developed by Scatec, indicate that the Project Site is entirely composed of a single, homogeneous, arid desert habitat. Therefore, in order to characterize the whole site and its AoI, different survey points were selected.

In this respect, 10 locations (site visit points) numbered from 1 to 10 were visited by Environics' team, as shown in Figure 28. Point 8 is located within the Project Site, and Point 9 is located within Scatec's Usufruct Land, close to the southern borders of the Project Site. Points 1 and 10 are outside the Project Site or its AoI, while the rest of the points fall within the project's AoI.

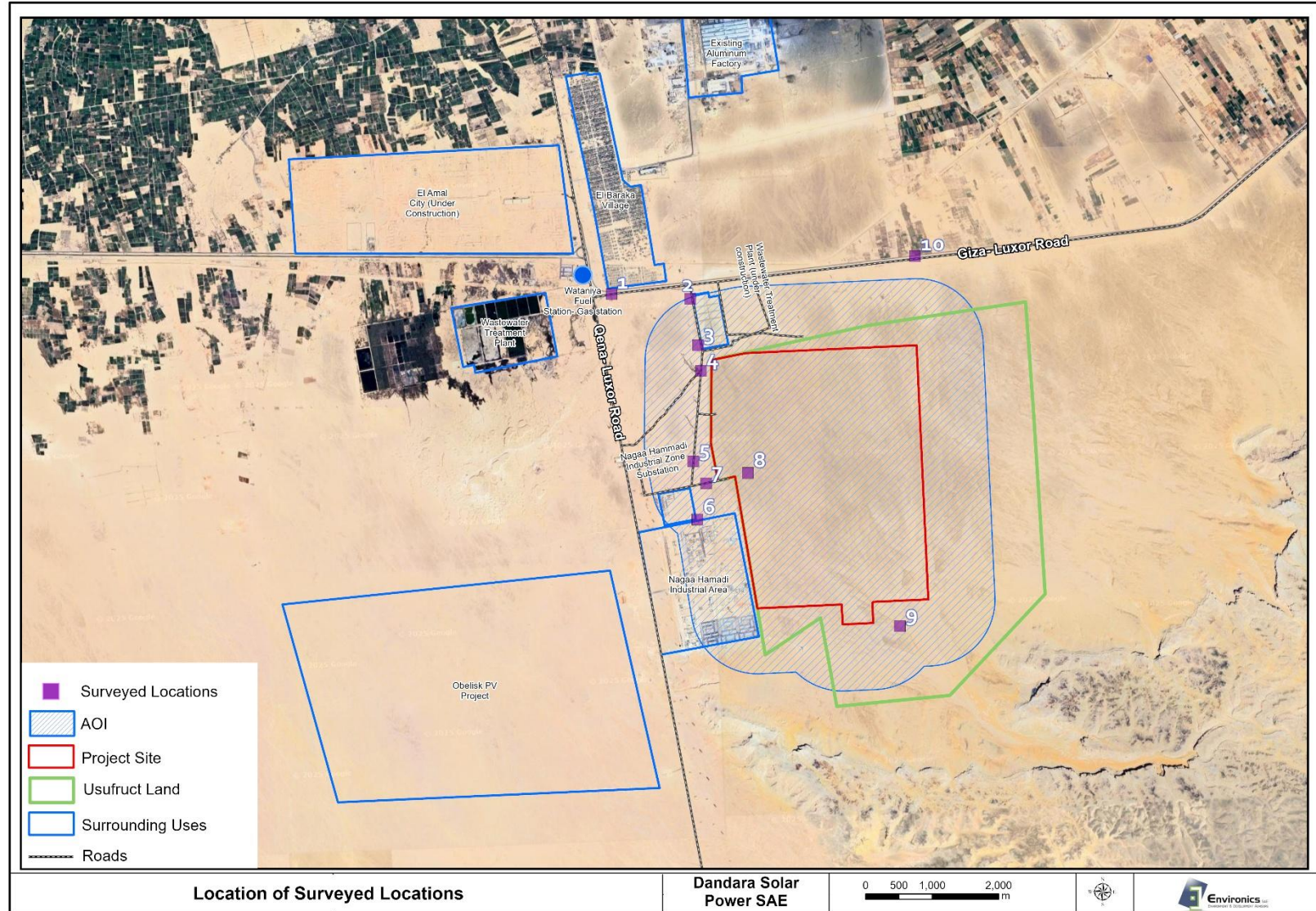
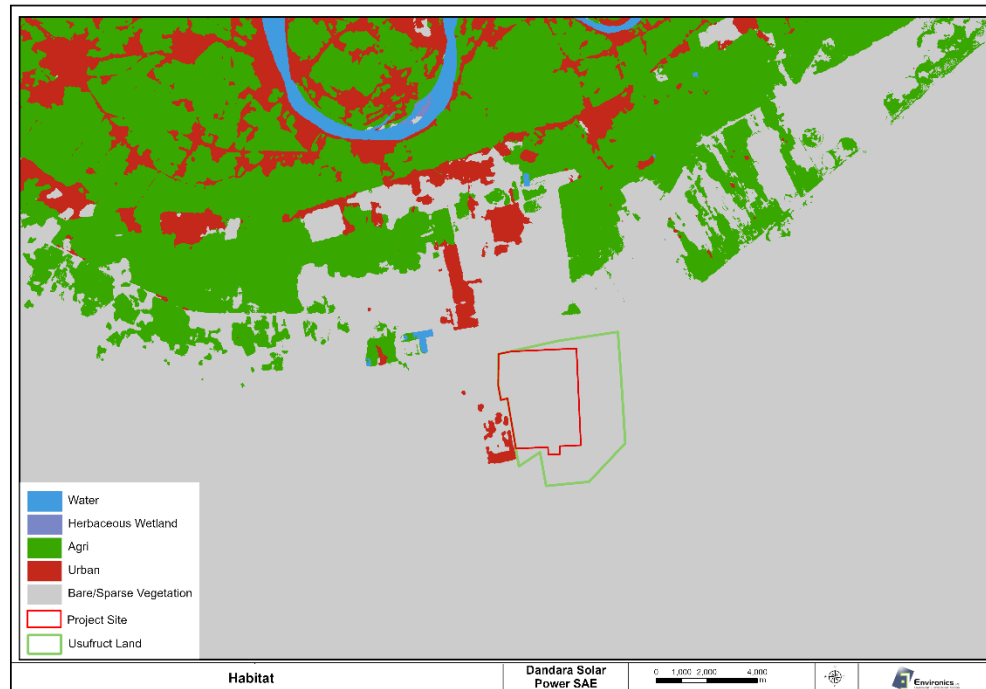


Figure 28: Location of surveyed sites during the October 2025 field visit

## Habitats

The project site consists entirely of bare ground. This was indicated by remote sensing (Figure 29) (Copernicus, 2025) and confirmed by site visits.



**Figure 29: Habitat types of the Project Site and the localities within its vicinity**

The site visits confirmed the bare nature of the site. The site is generally flat and composed of a sandy soil mostly covered with small stones, with some scattered boulders. Accordingly, the terrain is not very rough; however, its sandy nature limits the vehicles' accessibility to some parts of the site. No vegetation or signs indicating the presence of wildlife were recorded within the project site.

This is particularly true for a wadi located close to the southern borders of the Project Site and within Scatec's usufruct land (Point 9). This area was inspected for signs of vegetation or vegetation remains that might indicate the occurrence of flash floods. However, the entire project site area was found to be dry and totally devoid of vegetation, as shown in Figure 30.





Figure 30: General view of the Project Site showing its bare sandy soil

#### **Natural and modified habitats**

In accordance with IFC's Performance Standard 6 (IFC PS6), habitat types are categorized into natural and modified habitats. The entire Project Site is categorized as a "natural habitat".

On the other hand, the nearby wastewater treatment plant has created a modified microhabitat suitable for vegetation and its associated fauna. In this respect, the project should be careful in the management of its waste, and especially wastewater, in order to avoid creating new habitats within the Project Site that would potentially attract biodiversity and create additional hot spots of introduced wildlife alien to the area.

Modified habitats are present in the close vicinity of the western borders of the Project Site and include the wastewater treatment plant, a power sub-station, and the industrial area, as previously mentioned. These modified habitats are located outside the Project Site but within its Aol, while reclaimed agricultural lands are outside the project's Aol.

#### **4.4.3 Flora**

Due to the extreme aridity of the southern WD and southeastern MLP, the Project Site is poor in terms of plant diversity and vegetation cover. Perennial plant life in this part of the WD is confined to the oases and depressions of the plateau, of which none extend to the Project Site. Outside of these, plant life is mostly ephemeral (annual) and limited due to its dependence on the low chance of rainfall. This type of vegetation is defined as "accidental vegetation" as it occurs where precipitation is so low and falls so irregularly that no permanent vegetation exists (Abd El-Ghani, 2000).

Nonetheless, as reported in literature, there are some floral species adapted to life outside of the WDs oases and depressions, which have been recorded from the sandy desert habitats of the MLP. These are the Syrian Mesquite (*Prosopis farcta*) and *Caroxylon imbricatum* (synonym: *Salsola imbricata*). In terms of the limestone formations of the southeastern part of the MLP, the characteristic species are *Zygophyllum coccineum*, the Caper bush (*Capparis spinosa* subsp. *aegyptia*), and *Anabasis articulata* (Abd El-Ghani, 2000).

However, the results of surveys of the Project Site conducted in August and October 2025 indicated that the site is completely devoid of vegetation. Recorded flora and fauna were observed outside of the Project Site, restricted to areas subject to anthropogenic modifications (such as the wastewater treatment plant and reclaimed agricultural lands). The total absence of even dry/defoliated plants indicates that the Project Site does not support annual floral species.

On the other hand, the nearby treatment plant has created a “wet” modified environment within the desert habitat, resulting in the growth of several plant communities, extending southwards. Recorded plant species include *Calitropis procera*, *Pluchea dioscoridis* and *Phoenix dactylifera* in the northeastern part of the wastewater treatment plant, and *Artemisia herba-alba*, *Phragmites australis*, and *Tamarix canariensis* in the southeastern part of the plant. *Tamarix canariensis* and *Calitropis procera* were also found extending southward of the wastewater treatment plant, forming extended spots of vegetation.



Figure 31: *Calitropis procera* in the northeastern part of the wastewater treatment plant



Figure 32: *Pluchea dioscoridis* in the northeastern part of the wastewater treatment plant



Figure 33: *Phoenix dactylifera* in the northeastern part of the wastewater treatment plant



Figure 34: Vast extension of *Artemisia herba-alba* in the southeastern part of the wastewater treatment plant





Figure 35: *Phragmites australis* in the southeastern part of the wastewater treatment plant



Figure 36: *Tamarix canariensis* in the southeastern part of the wastewater treatment plant

#### 4.4.4 Fauna

- **Herpetofauna**

Based on species distribution maps for the reptiles of Egypt and each reptilian species' suitable habitat types and preferences, the following species have a likelihood of visiting the Project Site.

##### **Snakes**

The Sahara Sand Viper (*Cerastes vipera*) is a true desert species and is particularly widespread throughout Egypt's WD. It is almost exclusively found on sandy soils, including areas with sparse or no vegetation. Similarly, the Horned Viper (*Cerastes cerastes*) is also a widespread desert species found throughout Egypt's WD and found in most desert habitat types. It is more frequently found in patches of loose sandy soils in fairly exposed situations and has a high capacity to tolerate extreme hyper-arid habitats. *C. cerastes* is one of only two snakes to be encountered over almost all of Egypt's deserts, with the other being the Saharan Sand Snake (*Psammophis aegyptius*). The Saharan sand snake is predominantly found in sandy and rocky desert areas and is particularly common in open desert habitats devoid of vegetation, such as in the Project's Site. Lastly, the Diadem Snake (*Spalerosophis diadema*), another common snake species in Egypt, is widely distributed in the WD along the margins of the Nile Valley, such as in localities in the vicinity of the Project Site. This snake is associated with arid and semi-arid areas, particularly sandy deserts with sparse vegetation (Baha El Din, 2006; Saber & Masood, 2011; IUCN, 2025).

Although the Egyptian Catsnake (*Telescopus obtusus*) is a desert-dwelling species, it mainly occurs near cultivated areas, along riparian areas and on the edge of urban areas. This snake prefers vegetated areas with trees in sandy desert, semi-desert, and gravelly areas. Moreover, reclaimed agricultural lands in the vicinity may attract species such as the Striped Sand Snake (*Psammophis sibilans*). This snake is found in cultivated areas and naturally vegetated habitats along the Nile in Egypt; however, subpopulations in Egypt are expanding into areas reclaimed from the desert, as well as into agricultural areas of the Nile Valley. Furthermore, the Egyptian Cobra (*Naja haje*) is not a species of true desert and is known to prefer semi-desert habitats and mostly occurs in areas with grassy vegetation. Likewise, the Nubian Spitting Cobra (*Naja nubiae*) is a semi-desert species and considered fairly common

in Egypt. This cobra's distribution throughout Egypt covers the Upper Nile Valley and has also been recorded from Qena Governorate (Baha El Din, 2006; IUCN, 2025).

Accordingly, *Telescopus obtusus*, *Psammophis sibilans*, *Naja haje* and *Naja nubiae* are present in the Nile Valley and might have expanded their range to reclaimed agricultural lands. However, their occurrence onsite is highly unlikely due to the extreme aridity of the area. Unless suitable conditions are made available by the project such as the provision of water, shelters and sources of food (e.g., rodents attracted by the presence of waste), these species are not expected to extend their presence to the Project Site.

### **Lizards**

The Desert Monitor (*Varanus griseus*) could potentially inhabit the project site, as indicated by its habitat preferences and its species distribution maps for Egypt. This lizard is found in sandy desert spots with some vegetation but has also been recorded throughout the WD in areas completely devoid of vegetation. Moreover, the presence of sandy or loose soils, which characterize the Project Sites substrate, seems to be essential for this lizard's persistence. Another lizard highly likely to occur at the Project Site is the Egyptian subspecies of Bosc's Fringe-toed Lizard (*Acanthodactylus boskianus* subsp. *asper*), which is one of the most common, prominent, and widespread reptiles in Egypt. In the WD, it is found in all of its suitable habitats in the WD, including the "very arid parts" of the WD "but where a minimal amount of vegetation is present".

With regards to geckos, the Elegant Gecko (*Stenodactylus sthenodactylus*) is also a widespread and common reptile in Egypt. It is known to inhabit desert plains; however, it occurs at low population densities in hyper-arid desert regions, but is a very resilient ground-dwelling insectivorous gecko that can tolerate extreme aridity for extended periods. This species is mainly found on hardened ground in such harsh environs (including bare ground habitats), in stony or rocky desert plains. In species-poor parts of the WD, much like the Project Sites locality, it is usually the only vertebrate to be easily found. Anderson's Short-fingered Gecko (*Stenodactylus petrii*) is a highly localised, but widespread lizard of the WD and is typically recorded in Egypt from the sandy habitats of the WD, such as the desert's sandy dry riverbeds (wadi paths). It is also found in the vicinity of these habitats on loose or consolidated sands, often with scarce vegetation (Baha El Din, 2006; Saber & Masood, 2011; IUCN, 2025).

During the August 2025 field investigations performed by Scatec, reptile tracks were recorded in a den located within the Usufruct Area, approximately 1.5 km east of the Project's western border, as shown in Figure 37. This confirms the presence of reptiles adapted to this hyper-arid habitat.



Figure 37: Reptile tracks recorded in August 2025

- **Avifauna**

Based on data extracted utilising the Migratory Soaring Bird Tool (MSBT) developed by BirdLife International, species distribution maps and recorded observations of the birds of Egypt, and their preferred habitat types, the following species are likely to inhabit or cross over the Project Site.

#### **Resident Breeding Birds**

The Project Site seems to be inhospitable for breeding birds due to its lack of shelter, cover, water, and food sources. However, some desert species might still occur within the site and vicinity, even. If they breed outside of it. Some of the characteristic species of the WD's sandy desert habitats that could occur in the area include the Spotted Sandgrouse (*Pterocles senegallus*), Cream-coloured Courser (*Cursorius cursor*), Bar-tailed Lark (*Ammomanes cinctura*), Desert Lark (*Ammomanes deserti*), Greater Hoopoe-lark (*Alaemon alaudipes*), Temminck's Lark (*Eremophila bilopha*), Desert Wheatear (*Oenanthe deserti*), Isabelline Wheatear (*Oenanthe isabellina*), and the Brown-necked Raven (*Corvus ruficollis*) (EEAA, 1995).

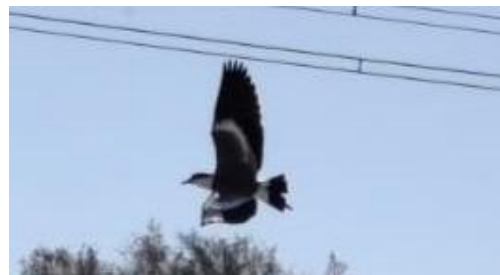
Common breeding birds of the Nile Valley and Delta include 66 species (Goodman et al. 1989) and at least 14 of these are known to breed outside the Nile Valley and Delta. Some of these species include the Cattle Egret (*Bubulcus ibis*), Black-winged Kite (*Elanus caeruleus*), Black Kite (*Milvus migrans*), Common Kestrel (*Falco tinnunculus*), Common Moorhen (*Gallinula chloropus*), Spur-winged Lapwing (*Vanellus spinosus*), Greater Painted-snipe (*Rostratula benghalensis*), Laughing Dove (*Spilopelia senegalensis*)<sup>12</sup>, Senegal Coucal (*Centropus senegalensis*), Barn Owl (*Tyto alba*), Asian green bee-eater (*Merops orientalis*), Crested Lark (*Galerida cristata*), Barn Swallow (*Hirundo rustica*), Western Yellow Wagtail (*Motacilla flava*), Graceful Prinia (*Prinia gracilis*), Hooded Crow (*Corvus cornix*)<sup>13</sup> and the House Sparrow (*Passer domesticus*) (Saleh, 1993). Some of these Nile Valley species can be expected to be

<sup>12</sup> Previously placed in the genus *Streptopelia*

<sup>13</sup> Considered until recent times a subspecies of *Corvus corone*

also present in the reclaimed agricultural lands located in close proximity to the Project Site, however, these are not expected to occur within the Project Site. Opportunistic species might further extend to the project site in case water, food scraps, and other organic waste are made available by project staff.

As a matter of fact, the nearby wastewater treatment plant attracts several birds, including species typical to the mesic habitats of the Nile Valley, such as the House Sparrow (*Passer domesticus*) and the Spur-Winged Lapwing (*Vanellus spinosus*). In addition, several rodent burrows were noticed within these areas of vegetation.



**Figure 38: Spur-Winged Lapwing (*Vanellus spinosus*) recorded in the modified habitat created by the wastewater treatment plant**

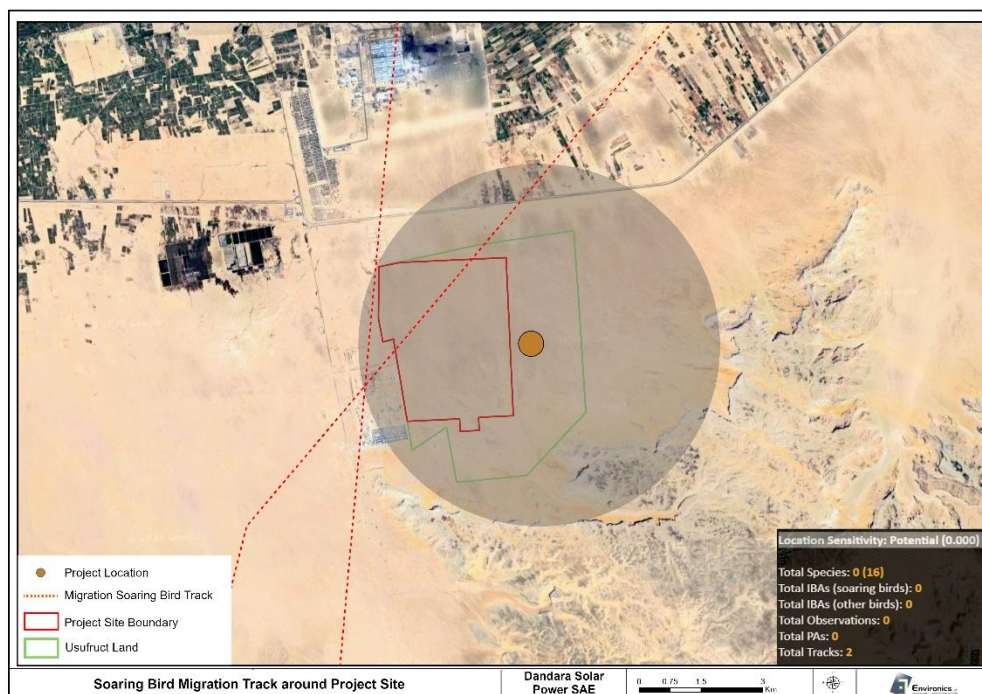
### **Migratory Birds**

According to the results of an assessment of the Project Site's importance to migratory birds as a migratory route using the MSBT, there are 16 migratory soaring bird species with a likelihood of crossing over the Project Site. These are the Black Kite (*Milvus migrans*), Black Stork (*Ciconia nigra*), Black-winged Kite (*Elanus caeruleus*), Common Crane (*Grus grus*), Common Kestrel (*Falco tinnunculus*), Eurasian Sparrowhawk (*Accipiter nisus*), Eurasian Spoonbill (*Platalea leucorodia*), Glossy Ibis (*Plegadis falcinellus*), Great White Pelican (*Pelecanus onocrotalus*), Hen Harrier (*Circus cyaneus*), Lanner Falcon (*Falco biarmicus*), Osprey (*Pandion haliaetus*), Pallid Harrier (*Circus macrourus*), Peregrine Falcon (*Falco peregrinus*), Western Marsh-harrier (*Circus aeruginosus*), and White Stork (*Ciconia ciconia*). The Egyptian Vulture (*Neophron percnopterus*) was not included in the results of the present MSBT assessment. However, it was included in a previous assessment carried out for the nearby Obelisk PV Project. Therefore, and given its threatened status, it is included among the potential migratory birds passing over the area, using a precautionary approach (for a total of 17 species).

Despite this, the MSBT assessment denoted that the Project Site is not an important location for migratory birds, as indicated by the site's Sensitivity Index being calculated to be  $\leq 0.001$  (Figure 39). In fact, these birds generally follow the Nile Valley during their migration as it provides sufficient availability of water, food and shelter. On the other hand, the Project Site has a low 'intensity passage', a low number of individuals per species passing over it. This is probably due to the fact that the barren and arid nature of the Project Site does not provide any advantages to migrating avifauna in terms of providing food, shelter, and water required during rest-stops. In addition, most of the 17 migratory birds mentioned above are categorized at the global level as species of Least Concern (LC) in terms of their susceptibility to extinction. There are two exceptions, the Pallid Harrier which is categorized as Near Threatened (NT) at the global level, and the Egyptian Vulture, which is globally Endangered (EN) and listed as a Vulnerable (VU) species at the Mediterranean level (IUCN, 2025; MSBT, 2025; 2025). Moreover, the Lanner Falcon, Hen Harrier, and Osprey are all globally categorized as LC but are respectively NT, VU and EN at the Mediterranean level.



The migration routes of migratory soaring birds over the Project Site, and the results of the MSBT assessment are provided below (Figure 39) (MSBT, 2025).



**Figure 39: Location sensitivity of the Project Site to migratory soaring birds**

An additional search was carried out using GBIF, iNaturalist and eBird to identify relevant avifauna and other taxa potentially occurring within the project site's wider area, which resulted in no additional birds potentially occurring in the area (see Section 4.4.6).

Moreover, BirdLife International has developed AVISTEP - the Avian Sensitivity Tool for Energy Planning to identify where renewable energy could impact birds and should therefore be avoided. AVISTEP provides users with spatial heat maps depicting potential avian sensitivity in relation to several types of energy infrastructure, including Solar Photovoltaic. Each 5km x 5km cell within the heatmaps has a sensitivity score. These scores have been grouped into four categories of sensitivity, namely: Low, Moderate, High, and Very High.

However, AVISTEP has not been used for the following reasons:

- Environics' Principal Ecologist had personally participated in the AVISTEP presentation workshop organized in Cairo by Nature Conservation Egypt (NCE) and BirdLife International and held on the 26<sup>th</sup> of June 2024. He discussed with Mr. Tris Allinson, BirdLife International representative, who agreed that the tool includes inaccuracies and is still not totally reliable for Egypt and requires updates, particularly with concern to the relationship between birds and the terrestrial habitats, which is not taken into consideration.
- The current tool could provide misleading information. For example, it includes resident bird species typical of the wetlands of the Nile Valley that do not occur in desert habitats.

For example, it includes the Common Pochard (*Aythya ferina*) and the Marbled Duck (*Marmaronetta angustirostris*), which are wetland species that would never occur in a hyper-arid desert environment.

- AVISTEP classifies any protected area (including geological protectorates) as of High sensitivity, irrespective of its relevance to birds.
- AVISTEP contradicts the results of MSBT and other tools.

Given the arid and inhospitable nature of the desert environment, with almost no vegetation, food and shelter, and due to the proximity of the Nile Valley and very close vicinity of reclaimed agricultural lands and other more "attractive" habitats (such as the habitat created by the wastewater treatment plant), it is highly unlikely that most of the species listed earlier would intentionally land in this location. In fact, the environment of the project area is likely to be a "bird barrier", where birds would actively avoid flying over or landing in the area due to its harsh conditions.

However, some bird species might still be seen in the wider desert area (and possibly at the Project Site), albeit rarely, and usually under specific circumstances, as follows:

- Accidental landings: Birds migrating or traveling through the area might be forced to make an emergency landing due to exhaustion, bad weather, or injury.
- Stopovers during migration: Some bird species, especially raptors and waders, might use this area as a brief stopover during their migration, even if it's not an ideal habitat.
- Birds blown off course: Strong winds or sandstorms could blow birds off their intended course, leading them to land in this area unintentionally.
- Presence of a man-made habitat suitable for birds' landing and providing water, shelter, roosting or perching sites, created as a result of waste and/or wastewater mismanagement.

In normal conditions, given the absence of attractive features for birds, such as food sources, water, shelter, or perching and roosting sites, it is reasonable to predict that bird presence in this area will be extremely low. References supporting this prediction include:

- A study on bird migration patterns in the Sahara Desert found that "*birds tend to fly around or over the desert rather than crossing it directly due to the harsh environmental conditions*" (Biebach, 1990);
- A study on the ecology of desert birds found that "*bird density and diversity are typically low in desert environments due to the limited availability of resources*" (MacLean, 2004);
- "Birds and Climate Change" by the IUCN states that "*birds tend to avoid areas with extreme temperatures, lack of water, and poor habitat quality*" (IUCN, 2010); and
- "BirdLife International" website states that "*deserts are generally avoided by birds due to the lack of food, water, and shelter*".

These references support the idea that birds tend to avoid areas with harsh environmental conditions, such as the arid sandy desert environment of the Project Site.



- **Mammals**

Based on species distribution maps for the mammals of Egypt and their preferred habitat types, the following species are likely to inhabit or visit the Project Site.

**Large Mammals**

Rüppell's Fox (*Vulpes rueppellii*) is the most widespread desert fox in Egypt, and the most likely to be seen in true desert areas. It is widespread throughout the WD and has been recorded from all desert habitat types, including areas devoid of water, as well as farmlands. Its typical habitat includes open sandy and stony deserts, often with sparse vegetation cover dominated by small brushes. The Fennec Fox (*Vulpes zerda*) could also be present within or around the Project Site, as this fox is mainly recorded in Egypt from the WD, including the harsh environs of the southern WD. This fox actively avoids fertile desert areas, preferring sandy desert spots with some vegetation, and is one of the few carnivores that can survive without water. Lastly, although the Dorcas Gazelle (*Gazella dorcas*) has the capacity to inhabit a wide range of arid and semi-arid habitats, including sparsely vegetated rocky and/or sandy plains, and the margins of sandy desert, it is less likely to frequent or inhabit the project site as its range in Egypt has been drastically reduced due to habitat loss and hunting activities (Hoath, 2009; Basuony et al., 2010; IUCN, 2025). Moreover, the site is almost entirely barren, and has already disturbed by the human presence, namely by the fringing road and the adjacent industrial area.

**Small Mammals**

There are three rodents with a high likelihood of occurring throughout the Project Site and in its vicinity (i.e., within a 50 km radius of the Project Site), these are the Lesser Egyptian Gerbil (*Gerbillus gerbillus*), Greater Egyptian Gerbil (*Gerbillus pyramidum*) and the Lesser Egyptian Jerboa (*Jaculus jaculus*). *G. gerbillus* is one of the most widespread Egyptian mammals and occurs throughout the WD. It is typically found in dry sandy or rocky areas, sometimes with sparse vegetation, and tends to burrow in sandy areas clear of vegetation. It is also known to be attracted to campsites. *J. jaculus* has been recorded throughout the WD and has been described as “one of the most successful mammalian colonists of the desert peninsula of Arabia”. *G. pyramidum*, is also widespread throughout the WD and along the Nile Valley to the western margins of the Delta. This gerbil is associated with sandy habitats in desert and semi desert areas, however, in the WD, it is associated with the WDs oases. In more barren and arid areas, it is more likely to be found around buildings, deserted buildings, cisterns, or near cultivated areas (Hoath, 2009; Basuony et al., 2010; IUCN, 2025).

According to Basuony et al. (2010), there are three species of bats whose range and records indicate that they may cross over or visit the Project Site and its environs. These are the Cape Long-eared Bat (*Nycteris thebaica*), Trident Leaf-nosed Bat (*Asellia tridens*) and Rüppell's Pipistrelle (*Pipistrellus rueppellii*). The Cape Long-eared Bat has a wide habitat, also ranging into desert. The Trident Leaf-nosed Bat is a desert and semi-desert species which forms large colonies. Rüppell's Pipistrelle is one of the most highly adapted bats to arid conditions and has been recorded from Qena Governorate. In Egypt, *P. rueppellii* is commonly found in desert and

semi-desert areas, including desert margins (such as the location of the Project Site). It is also known to roost under rocks, rather than caves (Hoath, 2009; Basuony et al., 2010; IUCN, 2025).

During the site visit carried out in October 2025, several rodent burrows were noticed within the areas of vegetation around the nearby wastewater treatment plant. However, no tracks, burrows, tracks, dung or other signs were observed within the Project Site.

#### 4.4.5 Ecological Sensitivities

- **Species of Concern**

The following sections identify and describe species of conservation concern (i.e., endangered, threatened, endemic, highly sensitive, keystone species) from the above-mentioned species potentially inhabiting or that may visit the Project Site. However, it should be taken into consideration that the size of the project site is negligible when compared to the vast extent of the Western Desert. Moreover, the site is not characterized by any ecological features that render it particularly attractive to faunal species. Therefore, even if one or more of these species were present onsite, relocation to other readily available suitable habitats is the most likely outcome to any disturbance.

##### **Flora**

As previously mentioned, the Project Site was found to be completely devoid of vegetation, and the few floral species occurring in close proximity to the Project Site as a result of anthropogenic activities are all common and widespread species.

##### **Fauna**

###### **Reptiles**

Out of the above-mentioned reptilian taxa that may inhabit or visit the Project Site, there are two lizards of conservation concern: the Desert Monitor and Anderson's Short-fingered Gecko.

The Desert Monitor (*Varanus griseus*) is globally listed as a species of LC but is nationally categorized as a NT species (currently possibly VU as the NT status was assessed by Baha El Din in 2006). The Desert Monitor is also listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), a multilateral treaty to which Egypt is party. This sensitivity is a result of the lizard's response to disturbance, wherein they retreat into their burrows, making them vulnerable to direct mortality through habitat alteration that destroys or compacts their preferred sandy substrate. Anderson's Short-fingered Gecko (*Stenodactylus petrii*) is also categorized as LC at the global level, but is a NT species in Egypt (Baha El Din, 2006; Saber & Masood, 2011; El-Gabbas et al., 2016; IUCN, 2025).

###### **Avifauna**

There are two threatened migratory soaring birds that are likely to cross the Project Site and/or the environs within its vicinity; the Egyptian Vulture (*Neophron percnopterus*) and the Pallid Harrier (*Circus macrourus*). *N. percnopterus* is the primary avifaunal species of

conservation concern, being threatened both at the global level (EN) and the Mediterranean level (VU). In addition, the Egyptian Vulture is listed in appendices I and II of the Convention of Migratory Species of Wild Animals (CMS) to which Egypt is a party. *C. macrourus* is globally NT and is also listed in Appendix II of CITES, Annex II of CMS, and Category 1 of the Raptors Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia (Raptors MOU), to which Egypt is also signatory. Moreover, although neither the White Stork (*Ciconia ciconia*) nor the Black Kite (*Milvus migrans*) is threatened, both are listed under Appendix II of CMS (IUCN, 2025).

However, based on the type and nature of the project, there will be no interaction between the project and the avifauna, even in the case of such birds (or any other birds) passing over the Project Site.

In fact, a key point relevant to considering the airspace utilized by avifauna is that the airspace is “anchored” to an important terrestrial area from which avifauna could take advantage. In other words, the airspace is typically considered with respect to the ecological use of terrestrial habitat and not “on its own”<sup>14</sup>. In the present case, the Project Site is located in an area which does not provide any resources to avifauna in terms of food and resting areas. However, the adjacent wastewater treatment plant may serve as an attractive stopover habitat for migratory birds.

### **Mammals**

The Dorcas Gazelle (*Gazella dorcas*) is the primary mammalian species of concern due to the important ecological roles it plays in Egypt’s deserts as one of the largest remaining herbivores. It has lost approximately 86% of its historical global range and is regionally categorised an EN species (at the Mediterranean level), globally as VU and is probably Critically Endangered (CR) in Egypt. It is also listed in Appendix I of CMS. Major threats to the animal are habitat degradation, overhunting, and drought (Hoath, 2009; Basuony et al., 2010; IUCN, 2025). This species is highly sensitive to human disturbance and tends to become nocturnal when threatened by human presence. Human activities and land use are currently limiting the distribution and abundance of gazelle populations, which are in rapid decline in Egypt, especially outside protected areas (El Alqamy & Bahaa El Din, 2006; Soultan et al., 2021; Nagy et al., 2022).

It is worth noting that the Project Site not only lacks suitable foraging habitats, but its close surroundings are also already disturbed by the nearby human presence and activities. Accordingly, the Dorcas Gazelle is highly unlikely to be encountered onsite. Moreover, according to Chammem et al. (2008), gazelles tend to avoid areas where agricultural development has occurred but do not seem to be disturbed by livestock. Therefore, their presence in the nearby reclaimed agricultural lands is not anticipated.

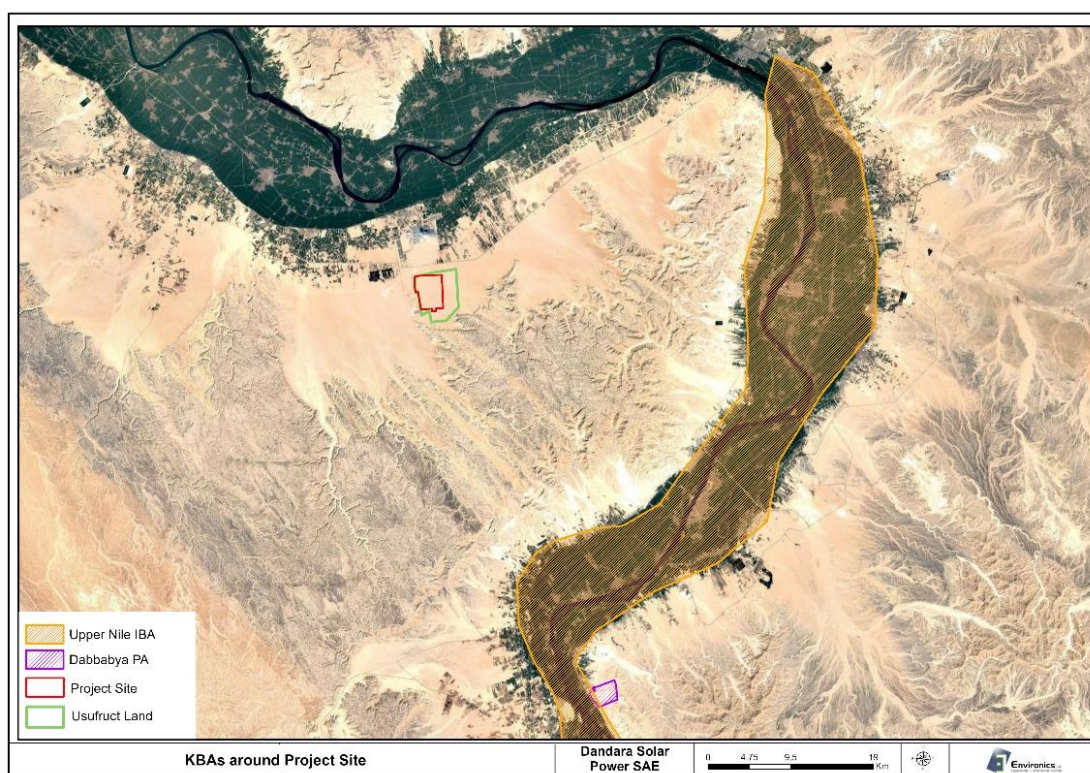
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<sup>14</sup> IFC (n.d.) Memorandum Determining Biodiversity Management Requirements Related to Airspace around Wind Energy Facilities.

Another mammal of conservation concern that may visit the Project Site is the Fennec Fox (*Vulpes zerda*). The Fennec Fox is categorized as LC at the global and Mediterranean levels, however, it is nationally classified as EN species, as it is mainly threatened by heavy trapping pressure for the pet trade. *V. zerda* is also listed in CITES Appendix II. The aforementioned bat species are also generally sensitive taxa, due to the marked sensitivity bats have to habitat loss, modification, and general disturbance. However, Rüppel's Pipistrelle (*Pipistrellus rueppellii*) and the Greater Mouse-tailed Bat (*Rhinopoma microphyllum*) are both markedly noteworthy due to their threatened statuses in Egypt. Despite being listed by the IUCN as LC at the global level, both species are categorized as VU at the national level (Hoath, 2009; Basuony et al., 2010; IUCN, 2025).

- **Key Biodiversity Areas**

The Project Site does not encompass any Key Biodiversity Areas (KBAs), Protected Areas (PAs) legally protected by the Egyptian Government, BirdLife International designated Important Bird Area (IBAs), or PlantLife International designated Important Plant Areas (IPAs). The only KBA in the vicinity (i.e., located less than 50 km away from the Project Site) of the Project Site is the Upper Nile IBA, which is located about 33 km east of the Project Site. There is one PA also in the vicinity of the Project Site, the Dababia PA, however this PA is not considered a KBA. The Dababia PA is a geological protectorate and is located approximately 45.6 km southeast of the Project Site and is separated from it by the Nile Valley (Figure 40).



**Figure 40: Nearest Key Biodiversity Areas (KBAs) to the Project Site**



There is also one proposed PA, the Wadi Qena proposed PA, located at a distance of about 53.5 km northeast of the Project Site. Similarly, it is separated from the Project Site by the Nile Valley and is located on the fringes of the Eastern Desert (Figure 41).



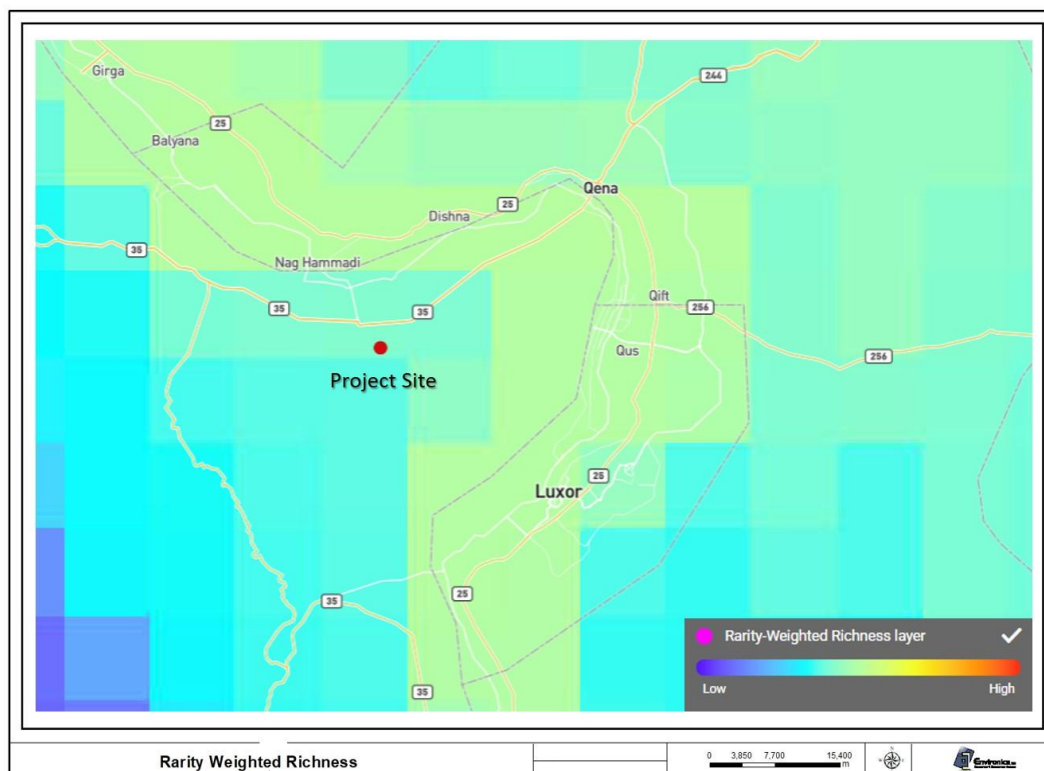
**Figure 41: Location of Wadi Qena proposed PA in relation to the location of the Project Site**

#### 4.4.6 Ecological Value and Significance

According to the Integrated Biodiversity Assessment Tool (IBAT), the biological significance or value of an area to the area's local flora and fauna can be represented by a rarity-weighted richness map. A rarity-weighted richness map is a raster layer showing the relative importance of each ~10 km grid cell in terms of its aggregate contribution to the global distribution of species of mammals, birds, amphibians, crabs, crayfishes, and shrimps and a representative set of plant taxa. High values show that a cell holds a large number of species and/or that the average ranges of the species present in the cell are small, so that the cell represents a relatively high proportion of their range<sup>15</sup>.

The Project Site is located in an area of low to medium rarity-weighted richness, i.e., its relative importance is moderate to the global distribution of different categories of species, ranging between low and moderate importance (Figure 42) (IBAT, 2025).

<sup>15</sup> <https://www.iucnredlist.org/resources/other-spatial-downloads#:~:text=Rarity%2DWeighted%20Richness%20is%20the,range%20contained%20within%20that%20cell>

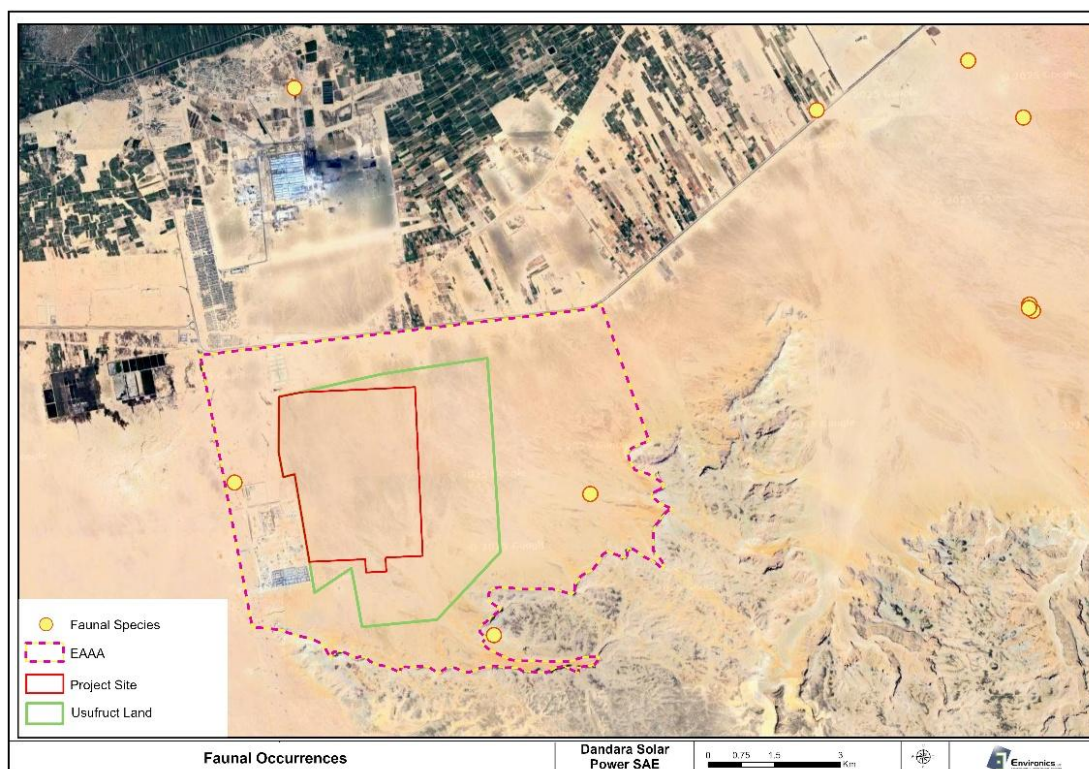


**Figure 42: Rarity-weighted richness map of the Project Site**

An additional search was carried out using GBIF, iNaturalist, and eBird to identify relevant avifauna and other taxa potentially occurring within the project site's wider area. The search was done within an "Ecologically Appropriate Area of Analysis (EAAA) of 63.37 km<sup>2</sup>, which included the project site, its Area of Influence, and a large extension of the desert habitat characterizing the site and its Aol, while excluding other habitat types (such as mountains and agricultural areas) which include a different biodiversity. This EAAA is the same one utilized to undertake the Critical Habitat screening exercise (see Section 4.4.8).

The three occurrences shown in Figure 43 are all bird species, with no mammalian or herpetofaunal species occurrences recorded over a 25-year observation period.





**Figure 43: Faunal occurrences within and adjacent to the Project Site's EAAA**

Although mammal, reptile, amphibian, and bird observations were included in this assessment, only one bird species, the Osprey (*Pandion haliaetus*) was observed and recorded at the project's EAAA over the 25-year period. Furthermore, there was only one observation of this migratory bird within the EAAA, and this observation was at a location east of the project site, significantly distant from its boundaries. The closest faunal occurrence to the projects EAAA was around 7 km north of it and was also of an Osprey. This species has an extremely large range, and its populations are increasing worldwide. It is not a bird of conservation concern and is listed as a species of LC globally (IUCN, 2025).

#### 4.4.7 Ecosystem Services

Paragraph 2 of IFC Performance Standard 6 (PS6) defines ecosystem services as the benefits that people, including businesses, derive from ecosystems. Ecosystem services are organized into four types:

- (i) Provisioning services, which are the products people obtain from ecosystems such as food, freshwater, timber, fibers and medicinal plants;
- (ii) Regulating services, which are the benefits people obtain from the regulation of ecosystem processes such as surface water purification, carbon storage and sequestration, climate regulation and protection from natural hazards;
- (iii) Cultural services, which are the nonmaterial benefits people obtain from ecosystems and may include natural areas that are sacred sites and areas of importance for recreation and aesthetic enjoyment; and
- (iv) Supporting services, which are the natural processes that maintain the other services.

**Provisioning services**

The Project Site is not being currently utilised by humans; thus, no benefits are derived from the mostly barren landscape of the Project Site.

**Regulating services**

The site's contribution to ecosystem processes (such as pollination, seed dispersion, etc.) is insignificant, again, due to its barren, species poor nature, particularly in terms of its lack of vegetation cover.

**Cultural services**

The Project Site does not entail any elements that would allow for recreational use, aesthetic enjoyment, and has no indications of its use for spiritual or other cultural purposes.

**Supporting services**

The Project Sites contributions to nutrient cycling processes and primary production is negligible given its scant vegetation cover. It, however, has a limited role in the water cycle as the Project Site is part of a wider area subject to occasional drainage from higher grounds. Although this is a rare occurrence, it plays a role in the infiltration of water, facilitating the recharging of the Quaternary aquifer beneath the Project Site. Its contribution is limited by the rarity of precipitation as well as the Project Site's geographical size compared to that of the Western Desert.

**4.4.8 Critical Habitats**

Critical habitat (CH) refers to the most sensitive biodiversity features in a defined area, regardless of whether these habitats are natural or modified. Both EBRD ER6 and IFC PS6 have similar criteria for defining critical habitat.

In this respect, a CH is an area with high biodiversity value, which meets at least one of the following criteria (EBRD, 2019):

- (i) Highly threatened or unique ecosystems;
- (ii) Habitats of significant importance to endangered or critically endangered species;
- (iii) Habitats of significant importance to endemic or geographically restricted species;
- (iv) Habitats supporting globally significant migratory or congregatory species; or
- (v) Areas associated with key evolutionary processes.

The occurrence of the above features does not automatically qualify a habitat as critical, and this is dependent on the proportion of such a CH-triggering species/feature being present in a project area. Numerical thresholds are applied to the first four critical habitat criteria to determine whether any of the species/features are likely to qualify habitats as critical, while there are no numerical thresholds for Criterion V. In this respect, the best available scientific information and expert opinion should be used to guide decision-making with respect to the relative "criticality" of a habitat in these cases.

EBRD ESR6 also considers Priority Biodiversity Features (PBF), which are features that are considered particularly irreplaceable or vulnerable, but at a lower priority level than critical habitats. On the other hand, PBFs are not considered in IFC PS6<sup>16</sup>. PBF includes:

- (i) Threatened habitats;
- (ii) Vulnerable species;
- (iii) Significant biodiversity features identified by a broad set of stakeholders or governments; and
- (iv) Ecological structure and functions needed to maintain the viability of priority biodiversity features.

As for CH, PBF criteria III and IV have no predetermined conditions. For these criteria, the assessment must rely on expert judgement.

### **Ecologically Appropriate Area of Analysis**

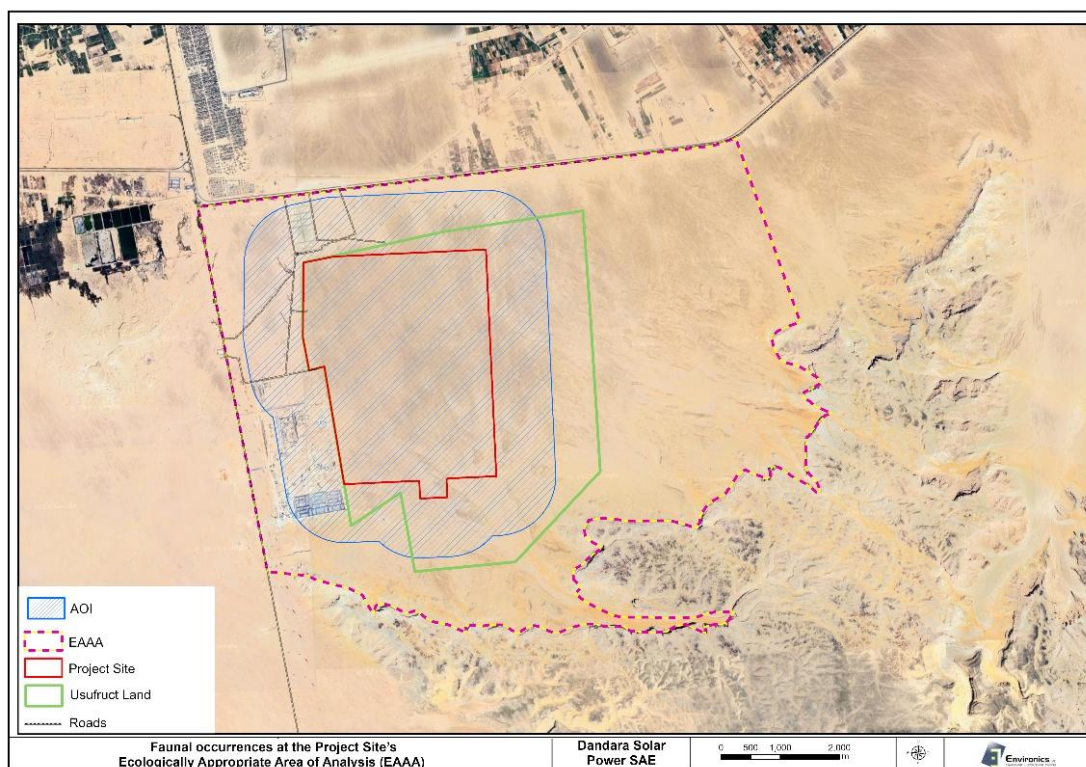
The scale at which a CH determination takes place depends on underlying ecological processes for the habitat in question and is not limited to the project site boundaries or its Area of Influence (Aol).

The EAAA (Figure 44) has been delimited as follows:

- It includes the project footprint and its Aol;
- It includes the extension of the site's single habitat type;
- It extends northwards to the Giza – Luxor Road;
- It extends eastwards within the same habitat for a distance of 4 km from the borders of the project's Aol; and
- It extends westwards to the main road and includes the nearby modified habitats (wastewater treatment plant, power sub-station and industrial areas); and
- It extends southwards to the mountain foothills (excluded).

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<sup>16</sup> Other items and requirements included in both EBRD ESR6 and IFC PS6, including Biodiversity Conservation, Protected Areas, Invasive Alien Species, Sustainable Management of Living Natural Resources and Supply Chains, are highly similar.



**Figure 44: Ecologically Appropriate Area of Analysis (EAAA) for the PV Project Site**

Excluding the industrial area, power sub-station and the wastewater treatment plant, the EAAA is entirely composed of a natural desert habitat and covers a large area of around 63.37 km<sup>2</sup>. This area is wide enough to determine the presence of critical habitat for each species with regular occurrence in the Project's Aol or ecosystems (including those extending outside the boundaries of the project's Aol) covered by Criteria 1-4, as stated in paragraph GN59 of IFC Guidance Note.

### Results of the Screening Exercise

Potential PBF- and CH-triggering species/features have been screened against the PBF/CH criteria and thresholds.

Four species have been identified as PBFs. Although the EAAA cannot be considered to "support" these species, they might occur in the area (at least as vagrants) and are herein considered PBFs using a precautionary approach. These are:

- The Desert Monitor (*Varanus griseus*);
- The Egyptian Vulture (*Neophron percnopterus*);
- Rüppel's Pipistrelle (*Pipistrellus rueppellii*); and
- The Fennec Fox (*Vulpes zerda*).

On the other hand, results of the screening process indicate that the EAAA does not qualify as CH, as none of the criteria/thresholds apply to the biodiversity and/or features of the area. Details on the screening exercise are provided in Annex 2.

## 4.5 Socio-Economic Environment

This section describes the baseline socio-economic and demographic characteristics of the Project Site, and details some general information on the Qena governorate, such as the governorate's existing infrastructure, utilities (e.g., services, roads, etc.), and land use types. The information described below is derived from secondary sources, namely the official website of the Qena Governorate (QG), the Central Agency for Public Mobilisation and Statistics (CAPMAS), and the State Information Service (SIS), the official media and public relations apparatus of the Egyptian state, amongst other sources.

The Project Site is located within the desert hinterland of the city and Markaz Nagaa Hammadi ('Markaz'<sup>17</sup> is the Arabic term for a governorate's second-level hierarchy beneath the governorates, the term loosely translates to the English definition of a 'county') of the Qena governorate. There are no human settlements or local communities within the Project Site, however, there are several villages of Markaz Nagaa Hammadi in close proximity (i.e., situated 15 km away, or less) to the Project Site. Thus, the following sections will primarily describe the socio-economic environment of the Qena governorate, focusing on Markaz Nagaa Hammadi due to its status as being the potential host communities of the project.

### 4.5.1 Socio-demographic Characteristics

The Qena governorate is one of Egypt's South Upper Egypt's governorates. It is known for its strong agricultural and industrial economic sectors, particularly as the nation's leading producer of sugar cane, tomato, banana, sesame, and hibiscus. The total cultivated area in the Qena governorate is approximately 1,225.14 km<sup>2</sup>, with sugar cane accounting for 64% of this area and contributing to 60% of the nation's sugar production.

The total area of the Qena governorate amounts to 10,798 km<sup>2</sup>, which translates to approximately 1% of the total area of Egypt proper. The inhabited parts of the governorate take up an area covering around 1,740 km<sup>2</sup>, accounting for 16.11% of the governorate's total area (SIS, 2016; QG, 2025).

- **Administrative Divisions**

The Qena governorate is divided into various administrative divisions including one "Kism" (i.e., district), Kism Qena, one new city, 41 main villages, 111 affiliated villages, and 1,466 hamlets and small villages. These villages and hamlets administratively fall under the governorates Marakiz, of which there are 8; Markaz Abu Tesht, Dishna, El-Waqf, Farshut, Naqada, Qena, Qift, and Markaz Qus. There is also one Markaz and city, Markaz Nagaa Hammadi (where the Project Site is located) (Figure 45) (SIS, 2016; QG, 2025).

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<sup>17</sup> A Markaz within a governorate may also be classified as both a Markaz and a city, as in the case of Markaz Nagaa Hammadi



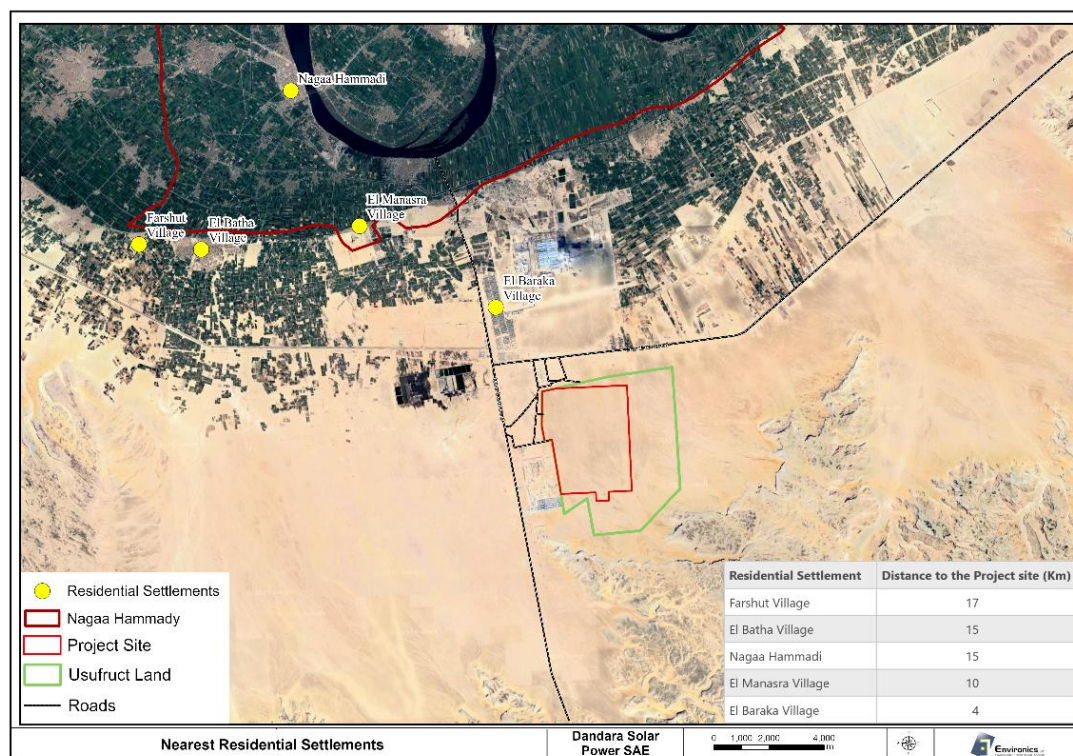


Figure 45: Location of residential settlements in close proximity to the Project Site

### • Population

The total population size of Qena governorate is 3,164,281 people, with a nearly equal gender distribution, with a population gender ratio of approximately 105 males to 100 females. However, rural residents make up the vast majority of the population (81.21%), while urban areas house the remaining 18.78% of the population. The governorate has 748,990 households and within its inhabited areas, the population density is around 1,827.8 individuals/km<sup>2</sup>. In Markaz Nagaa Hammadi, the total population size amounts to 578,237 individuals, with males accounting for 51.07% (295,357) and females 48.92% (282,880), again a highly balanced population in terms of gender. An overview of the population demographics of the Qena governorate and Markaz Nagaa Hammadi is provided below (Table 22) (CAPMAS, 2017).

Table 22: Population demographics of the Qena governorate and Markaz Nagaa Hammadi

Demographic Characteristic	Qena Governorate	Markaz Nagaa Hammadi
Total Population Size (TOT)	3,164,281	578,237
Male Population Size	1,623,352	295,357
No. of Male Residents (% of TOT)	51.3	51.07
Female Population Size	1,540,929	282,880
No. of Female Residents (% of TOT)	48.69%	48.92 %
No. of Households	748,990	135,018



#### 4.5.2 Labour Force and Economic Activities

The Qena governorate has a total labour force of 927,102 people; however, labour force participation rates differ greatly by gender, with 75.07% of the governorates total labour force being male workers (compared to only 24.92% being female. In Markaz Nagaa Hammadi, the total labor force size amounts to 182,449 workers, and similarly, male labour force participation rates (72.09%) significantly outweigh female labour force participation rates (27.9%) (CAPMAS, 2017).

Moreover, the labour force of Markaz Nagaa Hammadi makes up 19.67% of that of the Qena governorate. An overview of the labour force population demographics and labour force participation rates by gender of the Qena governorate and Markaz Nagaa Hammadi is provided below (Table 23) (CAPMAS, 2017).

**Table 23: Labour force population (≥15 years) demographics and participation rates at the Qena governorate and Markaz Nagaa Hammadi**

Labour Force Demographic Characteristic	Qena Governorate	Labour Force Participation Rate (%)	Markaz Nagaa Hammadi	Labour force Participation Rate (%)
Total Labour Force Size	927,102	N/A	182,449	N/A
Male Workers	696,020	75.07	131,542	72.09
Female Workers	231,082	24.92	50,907	27.90

- Economic Activities**

The principle economic activities practiced by the labour force of Markaz Nagaa Hammadi are manufacturing, which employs about 7.26% of the labour force and construction, which employs around 7.64%, and accommodation and food service activities, wherein 6.53% of the labour force are engaged. Following that, transportation and storage service activities are practiced by 4.13% of the labour force and about 2.66% of the labour force engage in the human health and social work economic sector. The wholesale and retail trade sector, including motor vehicle and motorcycle repairs, occupies around 1.64% of the labour force, and the electricity, gas, steam, and air conditioning supply services sector and administrative and support services sector closely follow, with 1.30% and 1.17% of the labour force partaking, respectively. On the other hand, the water sewerage, waste management, and remediation service sector only engages 0.57% of the labour force, similar to the information and communications services sector, where only 0.54% of the labour force are active. Lastly, professional, scientific, and technical activities are less practiced, with only 0.33% of the labour force engaging in these activities (Table 24) (CAPMAS, 2017).

**Table 24: Number of workers (≥15 years) from the Qena governorate and the Markaz Nagaa Hammadi labour forces according to main economic activity practiced**

Economic Activity	Qena Governorate Labour Force			Markaz Nagaa Hammadi Labour Force		
	Male Workers	Female Workers	Total	Male Workers	Female Workers	Total
Human Health and Social Work	15,039	7,948	22,987	2,762	2,082	4,844
Administrative and support services	7,815	1,244	9,059	1,830	308	2,138
Professional, Scientific and Technical Activities	2,885	498	3,383	472	131	603
Real Estate	2,328	146	2,474	355	20	375
Information and Communication	5,924	336	6,260	884	102	986
Accommodation and Food Service	27,228	20,121	47,349	6,273	5,639	11,912
Transportation and Storage	36,539	2,601	39,140	6,982	560	7,542
Wholesale and Retail Trade: Motor Vehicle and Motorcycle Repairs	11,980	2,335	14,315	2,382	604	2,986
Construction	96,023	679	96,702	13,808	139	13,947
Water Sewerage, Waste Management, and Remediation	5,308	281	5,589	985	59	1,044
Electricity, Gas, Steam, & Air Conditioning Supply	10,762	370	11,132	2,260	105	2,365
Manufacturing	33,052	8,221	41,273	11,087	2,157	13,244

- Occupation Types**

In the Qena governorate, the economically active population (i.e., workers officially documented in the labour force) working across all occupations practiced in the governorate amount to 927,111 workers. Male workers predominantly take up the plant and machine operator jobs, skilled trades posts, and the roles that fall under the umbrella of ‘elementary occupations’. On the other hand, female workers have higher participation rates when it comes to service and sales positions and clerical support roles (CAPMAS, 2017).

In Markaz Nagaa Hammadi, the economically active population engaged in all occupation types available at the Markaz amount to 182,451 workers. Again, male workers principally take on skilled trades posts, and the roles that fall under the umbrella of ‘elementary occupations’, whilst female workers have higher occupation participation rates in service and sales positions and clerical support roles. The labour force participation rates of workers from the Markaz Nagaa Hammadi labour force is highly variable when broken down by occupation types (participation rates range between 9.85% and 23.47% across different occupations) (CAPMAS, 2017).

More comprehensive information on the labour forces of the Qena governorate and Markaz Nagaa Hammadi broken down by gender and occupation type is provided below (Table 25) (CAPMAS, 2017).

**Table 25: Number of workers (≥15 years) from the Qena governorate and the Markaz Nagaa Hammadi labour forces according to the workers main occupation**

Occupation Type	Qena Governorate			Markaz Nagaa Hammadi		
	Male Workers	Female Workers	Total Labour Force	Male Workers	Female Workers	Total Labour Force
Elementary Occupations	128,745	9,351	138,096	24,944	1,959	26,903
Plant and Machine Operators	41,571	497	42,068	9,077	112	9,189
Crafts and Related Trades	139,579	16,178	155,757	23,352	4,414	27,766
Skilled Agricultural, Forestry, and Fishery Work	143,466	56,351	199,817	22,310	9,889	32,199
Service and Sales Roles	93,006	113,260	206,266	20,178	25,772	45,950
Clerical Support	28,896	3,618	32,514	6,572	1,060	7,632
Technician	52,786	11,269	64,055	11,791	2,618	14,409
Associate Professional						
Professional	50,871	18,607	69,478	9,841	4,567	14,408
Managerial	17,112	1,948	19,060	3,479	516	3,995

- Level of Education**

Qena Governorate has a total of 927,108 workers. The highest numbers are seen in the Technical Intermediate education level, totaling 291,793, followed by the illiterate level with 271,015 workers. Following that, University education also has significant numbers, totaling 119,404, and General / Al-Azhar Secondary with 97,114 workers, and the lowest number of workers is found in the intellectual education with 252 workers. In Markaz Nagaa Hammadi, the total number of workers is 182,450. The Technical Intermediate category shows the highest numbers, totaling 61,707, followed by the illiterate level with 51,801 workers. Following that university education, with 24,837 workers, and the lowest number of workers is found in the intellectual education with 48 workers (CAPMAS, 2017).

A more comprehensive breakdown of the economically active populations of Markaz Nagaa Hammadi and the Qena governorate according to level of education and gender is provided below (Table 26) (CAPMAS, 2017).

**Table 26: Number of workers (≥15 years) from the Qena governorate and the Markaz Nagaa Hammadi labour forces according to the workers level of education**

Education Level	Qena Governorate			Markaz Nagaa Hammadi		
	Males	Females	Total	Males	Females	Total
<b>Illiterate</b>	168,971	102,044	271,015	30,688	21,113	51,801
<b>Literate (Unqualified)</b>	16,318	5,564	21,882	3,087	11,83	4,270
<b>Literate (Qualified)</b>	4,131	945	5,076	720	235	955
<b>Special Education</b>	223	29	252	38	10	48
<b>Primary Education</b>	23,843	8,571	32,414	4,431	1,758	6,189
<b>Preparatory</b>	31,978	17,309	49,287	5,096	2,401	7,497
<b>General / Al-Azhar Secondary</b>	81,724	15,390	97,114	14,517	2,922	17,439
<b>Technical Intermediate</b>	246,818	44,975	291,793	49,348	12,359	61,707
<b>Above Intermediate</b>	28,625	6,913	35,538	5,809	1,371	7,180
<b>University Degree</b>	91,014	28,390	119,404	17,435	7,402	24,837
<b>Higher Diploma</b>	953	485	1,438	161	105	266
<b>Master's Degree</b>	843	243	1,086	107	0	107
<b>Ph.D.</b>	585	224	809	106	48	154

#### 4.5.3 Land Use Types

The Project Site is not currently utilized for any anthropogenic purposes, likely due to the fact that it consists entirely of bare ground (i.e., areas with exposed soil, sand, or rocks). However, land use types in close proximity to the Project Site (Figure 46) include the following:

- The Nagaa Hammadi industrial zone (200 m west of the Project Site);
- Reclaimed agricultural lands (1 km north of the Project Site);
- Wastewater treatment plant (2.5 km northwest of the Project Site);
- Under construction wastewater treatment plant (300 m northwest of the project site);
- The Giza – Luxor Road (950 m north of the Project Site);
- Baraka Village, the nearest residential area, is located 1.5 km northwest of the Project Site;
- The Obelisk PV+BESS project under construction (less than 1 km southenwest fo the project site);
- The Egyptalum factory located ---; and
- Other local communities located between 3 km and 9 km northwest of the Project Site.

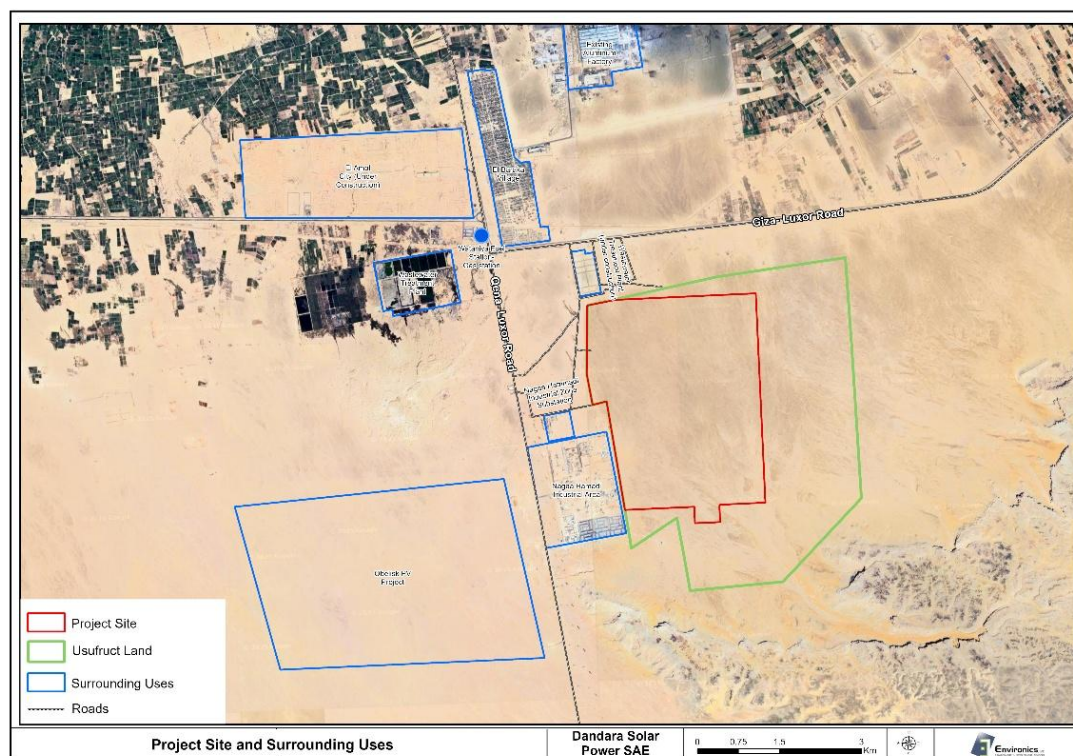


Figure 46: Land use types in close proximity to the Project Site

#### 4.5.4 Infrastructure, Utilities and Services

- Health Facilities**

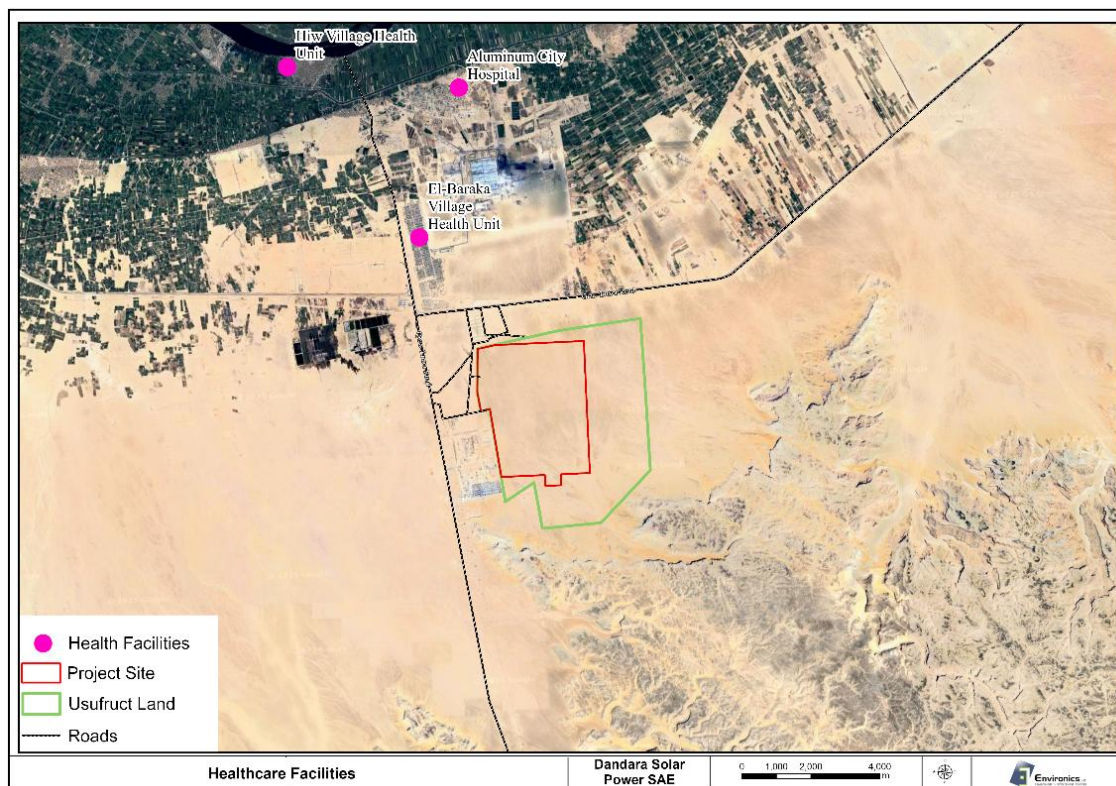
The Qena governorate boasts a total of 52 hospitals, 46 ICUs (intensive care units), and over 200 health units. The governorates healthcare infrastructure includes a fleet of 92 ambulances, which are maintained by a well-equipped network of both road ambulance stations and highway ambulance stations (Table 27) (QG, 2025).

Table 27: Hospitals and other healthcare facilities in the Qena Governorate

Healthcare Facility Type	Quantity
Central Hospitals	11
Specialised Hospitals	11
Private Hospitals	14
Health Insurance Hospitals	1
Educational Hospitals	1
Dialysis Centres	18
Health Units	241
University Hospitals	2
Specialised Medical Centres	1
Military Hospitals	1
Oncology Institutes	1
Ambulance Points and Centres	52
Ambulances	92
Highway Ambulance Units	20
Regional Blood Banks	1
Intensive Care Units	46



Furthermore, there are three healthcare facilities located in close proximity to the Project Site: the El-Baraka Village Health Unit (1.5 km northwest of the Project Site), the Aluminum City Hospital (located 7.5 km north of the Project Site), and the How Village Health Unit (9.5 km northwest of the Project Site) (Figure 47).



**Figure 47: Healthcare facilities in close proximity to the Project Site**

Furthermore, an ambulance point is available in the village of El-Baraka for immediate medical emergencies which is 1.5 km away from the project site (CAPMAS, 2017).

- **Potable Water**

According to the most recent (2017) national general census for population, housing and establishments, the total number of households in the Qena governorate amounts to 748,990. Out of these, 723,767 households rely on public water supply networks for their potable water. The majority of these are households located in the governorate's rural areas, with 579,064 rural households (out of a total of 603,680 rural households) connected to the public water supply network, and the remaining rural households (4.08% of the total number of rural households) relying on pumps, groundwater wells, and bottled water. With regards to the urban households in the governorate, there are 145,310 households in the governorate's urban areas, out of these, 144,703 use the public water supply network (translating to 99.58% of urban households relying on the public water supply network). The remaining 0.42% of urban households use pumps, groundwater wells, and bottled water (CAPMAS, 2017).



- **Sewage Facilities**

The Qena governorate has a total of 748,990 households. Of these, 115,895 households (15.47%) are connected to public sewage disposal networks, while the remaining 2.01% rely on private sewage disposal systems. A significant proportion of the total number of households within the governorate, 82.14%, rely on cesspits for sewage disposal. Around 0.35% of the governorate's households use open field drains, and other alternative sewage disposal methods. There are 145,310 households in the governorate's urban areas, of these, 92,961 households (63.97%) are connected to public sewage disposal networks with, whilst only 1.5% of these households are connected to private sewage disposal networks. A large share of the governorate's urban households (34.39%) relies on cesspits, whilst the remaining households in the governorate's rural areas (0.12%) use open field drains and other alternative methods for the disposal of their sewage. In the governorate's rural areas, the majority of households (93.64% of the governorates total number of rural households) rely on cesspits. In stark contrast, only 22,934 rural households (3.79%) are connected to the public sewage disposal network, and 2.13% of rural households solely rely on private sewage disposal systems. Lastly, 0.40% of the governorates rural households depend on open field drains and other alternative methods of sewage disposal (CAPMAS, 2017).

In terms of sewage treatment facility availability, there are 9 sewage treatment plants within the Qena governorate, with a combined total design capacity of 207,000 m<sup>3</sup>/day. This roughly equates to 48.1 million m<sup>3</sup> of sewage being treated per year (Table 28) (CAPMAS, 2021).

**Table 28: Number of sewage treatment facilities in the Qena governorate and other sewage treatment facility metrics (data from July 2019 to June 2020)**

Sewage Treatment Facility Metric	Qena Governorate
Number of Stations	9
Total Design Capacity of Sewage Treatment Stations (m <sup>3</sup> /day)	207,000
Sewage Treatment Quantity (Mill.m <sup>3</sup> /year)	48.1

Since the aforementioned national general census for 2017, the government program “Hayah Karima” has invested in multiple wastewater projects in the Qena governorate. As such, it is expected that the percentage of households connected to the public sewage disposal network has currently substantially increased since 2017. In this same context, the figures in the table above, comparing the design capacity to the sewage treated, indicate that in 2021, the governorate had a surplus of design treatment capacity. This was probably in advance of extending the public sewage network to additional beneficiaries.

- **Transport Infrastructure**

The Giza – Luxor Road runs parallel to the northern boundary of the Project Site, approximately 5 km away from this northern boundary. This road connects the city of Qena and the city and Markaz of Nagaa Hammadi to the Project Site. The Giza – Luxor Road consists of two separate lanes, each 9 meters wide. Moreover, there is a paved, single lane road serving the industrial area west of the Project Site, located approximately 0.5 km east of the

Project Site. Additionally, there are two bridges leading from the east of the Nile to the Project Site, the Qena – Nagaa Hammadi Bridge, and the Nagaa Hammadi – Deshna Bridge.

- The Qena – Nagaa Hammadi Bridge is located within the city of Qena, approximately 50 km east of the Project Site. This bridge provides a direct route from the Qena – Safaga and Qusseir – Qeft roads to the Giza – Luxor Road.
- The Nagaa Hammadi – Deshna Bridge is located in the city and Markaz of Nagaa Hammadi and is situated about 19 km north of the Project Site. It wide and connects localities east of the Nile Valley to the Giza – Luxor Road.

#### 4.5.5 Cultural Heritage

##### • Tangible Cultural Heritage

According to the Egyptian Archeological Map (EAM) (2022) and the UNESCO World Heritage List of Egypt, there are no registered antiquities or cultural heritage sites within the Project Site. However, there are five archaeological sites and monuments located in close proximity to the Project Site, and one world heritage site in the vicinity of the Project Site (Figure 48). All six sites are described below (EAM, 2022; CULTNAT, 2022; UNESCO, 2025).

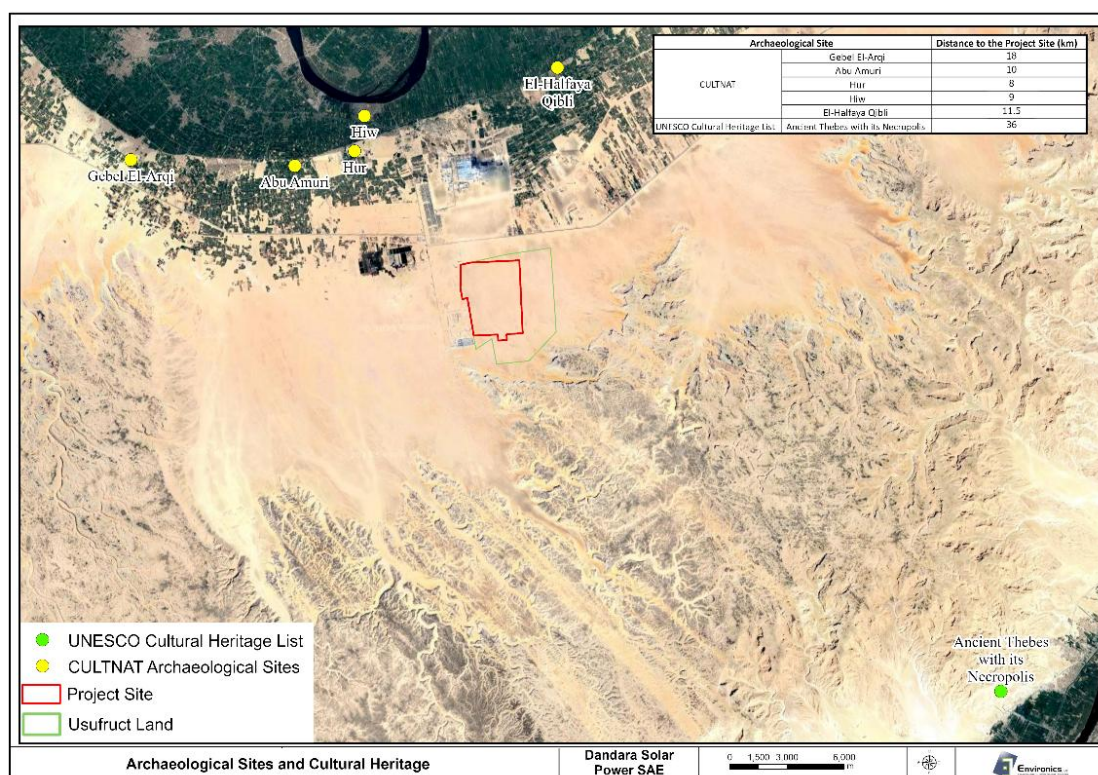


Figure 48: Archaeological sites, monuments, and cultural heritage sites in the vicinity of the Project Site

#### Archaeological Sites and Monuments

- **Abu Amuri:** Abu Amuri is an archaeological mound found in the Qena governorate, but one that has not yet been excavated (CULTNAT, 2023). It is located around 10 km north of the Project Site.

- **Hur:** Hur is a small archaeological site that has been recently excavated by the Supreme Council of Antiquities, revealing several mud-brick tombs dating to the Old Kingdom (CULTNAT, 2023). It is located about 8 km northwest of the Project Site.
- **Hiw:** This archaeological site is known for its extensive cemeteries and settlements dating back to the Naqada I-II of the Predynastic Period. Hiw is located in the Qena governorate and was the capital of the 7th Upper Egyptian Nome. Its significance in the early Middle Kingdom is indicated by its selection as the location for the royal estate named after King Senwosret I. From the Graeco-Roman Period, two temples remain at the site, one by Ptolemy VI Philometor and another by the Roman emperors Nerva and Hadrian. An inscribed Ptolemaic chapel was discovered at Hiw at the end of the 20<sup>th</sup> century, the site also includes extensive cemeteries of nearly all periods as well as burials of sacred animals (CULTNAT, 2023). The Hiw site is located approximately 9 km northwest of the Project Site.
- **Gebel El-Arqi:** This is a small site that essentially solely contains archaeological remnants. It is well-known only for a hippo-tusk handled knife from the Naqada II or the late Predynastic Period, which was excavated from the site. The handle is carved on both sides, one side depicts several animals, including a man subduing two lions, and the other represents combat scenes between two groups of armed men, and a naval battle. However, this knife has been re-located to the French Louvre Museum (CULTNAT, 2023). The Gebel El-Arqi site is located about 18 km northwest of the Project Site.
- **El-Halfaya Qibli:** This archaeological site consists of the prehistoric small village of El-Halfaya Qibli and its associated large Predynastic cemetery. No evidence of permanent architecture was found at the site. It is located about 11.5 km northeast of the Project Site (CULTNAT, 2023).

#### UNESCO World Heritage Site

- **Ancient Thebes and its Necropolises:** Thebes is the only UNESCO world heritage site located in the vicinity of the Project Site, as it is situated roughly 36 km south of it. Ancient Thebes was the capital of Egypt during the Middle and New Kingdoms. Today, Thebes is a striking testimony to Egyptian civilization at its height, with its temples and palaces at Karnak and Luxor, and the necropolises of the Valley of the Kings and the Valley of the Queens (UNESCO, 2025a).

#### • Intangible Cultural Heritage

Based on UNESCO's List of Intangible Cultural Heritage (ICH) in Egypt, none of the identified ICH elements are practiced within the Project Site. However, some elements may be practiced by the local communities in the vicinity of the Project Site. Examples include the following.

- **Handmade weaving in Upper Egypt:** This craft tradition is a complex process that requires time, effort, patience and practice. Many steps and techniques are involved in the loom preparation, threading and weaving to achieve the final product. For centuries, men and women have used their inherited knowledge to create embroidered textiles both as a family

legacy and as a profession. The basic principles have remained the same as those used in the past, whether for linen, cotton, wool or silk. Handloom weaving is considered as a source of identity and pride for the communities concerned and the persistence of handloom terminology attests to its deep-rooted significance for them. The practice currently faces many threats, however. Weaving is no longer lucrative, weaving at home requires unused space to accommodate the loom, and the working materials are expensive. The craft is therefore neglected and not transmitted as it was in the past. As such, the practice was inscribed in 2020 on UNESCO's List of Intangible Cultural Heritage in Need of Urgent Safeguarding (UNESCO-ICH, 2022).

- **Tahteeb (Stick Game):** In ancient Egypt, tahteeb was used as a form of martial arts. Its role has since changed to that of a festive game but some of the symbolism and values associated with the practice remain. Performed in front of an audience, it involves a brief, non-violent interchange between two adversaries, each wielding a long stick while folk music plays in the background. Today, it is a traditional martial art and folk dance performed with sticks, symbolising strength and cultural identity. This ICH was inscribed in 2016 on UNESCO's Representative List of the Intangible Cultural Heritage of Humanity (UNESCO-ICH, 2022).
- **Al-Sirah Al-Hilaliyyah Epic:** This oral poem, also known as the Hilali epic, recounts the saga of the Bani Hilal Bedouin tribe and its migration from the Arabian Peninsula to North Africa in the tenth century. This tribe held sway over a vast territory in central North Africa for more than a century before being annihilated by Moroccan rivals. As one of the major epic poems that developed within the Arabic folk tradition, the Hilali is the only epic still performed in its integral musical form. Moreover, once widespread throughout the Middle East, it has disappeared from everywhere except Egypt. It was inscribed in 2008 on UNESCO's Representative List of the Intangible Cultural Heritage of Humanity (UNESCO-ICH, 2025).
- **Date Palm knowledge, skills, traditions, and practices:** This encompasses the cultivation, maintenance, and cultural significance of date palms, integral to the local economy and traditions. For centuries, many populations have been associated with the date palm tree, which has aided them in the construction of their civilizations in arid regions. The ancient historical relationship between the Arab region and date palms has enabled a rich cultural heritage that has been passed on through generations. Similar to the Epic and Stick Game mentioned above, this ICH was Inscribed on UNESCO's Representative List of the Intangible Cultural Heritage of Humanity in 2022 (UNESCO-ICH, 2023).

## 5. Analysis of Alternatives

The analysis of alternatives involves evaluating various project options during the conceptual and pre-feasibility design phases. Emphasis is placed on both the environmental and social implications, ensuring that the selected option is technically and economically viable, environmentally sound, and complies with Egyptian laws and regulations.

### 5.1 No Project Alternative

The 'no project' alternative means that the 500 MW solar plant project (phase 1) will not be developed. If "no-project" alternative is selected, the project area would remain unchanged, retaining its current characteristics or allocated for other renewable energy project.

However, the benefits of the project would also not be realized. The project aims to meet part of the continuously increasing energy requirements in Egypt. Additionally, it contributes to sustainable development and reduces GHG emissions, particularly CO<sub>2</sub>, which would have been generated if the same amount of energy were produced from fossil fuel-fired power plants. It also aids in conserving resources such as oil and gas reserves. In regions with high solar power potential, like Upper Egypt, utilizing solar energy is one of the best alternatives to satisfy Egypt's growing energy demand. The project is expected to generate local employment and procurement opportunities during the construction and operation phases and commit to other social responsibilities.

*Therefore, the "no project" alternative is not considered a suitable alternative for this project.*

### 5.2 Alternative Site Location

The proposed project is located south of Nagaa Hammadi, in the vacant desert land, covering approximately 11.3 Km<sup>2</sup> ( $\approx$  2,690 acres). The site has been allocated by the Egyptian government, through the New and Renewable Energy Authority (NREA), for the project and does not conflict with other land uses.

*Therefore, alternative site location option is not considered, and the selected site is suitable to establish the project.*

### 5.3 Alternative PV Types

Types of PV module can be classified by the following 3 types:

- Mono and Poly Crystalline
- Silicon Thin-Film
- Compound Thin-Film

General classification of the types of PV modules is shown in Figure 49. Materials marked with red dotted lines mean that these are new emerging technologies modules that are under research and development.

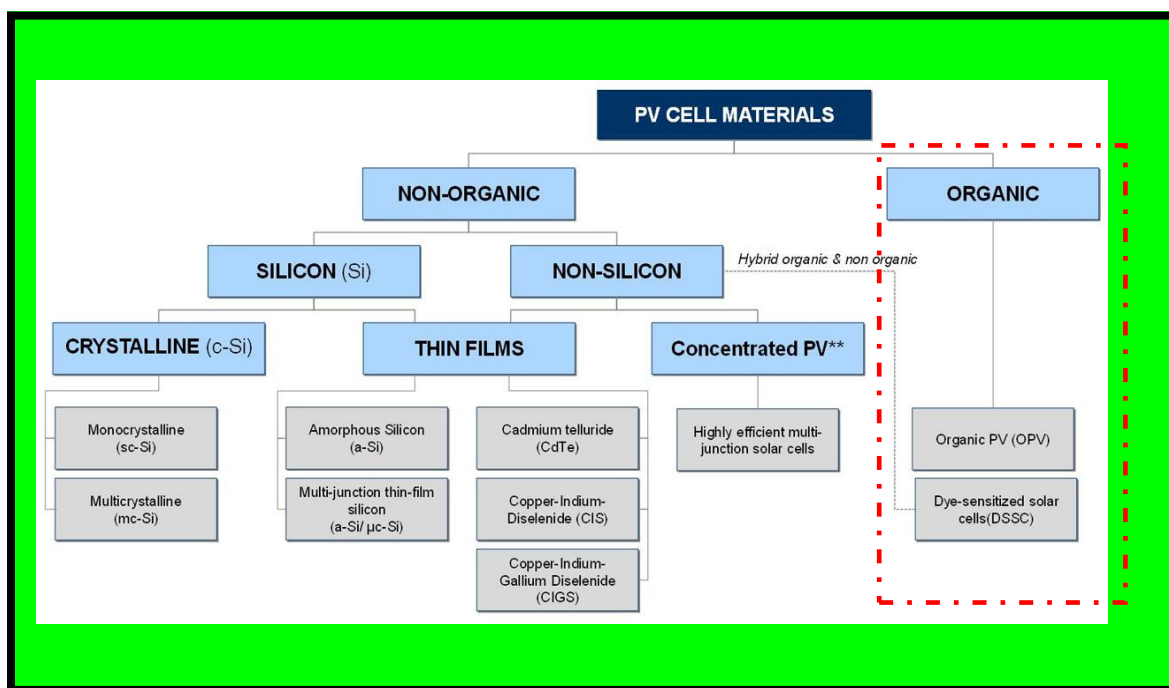


Figure 49: Types of PV modules<sup>18</sup>

Upon comparison of the three types of photovoltaic modules in terms of: cost; efficiency; temperature characteristics; lifetime; environmental consideration; and effect of shade, Mono Crystalline bifacial type is selected for the proposed project.

Table 29 below shows the comparison between various PV panel options.

Table 29: Evaluation Result for each Photovoltaic Module<sup>19</sup>

PV Module	Silicon crystallized		Silicon Thin film		Compound thin film	
	Mono Crystalline	Poly Crystalline	Amorphous Silicon	MLTF	Cd-Te	CIS
Cost	High	Low	Middle	Low	Low	Low
Efficiency	Excellent	High	Low	Middle	Middle	Middle
Temperature Characteristic	Middle	Middle	Excellent	Excellent	Good	Good
Life time	Good	Good	Middle	Good	Good	Good

<sup>18</sup> Source: [http://sovoxglobal.com/cell\\_classification.html](http://sovoxglobal.com/cell_classification.html)

<sup>19</sup> Developed based on: <http://www.sunsinesolution.com/faq.aspx>,  
<http://www.slideshare.net/gouravkumar220/solar-panel-technology-ppt>, -  
<http://www.geni.org/globalenergy/research/review-and-comparison-of-solar-technologies/Review-and-Comparison-of-Different-Solar-Technologies.ppt>.



<b>Environmental consideration</b>	does not include HS	does not HS	does not include HS	does not include HS	Includes HS Cd	Can include a small amount of Cd
<b>Land/per MW</b>	4-5 acres (16187 – 20234 m <sup>2</sup> /MW)		7.5-9 acres (30351 - 36421 m <sup>2</sup> /MW)			

\*HS: Hazardous Substances

## 5.4 Alternative Tracking Systems

Photovoltaic power systems are also classified according to their configurations: (a) Fixed PV systems, normally oriented to the south at northern latitudes and vice versa at southern latitudes; (b) PV tracking systems, which follow the sun's path in the sky (Figure 50).

Sun tracking systems are more efficient than fixed-tilt systems as they can capture a higher amount of incident solar irradiance, thereby increasing the annual electrical output. However, they require a larger area compared to fixed systems and consume a fraction of the generated electric power to track the sun. PV trackers can be further classified based on the number of their axes: single-axis tracking systems and double-axis tracking systems.

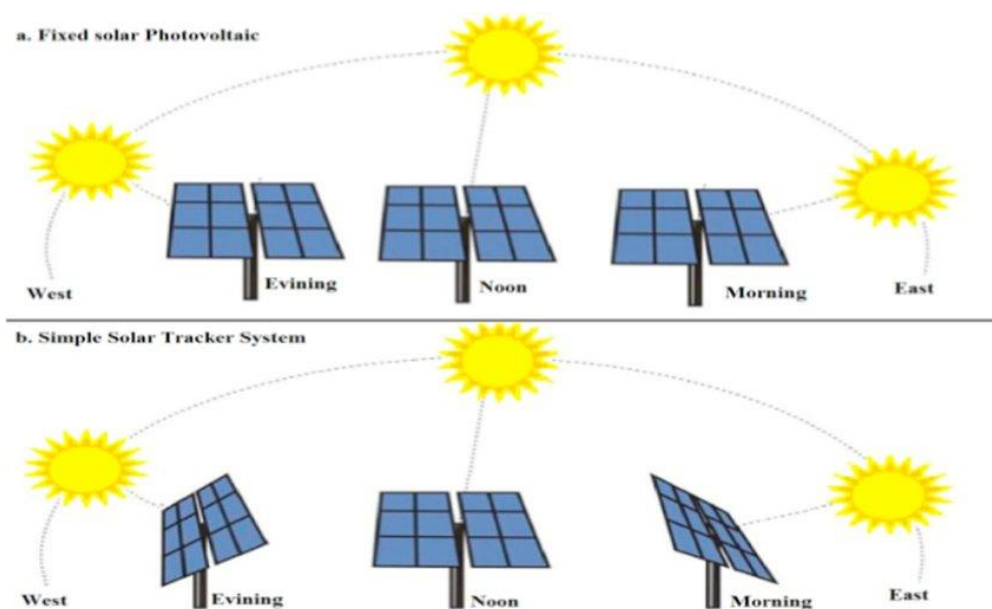
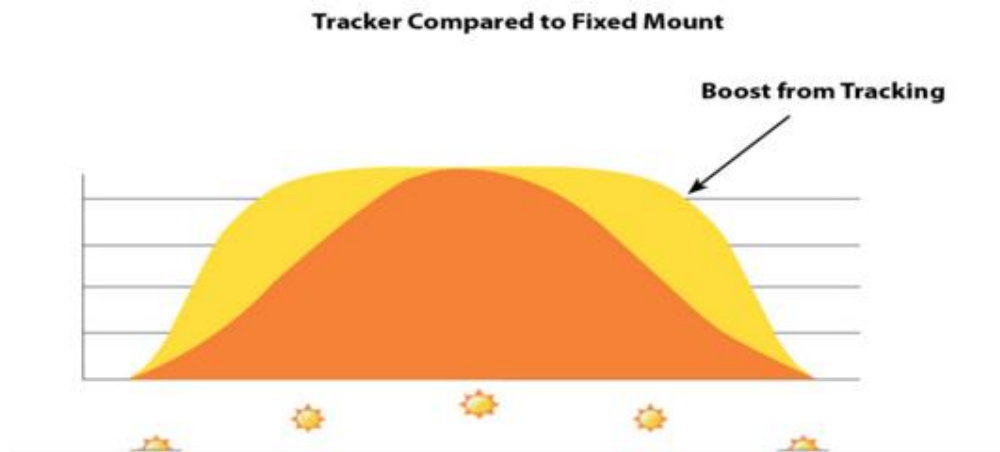


Figure 50: Fixed-angle solar panel (a) and solar panels with a tracking system (b)

Source: Nadia et al., (2018)<sup>20</sup>

<sup>20</sup> Nadia, A. R., Isa, N. A. M., & Desa, M. K. M. (2018). Advances in solar photovoltaic tracking systems: A review. Renewable and sustainable energy reviews, 82, 2548-2569.

Compared to a fixed mount, a single-axis tracker increases annual output by approximately 15% to 25%<sup>21</sup> as shown in Figure 51.



**Figure 51: Daily power production, fixed tilt versus tracking**

*Source: First Solar*

In addition, dual-axis solar trackers are equipped with two axes of movement to have a wider range than their single-axis counterpart. They are more efficient and provide significantly more energy throughout the day. On the other hand, they become more expensive and need more frequent maintenance because of the added axis of movement. For one-axis trackers, only one motor is required, whereas for two-axis trackers, two motors are needed.

*Based on the above, the single-axis solar tracking system has been selected for the project.*

## 5.5 Alternative Module Cleaning

At present, there are multiple cleaning options available to clean PV modules.

- (1) Manual Cleaning involves mostly manual labor, using brushes or cloths to clean small-scale PV modules, such as those on residential or commercial systems.
- (2) Semi-Automated Cleaning uses both automation and manual effort. It includes:
  - Robotic Cleaning Systems: Robots clean PV modules but need to be manually moved between rows.
  - Vehicle-Driven Cleaning Systems: A cleaning mechanism, typically a brush, is attached to a vehicle and driven along rows, with an operator controlling pressure to prevent damage to panels. These systems require a larger land area for vehicle maneuvering. Non-Automated Cleaning and Semi-Automated Cleaning are shown in Figure 52.
- (3) Fully Automated Cleaning uses Automatic Robotic Cleaning Systems (ARCS) to efficiently clean PV modules with minimal human intervention. Robots are permanently installed on each row and move along panel edges, cleaning both directions. They dock at stations located

<sup>21</sup> Design of a Solar Tracker System for PV Power Plants, Tudorache, T, Kreindler, L. Acta Polytechnica Hungarica, Vol. 7, No. 1, 2010

at the ends or within rows and move between arrays using bridges. ARCS can operate day or night, preferably at sunset for better moisture-based cleaning, and can be controlled remotely.



Figure 52: PV Modules cleaning options

Methods have been investigated for module cleaning, namely:

- Dry cleaning: Wiping modules with dry cloths
- Wet cleaning: Wiping modules with wet cloth
- Washing: Washing with high pressure water

### Wet vs Dry Cleaning

Wet Cleaning involves water and relevant chemicals in removing sediments from the solar panel and is more feasible for regions that have abundant water reserves and experience heavy rainfalls. However, based on the PI Photovoltaic-Institute Berlin AG, solar panel cleaning for large power plants involving water is rarely considered to be an optimal solution.

Dry Cleaning is a solution that does not involve water. Various reports and studies completed recently in desert-like environments recommend Dry Cleaning as the best cleaning option for such arid climatic zones. Table ?? below shows a brief comparison between the different cleaning techniques.

*The selected option for PV Module Cleaning is the automatic robotic dry-cleaning systems*

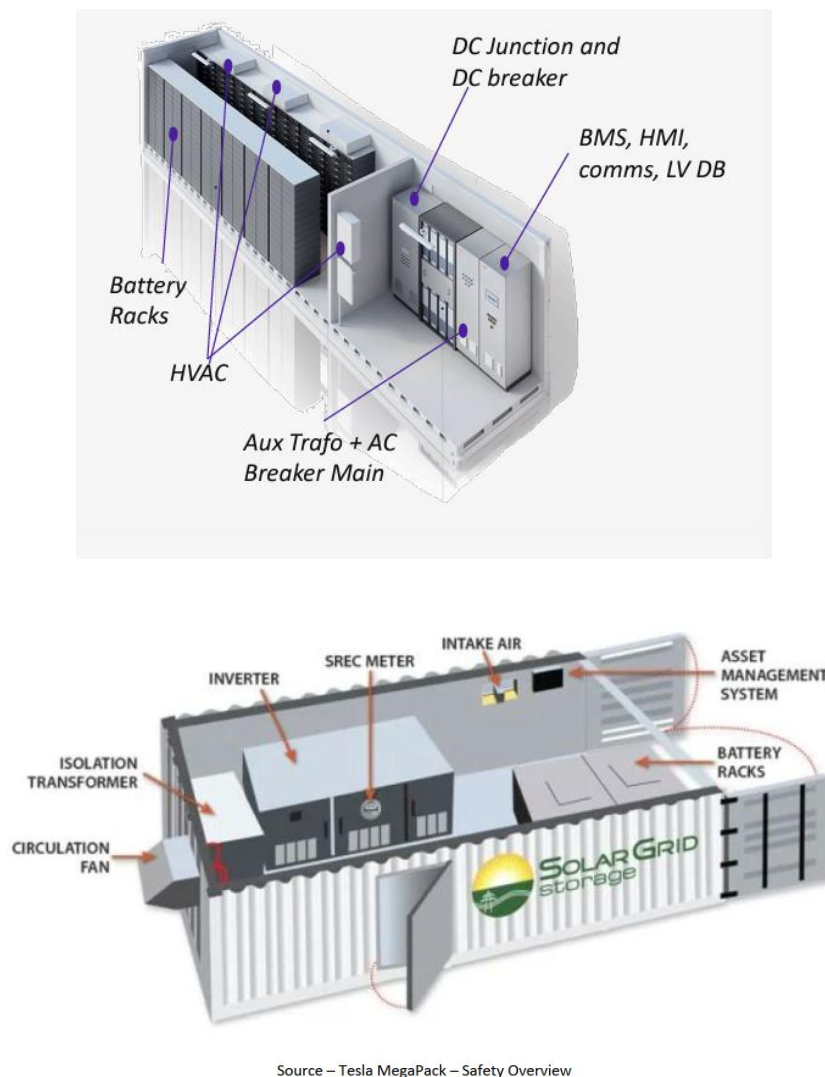
Table 30: Evaluation of the ways of module cleaning

Items	Wipe with dry cloth	Wipe with wet cloth	Washing	Robotic Cleaning
<b>Tools and resources</b>	Rotating brush / cloth carried by tractor; fuel	Rotating brush / cloth carried by tractor; water; fuel	Water truck; water; fuel	Cleaning machine, power
<b>Number of workers</b>	2 workers, one for each tractor per shift; two shifts per day (Fully manual cleaning would require 15 to 30 workers per shift, working in two shifts per day for similar cleaning)		1 x Driver also functioning as Team Supervisor and first Water Operator 1 x second Water Operator 2 x Washer 2 x Squeegee Dryer 2 x Cloth Dryer	each cleaning robot can clean up to 6,000 m <sup>2</sup> with one battery load; depending on the design of plant / length of table rows, min. 70 robots need to be deployed for daily cleaning; 2 workers per shift required for moving robots
<b>Water volume</b>	None	approx 0.4 – 0.6 ltr per module; in total 85 – 126 m <sup>3</sup> per cleaning cycle	approx 0.75 – 1.0 ltr per module	None
<b>Working effort</b>	Easy	Easy	Easy	Easy
<b>Damage on glass surface</b>	Scratch by dust on the surface might cause glass scratching	Stuck dust on the glass might remain and cannot be removed	No damage to the glass	No damage to the glass
<b>Waste</b>	Waste clothes	Waste clothes, wastewater for washing clothes	Potential wastewater generation	No wastewater
<b>Conclusion</b>	Does not need any water, but longer maintenance time, possible damage to the surface, and produces significant waste quantities.	Does not need much water, but longer maintenance time; dust might be stuck hard on the panels.	High resource consumption and potential generation of wastewater	Continuous cleaning is required to avoid significant accumulation of soil stuck hard on panels

## 5.6 BESS Alternatives

- *Lithium Solid State Containerized Batteries*

A Solid-State Battery consists of multiple battery cells assembled to form modules. Each cell contains a positive electrode, a negative electrode, and an electrolyte, which is mostly solid but can contain a small amount of liquid/polymer. The solid-state batteries that are being considered are Lithium-ion systems, as shown in Figure 53 below.



**Figure 53: BESS systems**

The possibility of thermal runaway potentially resulting from improper operation such as increased battery temperature, over charging or discharging. Li-Ion battery technologies have different chemistries, among the most promising ones are: lithium-ion titanate (LTO), lithium iron phosphate (LiFePO<sub>4</sub>), and lithium nickel manganese cobalt (NCM).

**Lithium Iron Phosphate Batteries:** This type has the safest chemistry among Li-ion technologies and has a relatively cheap cost. It also has high power density and can deliver all

power under a 100% of depth of discharge (DoD). In contrast, this type of battery presents low energy density, which ends up limiting its area of application.

**Lithium Nickel Manganese Cobalt Batteries (NCM):** They represent the most common type used in grid-scale power systems. These batteries present balanced characteristics in terms of power, energy, life cycles and costs.

**Lithium-Ion Titanate Batteries (LTO):** They have large life cycles, which can reach up to 20.000 cycles. They also have high power densities, and compared to previous Li-Ion batteries, they have the fastest charging process. However, it has a much lower energy density and higher costs.

- *Vanadium redox flow battery installations (VRFB)*

Redox Flow Batteries, typically Vanadium chemistry based (VRFB) are energy storage systems supplied either as containerized units or as a fixed installation. Redox flow batteries can be installed in containers where the individual quantities of electrolyte involved would be smaller but still significant. Because this technology has a low energy density, requiring a larger area for the electrolyte tanks, has not been selected for this project.

*The key disadvantage is the possibility of spills of corrosive electrolytes.*

- *Molten Metal Battery Energy Storage Systems*

Molten Metal batteries, typically the AMBRI Technology are energy storage systems supplied as containerized units. The liquid metal battery is comprised of a liquid calcium alloy anode, a molten salt electrolyte, and a cathode comprised of solid particles of antimony.

The key disadvantage is that they have to be heated to the melt temperature of the metals used to keep them constantly hot. This results in constant consumption of energy even when not being used to provide power.

- *Sodium-ion (Na-ion) batteries*

In this type of battery, the positive electrode is usually made of molten Sulphur (S) and the negative of molten sodium (Na). These electrodes are separated by a solid ceramic, called sodium beta alumina, which also serves as the electrolyte. The chemical reactions occur at high temperatures, between about 300 °C and 400 °C, in order to keep the electrodes in a molten state, which implies a heating system for the battery.

*Based on the above, the project will use lithium nickel manganese cobalt oxide (NMC) or lithium iron phosphate (LFP) for their cathodes.*

## 5.7 Water Sources Alternative

Water supply is required during construction activities and during operation activities, for sanitary purposes and for drinking water. The water supply may be trucked from the nearest cities/villages or from the connection to the nearest distribution network to the project.



The daily consumption is expected to be 76 m<sup>3</sup>/day during peak construction. The O&M consumption on site is expected to be limited to 75-100 m<sup>3</sup>/month, as the method used for regular cleaning of PV modules will be dry cleaning. Drinking water for workers will be bottled water and will be provided separately.

The potential options would include:

#### **5.7.1 Groundwater abstraction**

The groundwater at the project area occurs at shallow depth from 36 to 41 m close to the land reclamation areas to the north. There are no existing groundwater wells in the project area. The construction and utilization of groundwater wells needs permits from the Ministry of Irrigation and Water resources as well as Environmental Impact Assessment Study. In this context, the management of wells, potential well clogging and the disposal of the resulting pre-treatment liquid waste (brine and/or backwash of demineralization column) constitute the main constraints facing the option of groundwater usage.

*In this respect, constructing water wells is not a preferred option for the project*

#### **5.7.2 Water trucking and pipeline supply**

The required water for the construction activities would be trucked and stored in on-site tanks, located near sanitary and eating facilities. The same tank(s) will be used to store water required for construction purposes and domestic use. The water will be trucked to the site when needed during operation. O&M consumption is expected to be 75-100 m<sup>3</sup>/month, with dry cleaning used for PV modules.

*This option is a preferred option for water supply.*

## 6. Assessment of Environmental and Social Risks/Impacts and Mitigation Measures

### 6.1 Methodology

An environmental assessment was carried out to cover potential risks and impacts of the project on the environment as well as risks/impacts of the environment on the project.

The assessment was carried out in five main steps, as follows:

1. Delineation of the Area of Influence;
2. Identification and classification of risks and impacts into irrelevant (scoped out), positive and negative;
3. Assessment of negative risks and impacts in terms of their significance;
4. Identifying and proposing suitable mitigation measures for minimizing the effects of negative impacts; and
5. Detailing residual risks and impacts.

The main cumulative impacts have been also assessed using the same methodology utilized to assess potential negative impacts.

#### 6.1.1 Delineation of the Area of Influence

The Area of Influence (Aol) may be defined as “such area where significant risks and impacts caused by the project performance are evident on the physical, biotic, social and socioeconomic components of the environment. The expression of these risks and impacts must be objective and, to the extent possible, quantifiable, provided this is feasible, in line with the available methodologies”.

The Aol during the construction phase includes the project site and its immediate surroundings. During operation, although the IFC standards do not define a specific extent of the Aol for solar panels’ projects, previous studies proposed best practices that consider a buffer area of 1 km from the project site boundaries (ERM, 2018; Masdar, 2022). Accordingly, the Aol considered for the project extends for 1 km from the project site boundaries. Details on the Aol are provided in Section 2.9.

#### 6.1.2 Identification and Classification of Impacts

Interaction between the different activities and the environmental receptors, identified through the baseline information, was specified. As such interactions could result in negative or positive impacts, the different types of impacts were identified.

Based on the analysis of the baseline environmental and social conditions and the nature of the receiving environment, some aspects were found to be irrelevant to the specific activities of this particular project. These are “scoped out risks and impacts”. Those that were considered relevant were “scoped-in risks and impacts”

Scoped in risks and impacts were subject to a process of impact evaluation, based on the analysis of the proposed project components and activities, to determine the magnitude of the related aspects, in relation to the importance of the receptors. Accordingly, the

significance of the different impacts was assessed. The evaluation process took into account the information collected in the field, available in the literature, and/or based on the professional judgment of the consulting team, as well as concerns and opinions expressed during stakeholder consultation.

### 6.1.3 Assessment of Negative risks and Impacts

Impacts are the result of the interaction of an aspect of the project with a receptor. If the aspect and receptor are concluded during scoping to be connected by a pathway, the impact is relevant and is scoped in, irrespective of its significance. This provides the skeleton of the “impact assessment” chapter, where each scoped-in impact would be described and assessed.

It should be noted that the significance of each potential negative risk and impact is determined before and after implementing the design integrated measures and/or applying mitigation, management and monitoring practices (i.e. residual risks/impacts).

#### Procedure to Assigning SIGNIFICANCE

Risk and Impact assessment is the assignment of **SIGNIFICANCE** to each risk/impact. The **SIGNIFICANCE** of potential negative impacts is assessed, considering the **MAGNITUDE** of an **ASPECT** in combination with the sensitivity of the **RECEPTOR** exposed to this aspect through a defined **PATH**.

The **MAGNITUDE** of the aspect is based on assessing the following three criteria:

- The temporal scale or timeframe within which the impact can occur;
- The *spatial scale* or geographic extent of the impact; and
- The **intensity scale** or severity of the impact.

Temporal scale + spatial scale + intensity scale = Magnitude of risk/impact

The overall **SIGNIFICANCE** of the risk/impact considers the magnitude of an aspect in combination with the importance of the receptor or resource (according to its sensitivity or vulnerability or value), in the absence of quantified standards.

A more detailed explanation on the adopted methodology is provided hereafter.

#### A) Assessing the MAGNITUDE

The magnitude of an aspect is determined according to the following criteria:

- The temporal scale or duration of the aspect;
- The spatial scale or geographic extent of the aspect; and
- The intensity scale of the aspect.

1. The temporal scale defines the aspect at various time scales, as an indication of the overall duration of the aspect.

Category	Description
Short term	Less than 5 years. Aspects will be of short duration
Medium term	Between 5 and 20 years
Long term	Between 20 and 40 years (a generation) and from a human perspective essentially permanent
Permanent	Over 40 years and resulting in a permanent and lasting change that will always be there

2. The *spatial scale* (geographic extent) defines the physical extent of the aspect.

Category	Description
Localized	At localized scale and a few hundred meters in extent
Study area	The project area and its immediate surroundings
District	District level (e.g. Markaz or equivalent)
Regional	Provincial level (e.g. Governorate or equivalent)
National	Country wide – Egypt
Global	Global scale

3. The **intensity scale** is used in order to scientifically evaluate the size of an aspect would be on a particular affected system or a particular affected party. It is a methodology that attempts to remove, as much as possible, value judgments from the assessment, although it mainly relies on the professional judgment of the specialist.

Category	Description
Very severe	Usually an irreversible change to the affected system(s) or party(ies) which cannot be mitigated. For example, the change to topography resulting from a quarry. However, professional judgment is also required in order to categorize an impact as “very severe”.
Severe	Impacts that could be mitigated. However, this mitigation would be difficult, expensive or time consuming or some combination of these. For example, the clearing of vegetation which is fairly common elsewhere, as the area could be rehabilitated.
Moderate	Impacts that could be mitigated. For example, constructing a narrow road through vegetation with a low conservation value.
Slight	Mitigation is either integrated in the project design or is very easy, cheap, less time consuming or not necessary. For example, the temporary change in the water table of an irrigation canal, which is adapted to fluctuating water levels.
No effect	The system(s) or party(ies) is not negatively affected by the proposed development. For example, construction activities will be of no effect on the overall geological context of the area.

In addition, other parameters that might be considered to assess the intensity of an aspect include its frequency, duration (i.e. the period of time during which the aspect persists)<sup>22</sup>, probability of occurrence and the degree of certainty or confidence with which the intensity of an aspect has been predicted<sup>23</sup>. Accordingly, assessing the intensity of an aspect is still subjective and is influenced by the expert’s experience, estimation and professional orientation.

<sup>22</sup> The duration meant here differs from the temporal scale. For example, an oil spill is a long term impact as it can happen throughout the project lifetime but it usually has a short duration when it occurs.

<sup>23</sup> The degree of certainty can be categorized into definite, probable, possible and unsure. To define a specific impact as definite, substantial supportive data are usually required.

The MAGNITUDE scale is an attempt to evaluate the importance of a particular risk or impact taking into account the temporal, spatial and intensity scales.

Temporal scale + spatial scale + intensity scale = Magnitude of aspect:

- Large
- Medium
- Small
- Negligible

Assigning numerical values can assist in assessing the MAGNITUDE of an impact; however, this type of assessment is not always realistic and should be better taken as a guide to assist professional judgment.

For some aspect, especially noise, air and water pollution, the intensity can be assessed directly against numerical criteria and standards<sup>24</sup>. If exceeding, further mitigation must be incorporated by the Project to reduce the magnitude of the impact (and the significance of its effect).

For other aspect +nominal levels of magnitude (small, medium, large) may be adopted based on widely recognized factors such as: the nature of a change; its duration and reversibility, size or intensity and, for unplanned events, likelihood of occurrence.

Some activities will result in changes to the environment that may be immeasurable or undetectable or within the range of normal natural variation. Such changes will be assessed as having no impact or to be of negligible magnitude and will not lead to significant effects.

## **B) Assessing the SIGNIFICANCE**

In evaluating significance, the ESIA process is seeking to inform regulators and stakeholders about the effects of the project in a way that helps them make decisions on whether to approve it and allows them to develop suitable conditions to attach to an approval. The evaluation of significance should ideally demonstrate legal compliance at least (e.g. compliance with quantified standards, avoidance of effects on legally protected resources).

In the absence of quantified standards, significance can be evaluated through considering the magnitude of a risk/impact in combination with the sensitivity / vulnerability / value (collectively called “importance”) of the receptor or resource that is affected.

### **Terminology used to describe the Receptor / Resource**

The terms sensitivity, vulnerability and value of a receptor and/or resource are explained through the following definitions.

Receptor (or resource) sensitivity is the degree to which a particular receptor is more or less susceptible to a given risk/impact. Examples: cold-blooded animals are more sensitive to temperature variations than warm-blooded animals. Hospitals, schools, daycare facilities,

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<sup>24</sup> Environmental measurements are usually not available since it is assumed that the project has not started yet; however, these can be sometimes available from previous similar projects, from utilities and machinery technical specifications, from simulation activities (such as mathematical modeling), if the project is an extension of an existing project, or if, for any reason, the project has already started and measurements can be carried out.

elderly housing and convalescent facilities are sensitive receptors as their occupants are more susceptible to the adverse effects of exposure to pollutants.

Receptor (or resource) vulnerability (or conversely, resilience) describes the ability of the receptor to withstand adverse impacts. It takes into consideration not only activity-impact-receptor pathways, but also environmental characteristics of the receptor that might make it more or less resilient to change. As such, a receptor can be considered as existing within a spectrum of “vulnerable” to “resilient”, with the former more likely to experience significant impacts as a result of a given change.

Receptor (or resource) value takes into consideration its quality and its importance as represented, for example, by its conservation status, its cultural importance and/or its economic value.

It is, therefore, important to use the appropriate terminology when assessing a receptor/resource. For example, a population living close to a source of noise is more vulnerable to disturbance than a population located at a greater distance from the same source, although both populations are sensitive to noise and have the same value (as from an ethical point of view, all human beings have the same value). In this case, the term “vulnerability” should be used instead of “sensitivity” or “value”.

The appropriate use of the terms “receptor” and “resource” is less confusing than those used to describe its “importance”. For example, ambient air is generally considered as a receptor. A groundwater aquifer is also a receptor, but the term “resource” would better apply if groundwater is used for irrigation or as a source of potable water.

### Method for Determining the Resource / Receptor Importance

Receptor importance (sensitivity / vulnerability / value) is determined based on the following parameters, which are equally weighted and are each assigned a rating of 1, 2 or 3.

- **Physical Receptor/Feature**

Presence (to the identified stressor); ranges from:

<b>3</b>	Presence of feature of any type which has national or international value (e.g. state protected monument); to
<b>2</b>	Feature with local or regional value sensitive to disturbance; to
<b>1</b>	Feature which is none of the above.

Resilience<sup>25</sup> (to the identified stressor); ranges from:

<b>1</b>	Feature/receptor is unaffected or marginally affected or highly resilient to change; to
<b>2</b>	Undergoes moderate but sustained change which stabilizes under constant presence of impact source with physical integrity maintained; to
<b>3</b>	Potential for substantial damage or loss of physical integrity.

<sup>25</sup> Ability to recover



- **Soil, Groundwater and Surface Water**

Presence; ranges from:

<b>3</b>	Receptor/resource is highly valued, either environmentally (e.g. a lake categorized as Important Bird Area) or socio-economically (e.g. used extensively for agriculture or used as a public water supply); to
<b>2</b>	Receptor/resource has moderate environmental and/or socio-economic value (e.g. moderate/occasional use for agriculture purposes); to
<b>1</b>	Receptor/resource has limited or no value.

Resilience (to the identified stressor); ranges from:

<b>1</b>	No or low levels of expected contamination (well below accepted standards) and/or receptor/resource is unaffected or marginally affected or highly resilient to change; to
<b>2</b>	Moderate levels of expected contamination and/or receptor/resource is vulnerable to physical disturbance; to
<b>3</b>	High levels of expected contamination and/or receptor/resource is highly sensitive to physical disturbance.

- **Biological/Ecological Receptors/Features**

Presence; ranges from:

<b>3</b>	Routine, regular or reliably predictable presence of any species/feature which is of conservation concern (unique and/or critical feature such as protected area, critical habitat and key biodiversity area; and/or threatened, protected and endemic species) or not threatened but largely confined to the Project Area; to
<b>2</b>	Not threatened at the national level but regionally rare and/or sensitive to changes and/or disturbance and/or of social importance; to
<b>1</b>	A species/feature which is none of the above.

Resilience (to the identified stressor); ranges from:

<b>1</b>	Species or community / feature unaffected or marginally affected; to
<b>2</b>	Species/feature undergoing moderate but sustainable change which stabilizes under constant presence of impact source, with ecological functionality maintained; to
<b>3</b>	Substantial loss of ecological functionality (e.g. loss of species in key groups, substantially lower abundance and diversity, habitat loss/modification affecting ecological processes).

- **Human Receptors**

Presence; ranges from:

<b>3</b>	People being permanently present (e.g. residential property) in the geographical area of anticipated impact; to
<b>2</b>	People being present some of the time (e.g. commercial property); to
<b>1</b>	People being uncommon in the geographical area of anticipated impact.

Resilience (to the identified stressor); ranges from:

<b>1</b>	People being at least risk to change or disturbance (i.e. ambient conditions such as air quality and/or noise are known or expected to be well below applicable legislation and/or international guidance); to
<b>2</b>	People being at risk to change or disturbance (i.e. ambient conditions such as air quality and/or noise are known or expected to be below adopted standards); to
<b>3</b>	Most groups at risk (i.e. ambient conditions such as air quality and/or noise are known or expected to be at or above adopted standards).

As for the magnitude, numerical values can be used as a support to assess the importance of receptor/resource, but professional judgment might be needed to complement/modify the result. The importance (sensitivity / vulnerability / value) of a receptor or resource could sometimes be hardly quantifiable (e.g. if we are not able to evaluate if air emissions and/or noise intensity will be below or above regulatory standards) but it is not usually difficult to evaluate based on professional judgment, without using numerical values. For example, from an ecological perspective, the ecological value of an industrial zone is Low, while that of a protected area is High. On the other hand, the value of a natural area of no particular conservation concern may be deemed as “Medium”, as long as it does not include features or species of particular importance. Moreover, given the High importance of human receptors, if a community is exposed to noise/emissions of unknown or unquantifiable intensities/loads, the worst-case scenario would be adopted.

### **SIGNIFICANCE SCALE**

Magnitude and significance tend to be related, but do not necessarily directly correlate. Magnitude can be measured, in terms of how much an area is affected by the development and how badly, but significance is a more subjective measurement. While a proposed development may have a large impact in terms of magnitude, the effects it causes may not actually significantly affect the environment as a whole. On the other hand, for a given impact magnitude, different receptors (either directly or indirectly) may be deemed of greater importance and as such the significance of the impact is greater than the impact magnitude alone.

The following table assesses the significance of a potential impact by combining the stressor's magnitude with the sensitivity / vulnerability / value of the receptor or resource that is affected.

Magnitude of impact	Sensitivity / Vulnerability / Value of Resource / Receptor		
	Low	Medium	High
Negligible	Insignificant	Insignificant	Insignificant
Small	Insignificant	Minor	Moderate
Medium	Minor	Moderate	Major
Large	Moderate	Major	Extreme

Impacts/effects of more than minor significance may warrant re-examination to see if an impact magnitude can be reduced further. Different mitigation options may be examined and the reasons for selecting one and rejecting others explained. Some impacts/effects that cannot be adequately mitigated may need to be addressed through the consideration of offsets<sup>26</sup> or compensations. A cautious judgment is undertaken before assessing the significance of an impact as “Extreme”, which should comply with the definition provided in the table below. Otherwise, the impact is categorized as “Major”.

Adoption of mitigation measures can decrease the magnitude of the risk/impact but not the sensitivity and/or vulnerability and/or value of the resource and/or receptor.

### Impact significance definitions

Significance	Definition
<b>Extreme</b>	<b>Highly significant.</b> Impacts with an “ <b>Extreme</b> ” significance are known to permanently disrupt the function and value of the resource/receptor, and have broader systemic consequences (e.g. ecosystem or social well-being). These impacts are very difficult or impossible to mitigate and might require the implementation of offset and/or compensation measures, contributing to national and/or regional-level conservation goals rather than solely site-level impact mitigation.
<b>Major</b>	<b>Significant.</b> Impacts with a “ <b>Major</b> ” significance are likely to disrupt the function and value of the resource/receptor and may have broader systemic consequences (e.g. ecosystem or social well-being). These impacts are a priority for mitigation in order to avoid or reduce the significance of the impact.
<b>Moderate</b>	<b>Significant.</b> Impacts with a “ <b>Moderate</b> ” significance are likely to be noticeable and result in lasting changes to baseline conditions, which may cause hardship to or degradation of the resource or receptor, although the overall function and value of the resource or receptor is not disrupted. These impacts are a priority for mitigation in order to avoid or reduce the significance of the impact.
<b>Minor</b>	<b>Detectable but not significant.</b> Impacts with a “ <b>Minor</b> ” significance are expected to be noticeable changes to baseline conditions, beyond natural variation, but are not expected to cause hardship, degradation, or impair the function and value of the resource or receptor. However, these impacts warrant the attention of decision-makers, and should be avoided or mitigated where practicable.
<b>Insignificant</b>	<b>Not Significant.</b> Any impacts are expected to be indistinguishable from the baseline or within the natural level of variation. These impacts do not require mitigation and are not a concern of the decision-making process.

<sup>26</sup> Offsets are a set of actions with on-the-ground “*measurable conservation outcomes*” that can balance significant residual environmental and/or social losses caused by the project *only after appropriate avoidance, minimization and restoration measures have been applied*, with equivalent or higher environmental and/or social gains in terms of characteristics and size of expected gains. The decision to undertake an environmental and/or social offset therefore would never be a substitute for the implementation of good management practices that prevent significant impacts.

In certain cases it may not be possible to determine the significance of an impact due to the lack of precise and/or reliable information, because the temporal scale is too extended in time or because the area potentially affected is too small to be evaluated on the long run. In these cases, the significance of the impact is deemed **UNKNOWN**. Examples include impacts on potentially buried artifacts in an area considered of unlikely archeological potential; or potential impacts of climate change on a particular crop in a specific area. For impacts of unknown significance, the “precautionary principle” should be implemented, and mitigation measures should be proposed (whenever possible) as if the impacts are likely to occur. Example: implementing a chance find procedure in case archeological remains are found during excavations.

#### 6.1.4 Mitigation Measures

The mitigation of impacts should follow a hierarchy of actions, referred to as the “Mitigation Hierarchy”, which comprises the following sequential steps:

- **Avoidance:** actions taken to fully prevent impacts, such as relocating a project or changing its spatial layout to prevent impacts in specific locations;
- **Minimization:** actions taken to reduce the duration, intensity and/or extent of impacts that cannot be completely avoided;
- **Restoration:** actions taken to assist in the recovery of a feature that has been degraded, damaged, or destroyed; and
- **Offset:** measurable outcomes resulting from actions designed to compensate for significant residual adverse impacts arising from project development and persisting after appropriate avoidance, minimization, and restoration measures have been taken. These could be applied in both biodiversity conservation (e.g., restore and protect areas degraded by impacts unrelated to the planned development or avert the loss of biodiversity from impacts unrelated to the planned development) and pollution loads (e.g., by investing in pollution abatement in an adjacent industrial facility emitting pollutants in the same air shed).

Mitigation measures are either incorporated as integral part of the project design or through management and monitoring measures. By implementing both types of mitigation measures, the residual impacts, which are those potentially, remaining after implementing the mitigation measures, will be minimal and acceptable.

As much as possible, the avoidance and prevention of impacts is favoured over minimization, restoration or offset. Based on the impact identification and evaluation process, irrelevant impacts are scoped out of the assessment process, and mitigation measures are proposed for significant impacts, while minor impacts are usually integrated within the management plans of the project.

#### 6.1.5 Residual Impacts

Residual impacts have been evaluated and their significance is stated in this chapter after the implementation of the design integrated measures and all relevant mitigation measures.

#### 6.1.6 Cumulative Impacts

The present ESIA assesses the cumulative impacts in Section 6.5. The methodology used to assess cumulative impacts is the same utilized to assess negative impacts.

## 6.2 Impacts and risks Identification

Interaction between the different activities and the environmental and social receptors, identified through the baseline information, was carried out. Such interactions may result in negative or positive impacts. The different types of risks and impacts were identified.

Based on the analysis of the baseline environmental and social conditions and the nature of the receiving environment, some aspects were found to be irrelevant to the specific activities of this particular project. These are identified as "scoped out impacts".

Potentially relevant aspect was subject to a process of impact evaluation, based on the analysis of the proposed project components and activities, to determine the significance of the different impacts. The evaluation process takes into account the information collected in the field, available in the literature, and/or based on the professional judgment of the consulting team and public consultation. Impact evaluation is based on pre-set criteria including, impact magnitude, duration, planned mitigation measures, regulatory standards, and sensitivity of environmental receptors.

### 6.2.1 Scoped Out Impacts

The potential impacts of the project are identified based on the analysis of impacts of surrounding environment and social aspects. This step would facilitate eliminating and scoping out irrelevant impacts taking into consideration the following:

- Type of project
- Location
- Characteristics of the surrounding environment.
- Receptor sensitivity or importance: depends on its nature, value, scarcity, etc.

**There are three types of receptors:**

- On-site receptors encompassing soil and workplace.
- Receptors surrounding the site such as ambient air, humans, plants, and animals.
- Final sinks/receptors such as surface and groundwater.

Examination of the environmental setting of the area and the operational processes has shown that the impact on the following resources/receptors is irrelevant:

#### ***Impacts on "surface water quality" and "aquatic life"***

As the location of the project is located in a desert region with no water bodies or surface canals within its boundaries, and the nearest water body, Alranan Canal, approximately 8.5 km north of the project area, there are no surface water sources in the vicinity of the project.

Therefore, impacts on surface water can be scoped out.

#### ***Impact on groundwater***

Based on the nature of the project there will not be any interaction with the groundwater in the area.

The groundwater in the project area occurs at shallow depths from 36 to 41 m close to the cultivated lands and the depth increases toward the plateau to reach about 70 m and will not be affected by the potential spills from the project site.

### 6.2.2 Positive Impacts

#### *Environmental Impacts*

1. The first phase of the project aims to produce approximately 500 MWac and 100 MWh BESS for EgyptAlum, the largest aluminum producer and industrial electricity consumer in Egypt, which exports approximately 60% of its production to Europe. Thus, the project will provide EgyptAlum with a substantial quantity of clean, renewable electricity. This will reduce the region's reliance on fossil fuels for power generation and reduce CO<sub>2</sub> emissions by approximately 1.34 million tonnes annually compared to a fossil fuel (diesel) power plant<sup>27</sup>.
2. The solar plant will not produce air pollutants like nitrogen oxides, sulfur oxides, and particulate matter during operation, unlike fossil fuel power plants.
3. Solar photovoltaic power generation do not require water compared to traditional thermal power plants, helping conserve water resources in this desert area.
4. The inclusion of a BESS allows for better integration of renewable energy into the grid, potentially reducing the need for fossil fuel-based peaking power plants.

#### *Socio economic Impacts*

1. The project is likely to provide around 5000 direct jobs at the PV project during the peak construction phase. The hiring and procurement policies, as well as the use of all local channels, official and societal, for job advertisement would ensure maximizing the local hires from the surrounding communities and the Qena governorate in general.
2. Once operational, it may provide about 100 permanent jobs for maintenance and operation.
3. Indirectly, it could support more than 500 jobs in the supply chain and related services.
4. Increased economic activity in Nagaa Hammadi will likely boost local businesses and services.

In addition to the above, the project is also committed to develop an CSR program parallel to construction to be launched during operation aiming at supporting the community with specific focus on vulnerable groups.

The positive impacts of the project during the construction phase are short-term and highly beneficial due the provision of large number of direct and indirect job opportunities, thus the significance of the positive impacts is high.

The operation phase during its lifetime will provide small number of direct and indirect job opportunities however, this will be for the lifetime of the project. In addition, the project will significantly contribute to meeting the increasing demand on energy. The positive impacts are long term and highly beneficial and thus their overall positive impact is high.

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<sup>27</sup> <https://www.iea.org/data-and-statistics/charts/annual-direct-co2-emissions-avoided-per-1-gw-of-installed-capacity-by-technology-and-displaced-fuel>



## 6.3 Assessment of Potential Negative Impacts and Proposed Mitigation Measures

### 6.3.1 Potential Impacts during Construction Phase

In general, mitigation measures at the construction phase of any project depend mainly on environmental management procedures, which include preventive maintenance procedures for construction equipment, and material transport trucks, proper waste management procedures, continuous monitoring, supervision and follow-up procedures.

#### A. Potential risks and Impact on the Physical Environment

##### • Potential risks/Impacts on Air Quality

Dust generated from construction activities including the excavation, soil leveling, road works, and emissions from construction equipment and uncovered truckloads; exhaust and GHG emissions from construction vehicles and machinery; Fuel combustion in construction power generators. Exhaust emissions are likely to include nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO), Sulphur oxides (SO<sub>2</sub>), hydrocarbons (HC) and total suspended particulates (TSP)

The construction activities will be carried out within the PV project boundaries with BESS (*localized*), and over a total of 15 months (*short-term*), with a medium air quality magnitude (*slight*), the significance of the impact is considered **SMALL**.

The impacts are expected to be short-term and primarily affect the workplace environment. Additionally, the likelihood of public health impacts from on-site activities is low, as the nearest residential area (Baraka Village) is about 1.5 km northeast of the project site, outside the project's Aol. Therefore, this impact is considered **MINOR**. However, the potential impacts on the adjacent Nagaa Hammadi industrial area is **MODERATE**.

#### Mitigation Measures

To address these potential impacts, mitigation measures would be implemented as the project management will ensure that the construction contractors will carry out the necessary measures to minimize impacts and include them in the contractors' agreements.

The following mitigation measures are usually used to minimize the impacts of construction activities on the air quality:

- Implement policies/procedures to reduce idling times for vehicles and machinery
- Maintaining machinery and vehicles in good working conditions to minimize fugitive emissions and exhaust;
- Ensuring workers with aware of safe driving and maintain good practices in machinery usage;
- Emissions from power generator stacks will comply with Law 4/1994 and its relevant executive regulations.
- Implement dust suppression measures.

#### Residual Impacts

- The above mitigation measures are expected to be efficient in minimizing the potential impacts. Therefore, the residual impacts of construction activities of the proposed project on workplace air quality are deemed **INSIGNIFICANT**.

- **Potential Impacts on Ambient Noise**

The predominant noise generation during construction will result from the operation of heavy equipment, power generators, vehicle movement, and ramming for foundations. Such impacts will occur for a relatively short period and are expected to affect mainly the work environment. Since the construction activities will take place in the expansive Western Desert vacant land and the adjacent Nagaa Hammadi industrial area, the impact will be localized. The duration of the impact is expected to be short-term, lasting 15 months, and the severity is considered medium (moderate). Therefore, the magnitude of the impact is deemed **SMALL**.

Table 31 shows typical noise levels, in decibels, expected at various distances from construction machinery.

**Table 31: Average Noise Levels from Construction Equipment**

Equipment Type	Distance from Noise Source (dBA)		
	10m	50m	100m
Ramming Machines <sup>28</sup>	100	88	80
Bulldozer	74	60	54
Generator	76	62	56
Backhoe	79	65	59

As the proposed project will be carried out in the wide Western Desert, the sensitivity of the receptor (workers) is Medium. Therefore, the overall significance of the impact is assessed as **MINOR**.

#### Mitigation Measures

The following mitigation measures will be included in the contracts of the construction contractors:

- Ensuring regular maintenance of construction equipment and machinery to minimize noise emissions.
- Use low-noise machinery and equipment where possible.
- Schedule high-noise activities to avoid simultaneous operations that could amplify noise levels.
- Provide hearing protection equipment to workers exposed to high noise levels.

#### Residual Impacts

The above mitigation measures are expected to efficiently minimize the potential impacts. Therefore, the residual impacts of construction activities of the proposed project on the ambient and workplace noise are deemed **INSIGNIFICANT**.

- **Potential Impacts on Soil**

Potential impacts on soil during the construction phase generally result from domestic wastewater management, construction waste management, accidental spills or leaks of fuels, oils, and other chemicals from construction equipment that can contaminate the soil.

<sup>28</sup> [Noise Reduction System - IQIP](#)

In general, the construction activities are unlikely to result in soil contamination that will need future decontamination and clean-up activities.

The impact is *localized*, and short-term. risks of the construction phase on soil are thus considered of **SMALL** magnitude. As the proposed project will be carried out within the region of the Western Desert., the sensitivity of the receptors is **MODERATE**.

Therefore, the overall significance of the impact is assessed as **MINOR**.

#### Mitigation Measures

Despite the risks of the construction phase on the soil are limited, mitigation measures are recommended to manage the potential impacts.

- Conduct maintenance of vehicles, trucks, and construction equipment off-site to reduce on-site effluents and spills.
- Collect and dispose of spillages from tank filling or generator operation through licensed/authorized waste contractors.
- Develop spill management plan
- Maintain good housekeeping practices to ensure a clean and organized construction site.
- Collect and transport wastewater by authorized contractors to ensure proper disposal and prevent contamination.

#### **Non-Hazardous Solid Waste**

- Collect waste at designated collection points and store it in appropriate containers following regulations.
- Use licensed contractors for the collection and disposal of non-hazardous waste.

#### **Hazardous Waste**

- Establish marked and physically separated storage areas for hazardous waste.
- Use licensed contractors for the collection and disposal of hazardous waste.

#### Residual Impacts

By implementing the above mitigation measures, the residual impacts of the construction activities on the soil will be **INSIGNIFICANT**.

#### **B. Risks and Impact on the Biological Environment**

The project site is located within the Middle Limestone Plateau which is an extremely arid part of the Western Desert and practically rainless. Vegetation cover is generally absent with the exception of few scattered desert shrubs. This is a common feature of the Western Desert which, except for its coastal part, is almost devoid of vegetation and plant communities are restricted to oases and areas where water can accumulate such as small basins filled with fine sediments in the otherwise barren gravel desert (these areas are absent in the project area, which has a sandy soil).

The project area represents a small part of the vast Western Desert (which covers two thirds of the surface of Egypt) and while several species are reported from literature in the wider area, the site is devoid of vegetation and expected to host a very limited faunal diversity

associated with hyper-arid sandy habitats, although vagrant species may occur, including a few species of conservation concern.

In fact, results of the field survey indicated that the project site is characterized by bare ground, and no flora was observed within the project site. This is reflected on the presence of fauna, which has usually a scattered distribution and mainly includes species adapted to these harsh conditions. Flora and other signs of wildlife were only recorded at the location of the public wastewater treatment plant north of the site, which falls within the project's Aol. This facility has created a "wet" modified environment within the desert habitat, resulting in the growth of several plant communities and some associated fauna. However, none of the recorded species are of conservation concern.

Moreover, no CHs have been identified within an EAAA covering 63.37 km<sup>2</sup> (see Annex 2), which includes the project site and its Aol. On the other hand, four species have been identified as PBFs. Although the EAAA cannot be considered to "support" these species, there is a remote possibility of their occurrence the area (at least as vagrants) and are herein considered PBFs using a precautionary approach.

Moreover, the project is entirely located in a natural habitat. In such cases, IFC PS6 requires that a project does not significantly convert or degrade natural habitat, unless the following are demonstrated:

- *"No other viable alternatives within the region exist for development of the project on modified habitat.*
- *Consultation has established the views of stakeholders, including Affected Communities, with respect to the extent of conversion and degradation; and*
- *Any conversion or degradation is mitigated according to the mitigation hierarchy".*

IFC PS6 also defines what is meant by conversion of degradation as follows: *"the elimination or severe diminution of the integrity of a habitat caused by a major and/or long-term change in land or water use; or (ii) a modification that substantially minimizes the habitat's ability to maintain viable populations of its native species."*

Accordingly, it should be noted that that:

- There are no viable alternatives for development of the project on modified habitat, as the modified habitats are highly valuable agricultural lands;
- Consultation with relevant stakeholders has been carried out; and
- The project area does not include any community that could be affected by the project.

In addition, one of the main objectives is to adopt the mitigation hierarchy in the design and implementation of projects with the aim of achieving "no net loss", and where appropriate, a "net gain" of biodiversity. Net gains are additional conservation outcomes that can be achieved for the biodiversity values for which a critical habitat was designated. Therefore, the concept of "net gain" does not apply to the present project area, where no CH has been identified.

"No net loss" is defined by EBRD ESR6 as "the point at which project-related biodiversity losses are balanced by gains resulting from measures taken to avoid and minimize these

impacts, to undertake on-site restoration and finally to offset **significant** residual impacts, if any, on an appropriate geographic scale".

In this respect, potential risks and impacts have been properly addressed, and suitable mitigation measures have been developed. All residual impacts are deemed minor or insignificant as shown in the following sections, and do not require the implementation of offsets, also given that no CHs have been identified. Accordingly, the "no net loss" concept has been properly addressed.

- **Habitat loss, modification, and fragmentation**

During the installation of PV panels and construction of utilities, the soil nature and topographic structure of the area will change leading to a modification of the desert habitat from natural to modified due to constructions and potential soil levelling activities. Moreover, the presence of a fenced site might have a barrier effect on local faunal species, affecting their displacement from one place to another.

The risk is deemed permanent and irreversible (unless the project is terminated and the site is restored), involves the *study area*, and is considered **moderate** given the extension of study area, which is relatively small when compared to the vastity of the Western Desert, which covers two thirds of surface of Egypt. The magnitude is considered MEDIUM. Given the Low value of the receptor (a barren desert habitat with limited biodiversity), this risk is deemed **MINOR**.

#### Mitigation Measures

Mitigation measures will focus on avoiding the degradation of offsite habitats:

- Ensure proper housekeeping onsite and offsite to avoid the degradation of surrounding areas;
- Avoid offsite areas with vegetation cover to prevent further degradation of surrounding areas;
- Ensure proper speed limits onsite and offsite; and
- Provide awareness to the workers on the negative impacts of affecting flora and disturbing wild fauna.

To reduce the risks of habitat fragmentation, implement a wildlife friendly fence with the following characteristics:

- The fence should be highly visible to running and flying fauna.
- The lowest wires should provide some distance (about 30 cm) at different intervals to allow wildlife species to crawl under them without injury.

#### Residual risks

As habitat loss and modification are permanent, their residual risks will remain **MINOR**. On the other hand, by implementing a wildlife friendly fence, risks on biodiversity due to habitat fragmentation can be reduced to **INSIGNIFICANT**.

- **Disturbance to wildlife**

During the construction phase, air emissions, noise and vibrations, light emissions, as well as a relatively large human presence, may affect local wildlife which is reported to include some

threatened species and potential PBFs at the wider area level, and possibly within the EAAA. These stressors may drive fauna away from the site, whose area is, however, considered to be very limited. Heavy machinery may lead to soil compaction and destroy dens and burrows (if any), thus affecting fossorial species. Increased traffic may slightly increment animal road-kills. On the other hand, migratory avifauna is not expected to be affected as there is no correlation between the airspace utilized by avifauna and the terrestrial area of the site, which does not provide any resources in terms of resting and feeding areas (as confirmed by the site's Sensitivity Index being of  $\leq 0.001$ ).

Given the nature of the site, these risks are **moderate** in intensity, of short term and at the *study area* level. Their magnitude is considered MEDIUM. Receptors are considered of Medium value (due to the potential presence of some threatened species) but of Low vulnerability to these impacts as they are not confined to project site and/or its AoI and, therefore, will be unaffected or marginally affected. Accordingly, the overall significance of these impacts is deemed **MINOR**.

#### Mitigation Measures

Mitigation measures will mainly include the following:

- Develop, implement and update a solid waste, hazardous waste and wastewater management plan to include waste collection, storage, transport and disposal in an environmentally sustainable manner to avoid attraction of vermin and the potential consumption of waste from desert species;
- Provide awareness to the workers on the negative impacts of disturbing wild fauna;
- Ensure proper housekeeping practice;
- Avoid high intensity light directed outside the site that may disturb fauna;
- Ensure speed control and the prohibition of off-track driving; and
- Ensure the proper maintenance of construction equipment and any other equipment with high noise and vibration potential.

#### Residual Impacts

With the proper implementation of the mitigation and management measures the residual impacts will be **INSIGNIFICANT**.

- ***Attraction of pests and propagation of invasive species***

Solid waste and sewage wastewater mismanagement may result in the presence of water and the growth of marginal vegetation, which may in turn attracts pests (such as insects and rodents) and alien species to the area (such as feral dogs and cats). Pests may be disease vectors while feral dogs and cats may compete with native fauna for food resources.

The development will require large amounts of water during the construction phase, resulting in significant quantities of sewage and wastewater. Therefore, if mismanaged, the potential presence of water and the growth of marginal vegetation in a desert environment might also attracts several birds, including species typical to the mesic habitats of the Nile Valley<sup>29</sup>.

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<sup>29</sup> The wastewater treatment plant, located close to the northwestern borders of the Project Site, provides a good example of habitat modification of a hyper-arid desert environment due to anthropogenic activities. This treatment plant has created a "wet" modified environment within the desert habitat, resulting in the growth of



If properly managed, this risk is **slight** in intensity, of short term and at the *study area* level. The magnitude is considered SMALL as this is not a continuous and persistent impact and with a low probability of occurrence. Given the Low ecological value of the site, this impact is deemed **INSIGNIFICANT**.

#### Mitigation Measures

Mitigation measures will mainly include the following:

- Develop, implement and update a solid waste, hazardous waste and wastewater management plan to include waste collection, storage, transport and disposal in an environmentally sustainable manner to avoid attraction of vermin and the potential consumption of waste from desert species;
- Ensure that food storage areas are inaccessible to animals;
- Ensure proper housekeeping practices; and
- Provide awareness to the workers on the negative impacts of improper solid waste and wastewater disposal.

#### Residual risks and Impacts

With the proper implementation of mitigation measures, the residual impact will remain **INSIGNIFICANT**.

### **C. Impacts on Socio economic Environment**

#### • **Water Resources**

During the construction phase, the site will require 97 m<sup>3</sup>/day of potable water for various purposes, excluding drinking water for workers, which will be supplied separately. Water trucks will transport water from nearby water treatment plants to the site. The project's water consumption is minimal compared to the water plant capacity, resulting in limited impact.

In addition, workers camp will be constructed at site, with an estimated water demand of 50 liters per person per day.

The impact is slight, *localized*, and short-term. Impacts of the construction phase on the social environment are thus considered of **SMALL** magnitude, and the sensitivity of the receptors is LOW.

Therefore, the overall significance of the impact is assessed as **INSIGNIFICANT**.

#### Mitigation measures:

A water management plan will be developed.

#### Residual Impacts

By implementing the above mitigation measures, the residual impacts of the construction activities on the social environment will be **INSIGNIFICANT**.

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several plant communities, extending southwards. This area also attracts several birds, including species typical to the mesic habitats of the Nile Valley. In addition, several rodent burrows were noticed within these areas of vegetation.

- **Worker Influx**

The influx of workers can strain local resources such as water, food, and housing, potentially leading to shortages and increased prices for local communities. Workers' influx may result in raising apartment rents in the communities closest to the project which are relatively limited in size. This, however, does not apply to larger urban centers at commuting distance, such as Nagaa Hammadi and Qena, especially since the non-local worker influx will not be significant, as these will be small relative to the size of these communities, and that these centers normally receive out of town persons for various periods of time.

Additionally, the increased number of workers can result in higher volumes of waste, including solid waste and sewage, which can impact local sanitation and health. The arrival of a large workforce including speculative job seekers can also disrupt local communities, leading to potential conflicts, changes in social dynamics, and increased pressure on local services. Furthermore, construction activities and the increased human presence can lead to habitat destruction, soil erosion, and pollution if not properly managed.

The hiring policy entails maximizing utilization of local employment, while higher qualifications, potentially not available locally, will be sought from outside the surrounding communities. No housing of workers will take place in the neighbouring communities, specifically El Baraka village. Contractors will be encouraged to continuously increase the percentage of local content.

This approach and arrangements concerning worker influx makes the disruption of social norms highly unlikely and the limited size of non-local workers interacting with the communities would not be in a position to challenge the local context, culture and norms and traditions in Upper Egypt. Accordingly, Gender-Based Violence (GBV) and Sexual Harassment, should they take place, will be individual occurrences, and not trends created by the project.

Nevertheless, the EPC Contractors will be required to prepare labour management plans to be implemented for the construction phase of the project as well as development of a code of conduct for workers that takes into account the appropriate behaviour of workers at all times, religious customs and practices, traditional cultures and social norms of the region. In addition, it will include specific requirements regarding social issues, including violence, exploitation, sexual abuse and harassment.

In this context, the impact during construction is **MINOR**, and short-term. Impacts are thus considered of **SMALL** magnitude.

Therefore, the overall significance of the impact is assessed as **MINOR**.

#### Mitigation measures

- Prioritize hiring local workers not only to increase benefits to local communities, but also to reduce the number of incoming workers and minimize social disruption.
- Prohibit "hiring at the door" to control speculative job seekers. Job advertisement and applications receipt will be through the governorate labour office.
- Provide adequate accommodation facilities for workers to prevent overburdening local infrastructure.

- Implement comprehensive waste management plans to handle the increased waste generation, including recycling and proper disposal methods.
- Ensure that women and youth have opportunities for business such as supplier of construction of materials.

#### Residual impacts

By implementing the above mitigation measures, the residual impacts of the construction activities on the social environment will be **INSIGNIFICANT**.

- **Impact of site security**

For security measures, the project will assign an annually contracted security company to provide security services for the site premises. The security company will provide security guards on site, exchanging shifts. The presence of guards may have a negative impact on the community if not properly trained, equipped and monitored.

#### Mitigation measures

The security personnel will be adequately trained, have appropriate conduct toward workers and community and to act within the applicable law. Furthermore, a grievance mechanism will be developed to allow the potentially affected community to express concerns about the security arrangements and acts of security personnel.

#### Residual impacts

By implementing the above mitigation measures, the residual impacts will be **INSIGNIFICANT**.

### **D. Impacts on infrastructure**

- **Impacts on land use**

Large scale PV facilities can raise concerns about land uptake. Concerning the subject project, it will be located in a desert and unoccupied land, which is allocated by NREA for solar energy power generation. No land ownership claims, or other types of land uses exist at the project site. This was confirmed during stakeholders' meetings with local government representatives and nearby land uses and no risks are perceived with regards to potential land ownership.

Accordingly, this impact is deemed **INSIGNIFICANT**.

- **Traffic**

Trucks of various sizes will be required for transportation of the project's components distributed throughout its construction period, of about 15 months, with varying intensities. The main road leading to the site, the Giza- Luxor road, is a double lane road accommodating different types of transport means and services provided to the industrial area adjacent to the project, the Aluminium company north of the proposed project site as well as other undergoing infrastructure projects.

The risk is **MEDIUM**, *localized*, and short-term. Impacts of the construction phase on the traffic are thus considered of **MEDIUM** magnitude, and the sensitivity of the receptors is **MODERATE**.

Therefore, the overall significance of the risk is assessed as **MODERATE**.

#### Mitigation Measures

Dandra shall develop Transportation Management Procedures which applies to Dandra projects and operations as well as their contractors and subcontractors. The procedure defines the minimum safety requirements for Dandra's transportation activities. The requirements are supplementary to national regulatory specifications and project or business unit specifications and/or insurance requirements. Moreover, timing of transportation will be coordinated with the traffic department to avoid as much as possible problematic routes/segments and specific times of the day with high traffic volumes.

#### Residual impacts

With implementation of the traffic policy and management procedures, the residual impacts expected to be **MINOR**.

#### **E. Occupational health and safety**

Safety hazards are potential during construction due to;

- Accidents involving heavy machinery such as excavators, and pile drivers and physical injuries during the ramming activities.
- Electrocuting or electrical fires from improper handling of electrical equipment and installations.
- Exposure to hazardous chemicals such as fuels, solvents, and cleaning agents.
- Injuries from lifting, carrying, or moving heavy materials.
- Fires from flammable materials, electrical faults, or hot work activities.
- Heat exhaustion or heat stroke from working in high temperatures.

These risks are short-term, *localized*, and **moderate**. Accordingly, the magnitude of the risk is considered MEDIUM.

Based on the above, the overall significance of the risk is considered **MODERATE**.

#### Mitigation Measures

The following mitigation measures will be carried out to protect the health and occupational safety of workers:

- The excavation sites will be surrounded with warning signs to prohibit access to these places;
- Contractors will ensure that construction workers will be continuously supervised, through the continuous presence of on-site supervisor(s)
- Ensure proper training for operators, regular maintenance of equipment, and implementation of safety protocols.
- Use of personal protective equipment (PPE), proper storage and labelling of chemicals, and training on handling hazardous materials.
- Provide hearing protection, implement noise control measures, and schedule regular breaks for workers.
- Provide training on proper lifting techniques, and the use of mechanical aids, and encourage team lifting for heavy loads.
- Implement fire prevention measures, maintain fire extinguishers on-site, and conduct fire

safety training.

- Provide adequate hydration, schedule work during cooler parts of the day, and allow for regular breaks in shaded areas.
- Restrict vehicles speed so that they do not exceed the safety limit inside the site premises (15-20 km/h)
- All equipment will be inspected before the start of the job to ensure the safety of the workers.

#### Residual risks

The above mitigation measures are expected to be efficient in minimizing the potential impacts. Therefore, the residual impacts of the construction activities of the proposed project on the health and safety of workers are deemed to be **MINOR**.

#### **F. Impact on Cultural Heritage**

Based on Chapter 4 of this Environmental Impact Assessment report, there are no registered antiquities or cultural heritage sites within the project site based on the Egyptian Archeological Map (2022) and the UNESCO World Heritage List of Egypt. As described in section 4 above, the nearest cultural heritage area is at approximately 8 km from the project site. In this respect, the potential risk on these cultural heritage sites is **INSIGNIFICANT**.

As the area is surrounded by well-studied ancient, critical and irreplaceable cultural heritage of global importance, this might be seen to indicate a high likelihood of so far undiscovered buried sites. However, ancient Egyptians avoided building permanent structures in flood paths. For example, at sites like Deir el-Bahari and Valley of the Kings, the structures are positioned above or outside potentially flooded areas. This is not the case of the project site (see section 4).

Nevertheless, chance find procedures are to be developed to indicate the actions to be taken in case of any unlikely finds during excavations.

#### Mitigation Measures

- Develop and implement Chance Find Procedure indicating the actions to be taken in case of any significant findings during site leveling and construction activities.

#### Residual Impacts

By applying the Chance Find Procedure the residual impacts of construction activities on cultural heritage are expected to be **INSIGNIFICANT**.

#### **G. Contribution to Climate Change**

GHG emissions from onsite equipment usage have not been fully investigated despite their relatively reduction potential worldwide. A study<sup>30</sup> estimated the GHG emissions from onsite equipment usage for different activities according to equipment productivity related to site conditions of good, fair, and poor within expected ranges of such emissions. For the major

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<sup>30</sup> Greenhouse Gas Emissions from Onsite Equipment Usage in Road Construction, August 2012  
[Journal of Construction Engineering and Management](https://www.researchgate.net/publication/273432700_Greenhouse_Gas_Emissions_from_Onsite_Equipment_Usage_in_Road_Construction) 138(8):982-990,  
[https://www.researchgate.net/publication/273432700\\_Greenhouse\\_Gas\\_Emissions\\_from\\_Onsite\\_Equipment\\_Usage\\_in\\_Road\\_Construction](https://www.researchgate.net/publication/273432700_Greenhouse_Gas_Emissions_from_Onsite_Equipment_Usage_in_Road_Construction)

activities that produced most of the GHG emissions from onsite equipment, the value was estimated to be in the range of 256.52-376.70 tCO<sub>2</sub>eq, with 282.17 tCO<sub>2</sub>eq for fair site conditions.

In addition, photovoltaic systems, or solar panels, offer a significantly cleaner energy source compared to traditional fossil fuel plants. While the life cycle assessment (LCA) carbon footprint of PV systems can vary between 14 and 73 grams<sup>31</sup> of CO<sub>2</sub> equivalent per kilowatt-hour of electricity generated, it's still substantially lower than the 742 grams emitted by fuel-based power generation. This low environmental impact can be further reduced by employing innovative materials and manufacturing processes, potentially decreasing the carbon footprint by an additional order of magnitude<sup>32</sup>.

As per the EBRD Environmental and Social Policy (October 2024), projects meeting either of the following criteria will quantify their GHG emissions using the EBRD Protocol for Assessment of GHG Emissions:

- Projects with (or expected to have) gross annual emissions exceeding 100,000 tonnes of CO<sub>2</sub>-equivalent.
- Projects anticipated to cause a net change in emissions (positive or negative) of more than 25,000 tonnes of CO<sub>2</sub>-equivalent annually post-investment.

The projects that have or are expected to have gross emissions exceeding 100,000 tonnes of CO<sub>2</sub>-equivalent annually need to quantify and report these emissions using the EBRD Protocol for Assessment of GHG Emissions.

Accordingly, the proposed project's emissions during construction phase are relatively short term and expected to be much below this threshold.

Table 32 shows the risk and impact assessment matrix for the construction phase.

<sup>31</sup> Tawalbeh, M., Al-Othman, A., Kafiah, F., Abdelsalam, E., Almomani, F., & Alkasrawi, M. (2021). Environmental impacts of solar photovoltaic systems: A critical review of recent progress and future outlook. *Science of The Total Environment*, 759, 143528. <https://doi.org/10.1016/j.scitotenv.2020.143528>  
<https://www.sciencedirect.com/science/article/abs/pii/S0048969720370595>

<sup>32</sup> <https://www.sciencedirect.com/science/article/abs/pii/S0048969720370595>



Table 32: The Impact Assessment Matrix for the Construction Phase

Impacts/Risks		Without Mitigation					Significance of Residual Impacts after Mitigation	
		Temporal scale	Spatial Scale	Severity	Magnitude	Sensitivity / Vulnerability / Value of Resource / Receptor		Significance of Impact before Mitigation
PV project								
Construction Phase (15 months)								
Air Quality		Short term	Localized	Slight	Small	Medium	Minor	Insignificant
Ambient Noise		Short term	Localized	Moderate	Small	Medium	Minor	Insignificant
Soil		Short term	Localized	Moderate	Small	Medium	Minor	Insignificant
Biological Environment	Habitat loss, modification, and fragmentation	Permanent and irreversible	Study area	Moderate	Medium	Low	Minor	Minor to Insignificant
	Disturbance to wildlife	Short term	Study area	Moderate	Medium	Medium	Minor	Insignificant
	Attraction of pests and propagation of invasive species	Short term	Study area	Slight	Small	Low	Insignificant	Insignificant
Social Environment	Water resources	Short term	Localized	Slight	Small	Low	Insignificant	No Residual impacts
	Worker Influx	Short term	Localized	Moderate	Medium	Medium	Moderate	Minor
Infrastructure	Land use	Short term	Localized	Slight	Small	Low	Insignificant	No Residual impacts
	Traffic			Moderate	Medium	Medium	Moderate	Minor
Occupational Health and Safety		Short term	Localized	Moderate	Medium	Medium	Moderate	Minor
Site Security		Short term	Localized	Moderate	Medium	Medium	Moderate	Minor
Impact on Cultural Heritage		Short term	Localized	Slight	Small	High	Insignificant	No Residual impacts

### 6.3.2 Potential risks and impacts during the Operation Phase

#### A. Potential risks and impact on the Physical Environment

- **Potential Impacts on Ambient Air Quality**

Potential impacts on local air quality from the Project include emissions from the use of backup generators during power outages or maintenance activities, and potential emissions of SF6, if utilized for insulation of the switchgear. SF6, a GHG, is the most used insulation material in medium and high voltage systems.

In this respect, SF6 containing equipment is designed to avoid emitting any of this gas into the atmosphere mainly during maintenance and servicing, and de-commissioning. However, although small amounts of SF6 may escape to the atmosphere these could be controlled through cost-effective operational improvements and equipment upgrades. No GHG will result in case of using air insulation systems.

These impacts are short term, and *localized*, with a small air quality impact (**severity is slight**), the magnitude of the impact is considered SMALL. As the proposed project will be carried out within the western desert, the sensitivity of the receptors is **Low**.

Based on the above, the overall SIGNIFICANCE of the impact is considered **MINOR**.

#### Mitigation Measures

The company will ensure the following

- Optimize the operation of backup generators to reduce usage and emissions.
- Conduct annual stack emission measurements for the emergency generators
- If SF6 is used as insulator instead of air insulation, the mitigation measures will include leak detection and repair, use proper chambers vacuums during filling the SF6 into the GIS, and employee education/training.

#### Residual Impacts

The above mitigation measures are expected to efficiently minimize the potential impacts. Therefore, the residual impacts of the operation activities of the proposed project on the health and safety of workers are deemed to be **INSIGNIFICANT**.

- **Potential Impacts on Ambient/Workplace Noise & Vibration**

Potential impacts on ambient noise from the Project include the following;

- Operation of Transformers and other operational components of battery energy storage systems.
- Use of backup generators during power outages.

Table 33 below shows the expected noise levels from different Instrumentation in the workplace

**Table 33: Expected noise levels from different Instrumentation in the workplace**

Noise source	Noise level (dB(A))	Location
Invertors	75dB	Inside the inverter room
Transformer	64dB	Outside transformer room

*\*At 10m from the source*

These impacts are localized and slight. The magnitude of the impact is considered SMALL. Since the proposed project will be conducted on vacant land in the Western Desert, the sensitivity of the receptors is medium-low.

Based on this assessment, the overall significance of the impact is considered **MINOR TO INSIGNIFICANT**.

#### Mitigation Measures

- Potential noise-generating machines and equipment are designed to meet statutory regulations concerning noise.
- Workers at noise generating machinery and equipment will be provided with suitable personal protective equipment (PPEs).

#### Residual Impacts

Residual noise during operational activities is unlikely to have an impact on the public. Furthermore, the impact of noise on the workplace will be **INSIGNIFICANT** when implementing the above mitigations measures and health and safety procedures.

### **B. Potential risk on Biodiversity**

#### • *Disturbance to wildlife (excluding avifauna)*

There will be no air emissions, noise and vibrations arising from machineries during operation, while the human presence will be limited to about 100 persons. Moreover, during this phase, the potential occurrence of fauna onsite will be further reduced due to its modified and fragmented status. On the other hand, the presence of waste left by onsite personnel might attract opportunistic species.

These risks are *slight* in intensity, of long term and at the *study area* level. Their magnitude is considered MEDIUM. Given the Low vulnerability of the receptors, these risks are deemed **MINOR**.

#### Mitigation Measures

Mitigation measures will mainly include the following:

- Develop, implement and update a solid waste, hazardous waste and wastewater management plan to include waste collection, storage, transport and disposal in an environmentally sustainable manner to avoid the growth of marginal vegetation, attraction of vermin and opportunistic species and the potential consumption of waste from desert species;
- Provide awareness to the workers on the negative impacts of disturbing any wild fauna;
- Ensure proper housekeeping practice;
- Ensure that food storage areas are inaccessible to animals;
- Avoid high intensity light that may disturb offsite fauna;
- Ensure speed control and the prohibition of off-track driving;
- Ensure the proper maintenance of equipment and any other equipment with high noise and vibration potential;
- Ensure that the generators are properly insulated to avoid noise emissions; and
- Ensure that workers do not disturb native fauna potentially encountered.

#### Residual Impacts

With the proper implementation of the mitigation and management measures the impacts on biodiversity are deemed to be **INSIGNIFICANT**.

- **Risks and Impacts on Avifauna**

**Lake effect**

The smooth and uniform appearance of PV solar plants similar to a sheet of water, as they reflect light like a lake or a pond, are said to attract birds. This might be particularly relevant in a desert environment where the "lake effect" would be most intense. While there is no strong evidence of solar PV facilities having a "lake effect" impact on birds, this potential impact is herein considered, using the precautionary approach.

The potential lake effect for PV panels with tracking system is very low as this will happen only during a short portion of the day. Yet, there has been no sufficient evidence that PV is reflective surface to be mistaken by lake surfaces to attract birds<sup>33</sup>. Moreover, PV cells will have a double-sided anti-reflection film and aluminum frame for higher the visibility to birds.

**Collision risk****PV panels**

There are 16 migratory soaring birds likely to cross over the project area. Typically, for a single-axis horizontal tracking system (1p - single row system), the height can range up to approximately 2.8 meters above ground level; and O&M building structures shall not exceed 5 meters in height. Moreover, it is not expected to have birds roosting and perching on the photovoltaic panels.

In addition, as previously explained in the Baseline Section, there is no relationship between the airspace utilized by avifauna and the terrestrial area of the site, which lacks features potentially attracting avifauna to rest or forage. Accordingly, avifauna will avoid flying over or landing in the area due to its harsh conditions, except under rare and specific circumstances.

**OHTL**

Transmission lines present physical barriers to bird movement potentially resulting in collision risks especially in low-visibility conditions. Collision mostly takes place with the thinner and less visible ground wires. Larger, heavier species are more prone to collisions as a result of limited maneuverability.

The E&S aspect is long term, localized. Despite the low intensity of such birds in the project's area and the limited length of the OHTL (about 1 km and 2.7 km of the external and internal OHTLs respectively), some of those are of conservation importance, the risk on migratory birds is **MODERATE**.

**Mitigation measures**

Measures to reduce the risk of collision include:

- Install bird deterrents on the transmission lines at specific intervals along the transmission line, for both the internal OHTL as well as the OHTL connecting to the Nagaa Hammadi industrial area substation.
- Periodic carcass recording would take place to assess the effectiveness of the proposed mitigation measures.

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<sup>33</sup> Guidelines to minimize the impact on birds of Solar Facilities and Associated Infrastructure in South Africa. Smit, Hanneline A., BirdLife South Africa, 2012

- Implement good housekeeping and waste/wastewater management to avoid the presence of water and the growth of marginal vegetation that would make the site “attractive” to birds.

#### Residual impacts

With the implementation of the mitigation measures, the residual impacts will be **MINOR**.

#### **Electrocution risk**

The project substation located within the project footprint and thus might pose an electrocution risk for avifauna where the transmission line grid connects to the substation. Even if the risk is not high, the consequence of a single fatality is high, particularly on threatened birds (such as the Egyptian Vulture).

In addition, electrocution may occur by contact between the OHTL conductor and an earthed metallic structure (either the crossarm or an earth wire) but can also occur by contact between two conductors. Large birds with extensive wingspans are more vulnerable as they have a higher likelihood of making contact with conductors when perched and opening wings. Despite the low intensity of such birds in the project’s area, some as those are of conservation importance.

These impacts of long term and at the *study area* level and precautionarily considered **moderate** in intensity despite their low probability of occurrence. Their magnitude is considered MEDIUM. Given the potential occurrence of some threatened species, receptors are considered of Medium value. Accordingly, potential impacts on avifauna are deemed of **MODERATE** significance.

#### Mitigation Measures

To reduce the risks of electrocution, anti-perching devices will be implemented, as follows:

- Increase the number of insulators where conductors connect to each pylon, using insulators that prevent birds from landing on them and forcing birds to perch on crossarms only.
- Cover the crossarms of pylons with insulating materials such as PVC strips to ensure that birds are not earthed when perched; feasibility of this method will depend on pylon design.
- If insulating crossarms is not feasible due to pylon design, then crossarms need to either be designed to deter perching or to provide elevated perches above crossarms and conductors should be insulated at contact points with pylons.

#### Residual Impacts

With the proper implementation of the mitigation measures, impacts on avifauna are expected to be **MINOR to INSIGNIFICANT**.

### **C. Risks and Impacts on Social Environment**

#### • **Water Resources**

During the operation phase, water will mainly be required for sanitary purposes, as a dry-cleaning method will be used for regular cleaning of PV modules. As there will be only 100 workers present during the operation; the daily water demand and wastewater generation will be limited.

Accordingly, the impact of water consumption is localized, and long-term. The severity is slight and the Impacts of the operation phase on the social environment are thus considered of **SMALL** magnitude, and the sensitivity of the receptors is LOW.

Therefore, the overall significance of the impact is assessed as **INSIGNIFICANT**.

Mitigation measures:

Given the limited water consumption and wastewater generation, the wastewater produced during the operation phase will be collected by a contractor licensed by a competent authority and discharged to designated/approved treatment plants. No mitigation measures have been suggested for water consumption.

- **Waste generation**

- **Non-Hazardous Solid Waste**

- Collect waste at designated collection points and store it in appropriate containers following regulations.
    - Use licensed contractors for the collection and disposal of non-hazardous waste.

- **Hazardous Waste**

- Establish marked and physically separated storage areas for hazardous waste.
    - Use licensed contractors for the collection and disposal of hazardous waste.
    - Waste lithium batteries at their end of life (and damaged PV modules) will be returned to the suppliers or sent to competent and authorized facilities conducting sustainable recycling strategies. The most sustainable option is selected upon approach of batteries' end of life, i.e. in 19 years, when li-ion recycling technologies are matured, developed, and economically viable.

- **Visual Impacts**

The northern boundaries of the project are close to the Giza – Luxor Road that is scarcely used and has no specific visual character or vistas. It is also next to an evolving industrial area, whose plots are incrementally being constructed.

Accordingly, the Visual effects are **INSIGNIFICANT**.

- **Glint and Glare**

Solar photovoltaic (PV) modules are specifically designed to maximize light absorption and convert sunlight into electricity, making reflection fundamentally contrary to their intended function. Modern PV panels typically reflect no more than 2% of incoming sunlight, owing to their dark-coloured, anti-reflective glass surfaces. Although the panel glass is smooth and can, under rare conditions, produce a brief mirror-like reflection similar to that of calm water, such occurrences are highly limited and short-lived, especially in systems equipped with solar tracking mechanisms that continuously adjust panel orientation throughout the day to optimize solar exposure.

Within this context, and as part of the ESIA for the Dandara Solar Power Project, Environics conducted a comprehensive glare assessment to evaluate whether these minimal reflections could pose any visual or ocular risks to nearby receptors such as drivers on adjacent roads or people in surrounding open areas. The study aimed to determine the likelihood, duration, and intensity of potential glare events, assess their possible impact on human vision and safety,



and identify whether any preventive or corrective measures might be required under the project's current design and operational configuration. To achieve this, the analysis incorporated physical equations and mathematical modelling techniques to quantify the intensity of potential solar glare and its visual impact on observers, ensuring that appropriate mitigation measures could be defined if necessary. The complete glare assessment methodology, results, and technical details are presented in Annex 3 of this report.

The analysis relied on a scientifically based modelling approach that combined mathematical and analytical simulations developed internally by the Environics technical team. The models replicate the principles of the Solar Glare Hazard Analysis Tool (SGHAT) and were implemented using Python and ArcGIS Pro, allowing the integration of solar geometry, site-specific data, and system configurations to simulate the behaviour of sunlight reflections throughout the year. The modelling covered a full calendar year from January to December 2025, considering both summer and winter seasons, with simulation hours extending from 8:00 a.m. to 5:00 p.m. in summer and from 9:00 a.m. to 4:00 p.m. in winter.

The system was modelled as a single-axis tracking configuration with rotation angles ranging between  $-55^{\circ}$  and  $+55^{\circ}$ , panel offset of  $35^{\circ}$ , and elevation of approximately 2.8 meters. The glass surfaces were modelled as light-textured with anti-reflective coatings, resulting in a reflection dispersion of about  $\pm 3.4^{\circ}$  from the centreline of reflection.

The analysis considered all surrounding directions of the project site to identify the area's most likely to be affected by potential solar glare, as follows:

- North: This area includes the Giza–Aswan Road. No observation points were selected in this direction because the solar position remains predominantly oriented toward the south throughout the entire year, and the PV arrays are tilted southward to maximize energy capture. As a result, no reflected rays are expected to reach observers located to the north of the project site.
- South: The area south of the project site is largely vacant desert land with no human activity or visual receptors; therefore, no potential glare impact is expected.
- East: The eastern side is also composed mainly of open, undeveloped land, and given that sunlight originates from the east during morning hours while the panels face eastward to capture it, reflected rays are directed upward rather than horizontally. As a result, no significant glare can occur in this direction.
- West: This direction includes the Luxor Road, a primary traffic route with regular vehicle movement and occasional human presence. This area is the most probable to experience potential glare events from reflected sunlight. Consequently, five observation points were selected along Luxor Road to represent typical viewing positions for road users and nearby observers. These points were analysed based on their geographic coordinates, elevation, and distance from the photovoltaic field to determine whether reflected sunlight from the PV panels could reach them during any time of the year.

Figure 54 below illustrates the project site along with the locations of the observer points.

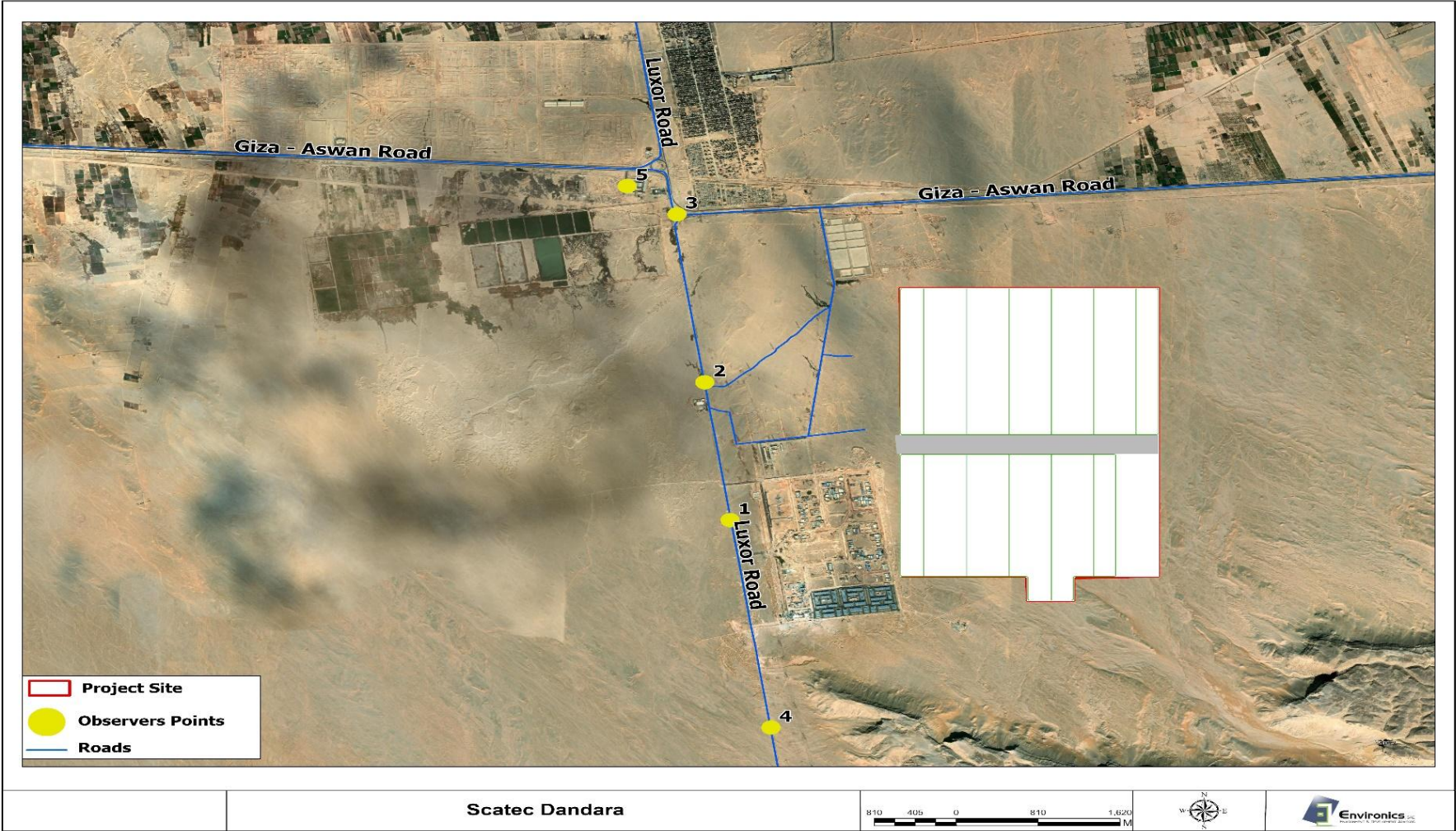


Figure 54: Observation points for glare assessment

The modelling demonstrated that no solar glare is expected to occur at any time of the year for any of the five observation points. Throughout the simulation, the calculated angular difference between the reflected rays and the observers' line of sight was consistently larger than the angular width of the reflected light cone (3.4°), confirming that no direct reflections would reach the observers. Representative samples taken during different seasons and times of day supported this finding, showing large angular margins that eliminate the possibility of glare events.

The following table presents selected observer values, representing a subset of the data extracted from the model.

**Table 34: Summary of Glare Assessment Results**  
Showing Glare Likelihood, Angles Between Observers and Reflected Rays, PV Rotation Angles, and Corresponding Observation Times for Winter and Summer Evaluation Dates

Day	Hour	PV rotation angle	Angle between observer and reflected ray					Glare likelihood
			Obs <sub>1</sub>	Obs <sub>2</sub>	Obs <sub>3</sub>	Obs <sub>4</sub>	Obs <sub>5</sub>	
1/1/2025	9:00 AM	46.88	139.10	134.34	144.42	82.72	144.15	No Glare
	10:00 AM	34.89	138.20	130.93	151.5	71.47	149.49	No Glare
	11:00 AM	19.78	128.43	119.81	147.94	56.71	144.06	No Glare
	12:00 PM	-2.15	108.72	99.65	130.36	36.52	125.83	No Glare
	1:00 PM	-15.79	95.79	86.80	117.47	27.05	112.91	No Glare
	2:00 PM	-31.61	81.40	72.88	102.33	25.78	97.89	No Glare
	3:00 PM	-44.31	71.85	64.36	90.98	35.28	86.86	No Glare
	4:00 PM	-54.218	67.92	62.02	83.98	47.65	80.41	No Glare
7/10/2025	10:00 AM	54.41	156.89	150.49	159.4	88.62	160.84	No Glare
	11:00 AM	38.37	148.96	139.69	169.06	72.78	165.48	No Glare
	12:00 PM	15.55	127.27	117.59	150.38	49.81	145.53	No Glare
	1:00 PM	-11.65	100.10	90.42	123.25	22.68	118.39	No Glare
	2:00 PM	-35.45	76.53	66.99	99.48	8.26	94.65	No Glare
	3:00 PM	-52.40	61.17	52.28	83.13	25.09	78.46	No Glare

The absence of glare can be attributed to several factors. The photovoltaic panels are designed to absorb sunlight rather than reflect it and are equipped with anti-reflective coatings that significantly reduce specular reflection. The single-axis tracking system restricts the rotation of panels within a defined range, preventing alignment with observer sightlines at critical times. Additionally, the relative elevations of the observers and the panels, combined with the long distances separating them - often exceeding two kilometres - further reduce the likelihood of any direct sunlight reflection toward sensitive receptors.

Consequently, the study concludes that the Dandra Solar Power Project does not pose a solar glare risk to surrounding areas, including nearby roads and open spaces. No visual or ocular hazards are expected under the current system design and operational parameters. Therefore, no additional mitigation measures are required beyond standard operational and maintenance practices, such as ensuring the cleanliness of panels and maintaining their anti-reflective coatings.

Based on the above, the potential glint and glare is **INSIGNIFICANT**.

#### D. Occupational Health and Safety

Impacts on workplace during operation are relevant when considering replacement of modules, converters, transformers etc. However, the probability of replacement of these units is considered as minor due to their expected lifetime.

These impacts are considered **long-term** (throughout the project's operation, the severity is **slight**). Thus, the magnitude of impacts is deemed **Small**. Therefore, the significance of impacts on occupational health and safety (sensitivity of the receptor is **low**) is deemed **INSIGNIFICANT**.

##### Mitigation measures

- A health and safety policy will be applied;
- Abide by all national occupational health and safety regulations; Labour Law 12/2003; and
- Provision of suitable PPE.

##### Residual impacts

By implementing the above mitigation measures, no residual impacts are anticipated.

#### E. Impact of site security

For security measures, the project will assign an annually contracted security company to provide security services for the site premises. The security company will provide security guards on site, exchanging shifts. The presence of guards may have a negative impact on the community if not properly trained, equipped and monitored.

##### Mitigation measures

The security personnel will be adequately trained, have appropriate conduct toward workers and community and to act within the applicable law. Furthermore, a grievance mechanism will be developed to allow the potentially affected community to express concerns about the security arrangements and acts of security personnel.

##### Residual impacts

By implementing the above mitigation measures, the residual impacts will be **INSIGNIFICANT**.

Table 35 shows the impact assessment matrix for the operation phase.

#### 6.3.3 Potential Impacts during decommissioning

The anticipated impacts during the decommissioning phase are similar to the impacts assessed during the construction phase – and specifically in impacts related to soil and groundwater (from potential improper management of waste streams), air quality and noise, and occupational health and safety. The mitigation measures for the potential impacts during decommissioning are also similar specifically related to proper management and disposal of non-hazardous and the hazardous waste. Therefore, the assessment of impacts for those receptors and mitigation identified during the construction phase is assumed to apply to this phase in particular without the need to reiterate.

Table 35: The Risk and Impact Assessment Matrix for the Operation Phase

Impacts/Riks		Without Mitigation					Level of Residual Impacts after Mitigation	
		Temporal scale	Spatial Scale	Severity	Magnitude	Sensitivity / Vulnerability / Value of Resource / Receptor		Level of Impact Before Mitigation
Operation Phase								
PV project								
Air Quality		Long term	Localized	Slight	Small	Low	Minor	Insignificant
Ambient Noise and Vibration		Long term	Localized	Slight	Small	Low	Minor	Insignificant
Biodiversity	Disturbance to wildlife (excluding avifauna)	Long term	Study area	Slight	Medium	Low	Minor	Insignificant
	Impacts on Avifauna	Long term	Study area	Moderately severe	Medium	Medium	Moderate	Minor to Insignificant
	Attraction of pests and propagation of invasive species	Long term	Study area	Slight	Small	Low	Insignificant	Insignificant
Social Environment (Water resource, Waste generation, Visual impacts, Glare & Glint)		Long term	Localized	Slight	Small	Low	Insignificant	No Residual Impact
Occupational Health and Safety		Long term	Localized	Slight	Small	Low	Insignificant	No Residual Impact
Site Security		Long term	Localized	Moderate	Medium	Moderate	Moderate	Minor



## 6.4 Risks and Impacts of the Environment on the project

- **Potential Impact of Dust and Sand**

The project area is subject to the dust and sand dynamics to which the narrow land strip of the Nile Valley in Upper Egypt is normally exposed.

### Haze

The frequent haze in **February**, with slower winds carrying fine particles, can reduce solar panel efficiency by **scattering and absorbing sunlight**. While the winds are light, the persistent nature of haze could lead to a gradual accumulation of particles on panel surfaces, requiring regular cleaning to maintain performance.

### Sand Rising

**High-speed winds (>5 m/s)**, especially in **March**, can carry larger sand particles, causing **abrasion and physical damage** to solar panels. The northwest direction of these winds means panels facing or exposed to this direction are more at risk. In the specific case at hand, panels are partially exposed when they are tilted to the west in the afternoon. Additionally, sand can accumulate on the panels, which may reduce their efficiency and necessitate more frequent cleaning or protective measures.

### Dust Storm

During **dust storms** in **March**, moderate wind speeds (2-5 m/s) can lead to **dust accumulation** on solar panels, reducing efficiency by blocking sunlight. Dust storms may not cause as much physical damage as rising sand, but the accumulation of fine particles can require **frequent maintenance** and cleaning.

### Sand Storm

**Sand storms**, peaking in **March**, bring **very high-speed winds (>5 m/s)**, capable of causing significant **erosion and abrasion** of solar panels, particularly those facing the **west**. This can lead to long-term degradation in the panels' surface, impacting their energy output and lifespan. Protective measures like anti-abrasion coatings may be necessary in regions frequently exposed to sandstorms.

### Overall Impact

The combination of haze, raising sand, dust storms, and sandstorms, particularly in the late winter to early spring months, could reduce the efficiency of solar panels. To mitigate these effects, it is essential to implement frequent cleaning, protective coatings.

These impacts are long-term, and localized, with a moderate impact (Moderate), the magnitude of the impact is considered MEDIUM. As the proposed project will be carried out within a vacant land in the Western Desert, the sensitivity of the receptors is **MEDIUM**. Based on the above, the overall SIGNIFICANCE of the impact is considered **MODERATE**.

### Mitigation measures

Periodic module cleaning and maintenance will minimize the impact of deposited dust.



Moreover, with high wind carrying sand, the tilt to the west, which should in principle take place in the afternoon, might be reconsidered for a specific day to protect the PV modules.

#### Residual impact

With appropriate design materials and with implementing proper maintenance and cleaning procedures the impact of dust and sand will be minimized. Therefore, the residual impacts of the operation activities of the proposed project on soil quality are deemed to be **MINOR**.

#### • **Contextual Risks: Impact of Climate Change**

The project's location in Qena Governorate, characterized by extreme temperatures, variable rainfall, and a history of flash floods, necessitates careful consideration of climate change impacts.

#### **Potential Impact of Extreme Heat**

Climate change projections, as indicated in Egypt's Second National Communication to the UNFCCC, indicate a potential increase in the frequency and intensity of extreme heat events. This could pose challenges to both the construction and operation phases of the project. During the construction phase, Extreme heat can lead to the following.

- Heat stress for workers, reducing productivity and increasing the risk of heat-related illnesses.
- Adverse effects on the operation of machinery.
- During the Operation Phase, high temperatures can reduce the efficiency of solar panels and the battery energy storage system. As a result of these reduced efficiencies, there may be an increased need for cooling systems to maintain optimal operating conditions for both the solar panels and the battery energy storage system. This increased cooling requirement means higher energy consumption to power the cooling systems and can result in increased maintenance and potential wear and tear on equipment.

#### Mitigation Measures

##### A. Construction Phase:

- Implement heat stress management plans, including providing shaded rest areas, frequent water breaks, and adjusting work schedules to avoid peak heat hours.
- Provide training to workers on recognizing and preventing heat-related illnesses.
- Utilize appropriate construction materials and techniques that are resistant to high temperatures.

##### B. Operation Phase

- Employ cooling technologies for BESS to maintain optimal operating temperatures.
- Utilize advanced monitoring systems to track temperature and performance data, enabling proactive maintenance and adjustments.
- Develop contingency plans for extreme heat events, including potential temporary shutdowns or reduced operations.

#### Residual Impacts

With the implementation of these mitigation measures, the residual impacts of extreme heat are expected to be minimal. However, ongoing monitoring and adaptive management will be essential to ensure the project's resilience to the changing climate.

### **Potential impact of Flash Flood**

The field visit indicated that the site is generally flat and composed of a sandy soil mostly covered with small stones, with some scattered boulders. Accordingly, its sandy nature limits water accumulation and facilitates drainage.

A wadi located close to the southern borders of the Project Site and within Project usufruct land was inspected for signs of vegetation or vegetation remains, that might indicate the presence of water and the occurrence of flash floods. However, the site was found to be dry and totally devoid of vegetation, like the rest of the site.

Moreover, a hydrological study identified the potential risks of the floods from outside the project. The full study is included as Annex 1 of this ESIA. For modelling the potential flood impacts, the following models were used:

- GIS Environment (Arc-Hydro Tools, Spatial Analyst, etc.): to delineate the watersheds, estimate watershed characteristics and develop runoff coefficient maps.
- HEC-SSP software was used to conduct a frequency analysis for the collected rainfall data records.
- HEC-HMS (by USACE) and some developed in-house spreadsheets (MS Excel) are used to estimate the peak flow and to estimate the other hydrologic parameters whenever needed.
- Flow Master or Culvert Studio in the hydraulic design of the proposed protection works such as channels and dikes, and to determine the different hydraulics parameters.
- Civil 3D for developing corridors and surface of Existing and proposed structures.
- HEC-RAS 2D 6.3 (by USACE) in determining the floodplain boundaries of the main streams that affect the study area.

For estimating and calculating the peak flows and runoff hydrographs resulting from the catchment areas affecting the project boundary, the most common methods in Egypt (Rational Method) and (SCS Unit Hydrograph) were used.

Meteorological data were obtained from the Station (Qena) where the maximum recorded daily rainfall depth at Qena Station is 55.3 mm, which occurred in 1949.

Morphological studies and identification of streams and drainage basins affecting the boundaries of the study area were performed using the SRTM on ArcGIS software. Figure 55 shows the streams affecting the Usufruct area.

Table 36 below shows the morphological characteristics of the watersheds affecting the project boundaries.

**Table 36: The morphological characteristics of the watersheds affecting the project boundaries**

<b>Watershed Name</b>	<b>Area (km<sup>2</sup>)</b>	<b>LFP (m)</b>	<b>Time of concentration (min)</b>	<b>Lag time (min)</b>
Subbasin-1	1.94	5966	86	51
Subbasin-2	0.23	1643	36	21
Subbasin-3	0.93	3575	63	38
Subbasin-4	7.86	8328	95	57
Subbasin-5	0.35	2332	42	25
Subbasin-6	2.34	5623	62	37
Subbasin-7	0.22	1707	28	17
Subbasin-8	0.81	2682	34	20
Subbasin-9	0.25	1430	15	9

Watershed Name	Area (km2)	LFP (m)	Time of concentration (min)	Lag time (min)
Subbasin-10	1.03	2803	31	18
Subbasin-11	15.98	11367	140	84
Subbasin-12	0.45	2395	26	16
Subbasin-13	0.31	1955	22	13
Subbasin-14	0.60	2221	25	15
Subbasin-15	0.46	2437	29	18
Subbasin-16	1.34	3695	43	26

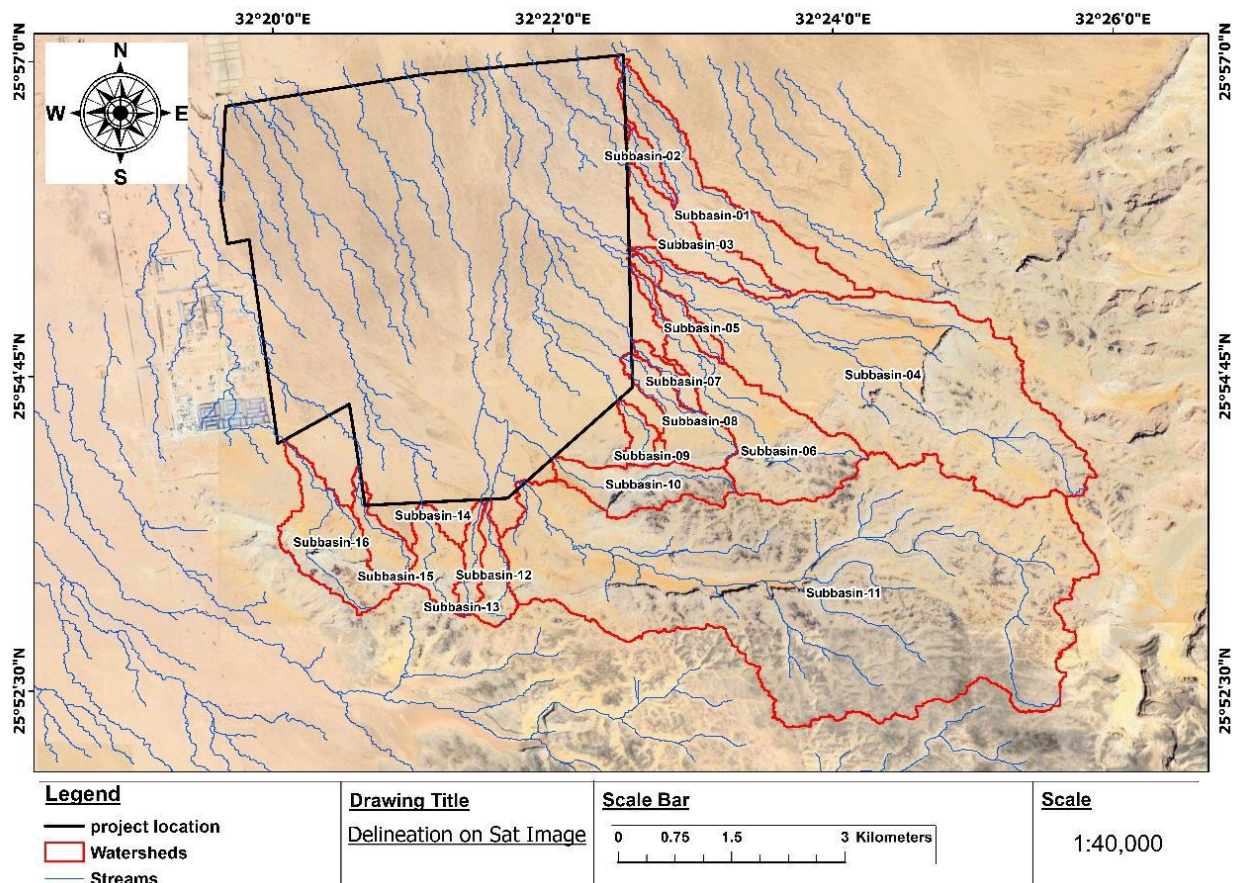


Figure 55: Streams affecting the Usufruct area

HEC-RAS 2D 6.3 software was used to build up a complete 2D hydrodynamic model to perform the flood inundation analysis required to identify the inundated locations which are subjected to the risk of flood hazards using the discharge hydrographs produced from the hydrological analysis.

- For low to moderate return periods (5, 10, and 25 years), no significant surface flow reaches the project boundary, confirming that the upstream catchments have limited runoff potential under typical storm conditions
- For extreme flood events (50 and 100 years), localized shallow flow accumulation is observed mainly along the natural drainage paths, with limited spatial extent and low hydraulic energy.
- For the extreme 200-year return period, the maximum simulated water depth and velocity at the project boundary are approximately 1.26 m and 1.6 m/s, respectively. These values

represent the upper bound of potential flood impacts under highly conservative rainfall assumptions.

In summary, the hydrological and hydrodynamic analyses confirm that:

- Local depressions play a key role in attenuating runoff and reducing flood peaks.
- The 200-year event represents the threshold for minor inundation at the project boundary.
- The site is generally safe from external flood hazards under realistic design conditions.
- Future design considerations should focus on avoiding localized low points and maintaining natural flow paths for effective surface drainage.

Figure 56 and Figure 57 show the Flood inundation and Water depth In Study Area and Risk Map of 100 year return period event based on DEFRA risk classification system

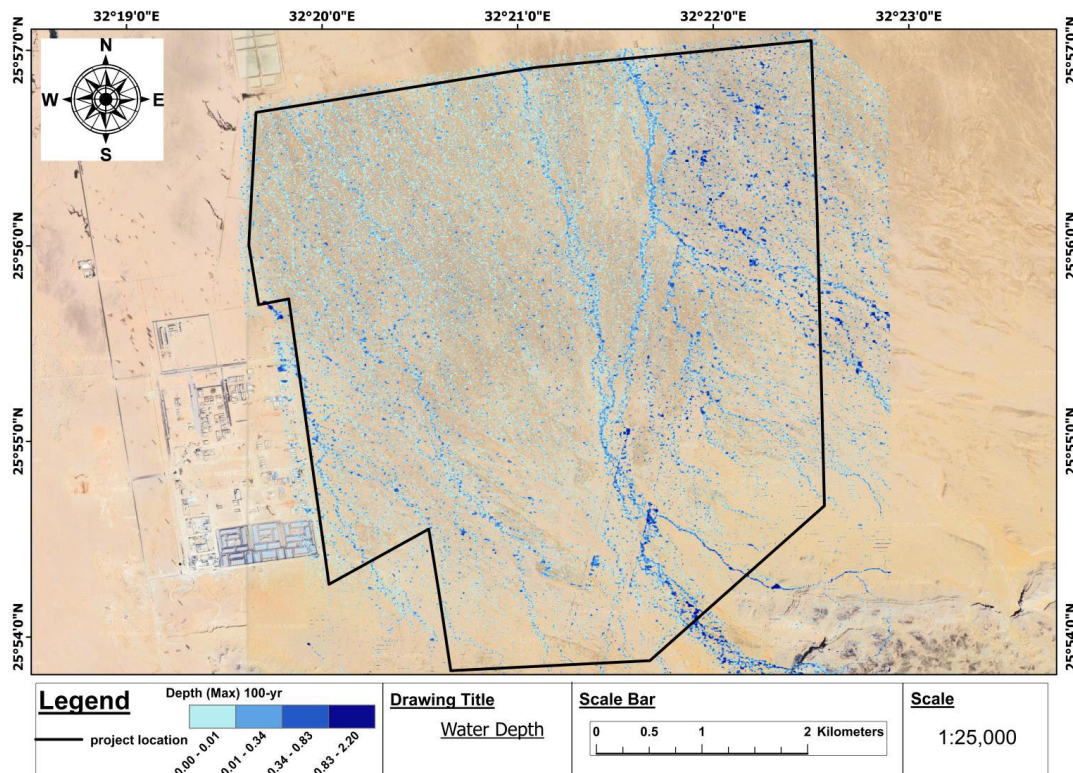


Figure 56 :Flood inundation and Water depth In Study Area



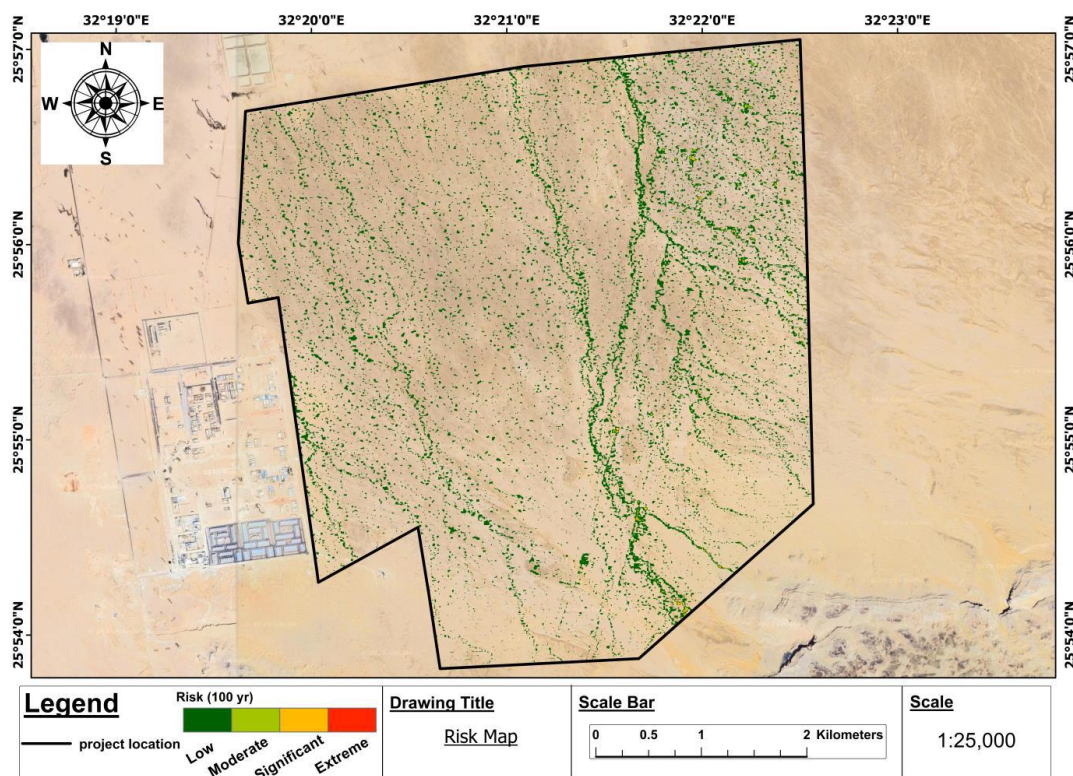


Figure 57: Risk Map of 100 year return period event

Based on the above the preliminary channel is designed to cater for sub-basins 11 and 6, providing protection for both Phase 1 and Phase 2 against those watersheds.

For Phase 2, a second channel will be implemented along the eastern fence of Phase 2 (the eastern boundary of the plot). This channel will protect against flows from sub-basin 4 and other inflows from the east. The second channel is not required at this stage for Phase 1 and is therefore not included in the current ESIA scope

The open channel will largely maintain the natural stream path and will not change the point of discharge. The outlet will be designed such that no change in the natural velocity occurs at the discharge point.

## 6.5 Cumulative Impacts

The IFC Performance Standard 1 emphasises addressing the cumulative impacts that are generally recognized as important on the basis of scientific concerns and/or concerns from affected communities. The methodology used to assess cumulative impacts is the same utilized to assess negative impacts.

According to the IFC “Good Practice Handbook Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets”, examples of cumulative impacts may include:

- Incremental contribution of gaseous emissions to an airshed;
- Reduction of water flows in a watershed due to multiple withdrawals; increases in sediment loads to a watershed;

- Interference with migratory routes or wildlife movement; or
- More traffic congestion and accidents due to increases in vehicular traffic on community roadways.
- Influx of workers

In this context, it is important to point out that PV projects generally do not pose environmental adverse impacts during operation activities, and the potential impacts during construction are localized and short term and their residual impacts are insignificant. Potential cumulative impacts as result of interaction with existing and foreseeable future construction activities within the project area, including the ongoing Obelisk PV project, would largely depend on the time frame within which the different neighboring projects are expected to be constructed.

Potential cumulative impacts may include:

- ***Neighbouring ongoing PV project***

As mentioned above, the cumulative potential impacts depend on the time frame of construction and potential overlap between both projects' activities. In this respect, it has been indicated that the ongoing Obelisk project will be at its final stages of construction by the time the proposed Dandra project initiates its construction activities, where the potential overlap might be for only one month duration. During this overlap period, the expected activities of both projects are not intensive and the potential impacts are not expected to be significant.

The neighbouring Obelisk project will be installing the final modules and entering the commissioning phase; no construction activities are planned, while the Dandra project will be starting early works such as roads, fencing, and camps.

- ***Traffic and logistics management***

Transportation of construction materials and PV project components (panels, mounting systems, BESS, etc.) would require considerable use of vehicles, which may increase the traffic loads on the nearby access roads. For the same reasons enumerated above, the potential cumulative impacts would be **INSIGNIFICANT**.

- ***Air quality***

Impacts of construction activities on air quality are mostly localized and limited to the construction boundaries. Generally, the area of influence of emissions from construction activities is limited to the site boundaries and its immediate vicinity. In addition to the reasons above, potential construction activities taking place in parallel with the PV project are not expected to have a cumulative impact on the airshed of the area.

- ***Influx of workers and worker accommodation, catering, and transport***

It is the common practice for EPC contractors working in Egypt to hire local workforce for the jobs that do not require significant skills, as their number is significant for construction, and this makes the project more economically viable. The availability of workers in the nearby villages was confirmed during the stakeholder meetings, and statistics confirm the same regionally. Whereas the required highly skilled labor may not be from the local communities, these will be of a limited number compared to the overall number of the workforce and the



size of the population in the area, including neighboring communities, Nagaa Hammadi, and Qena. In this respect, the number of non-local workers will be minimized as much as possible, and thus their impact on the community is not significant.

- ***Visual impacts***

No cumulative visual impacts are expected, given the different locations where infrastructure upgrading projects are located. The project is also partially concealed by the Nagaa Hammadi Industrial area and its substation. Moreover, the area is not characterized by a special visual character and vistas.

## 7. Environmental and Social Management Plan

This ESMP has been developed in accordance with national laws and international standards for the proposed PV Plant and BESS project.

The project's ESMP consists of a set of mitigation and monitoring measures that will be considered during the construction, operation phases and decommissioning to ensure the sound environmental and social performance of the project. The plan also includes the actions needed to be taken to implement these measures.

Decommissioning considerations are integrated into the overall environmental and social management framework, ensuring that potential impacts are minimized throughout the project lifecycle, from initial construction to final site restoration.

The purpose of the project's ESMP is to:

- Ensure continuing compliance with the relevant legislation and laws;
- Outline the ways in which the potential impacts identified in this ESIA report will be managed;
- Provide assurance to regulators and other stakeholders that the local requirements with respect to environmental and social performance are being met;
- Ensure that appropriate monitoring is undertaken, including the establishment of a monitoring plan; and
- Provide a framework for the compliance auditing programs that ensures the efficient environmental and social performance of the Project.

In general, the project's ESMP consists of the following components:

- **Summary of Impacts and Mitigation Measures** as identified in Chapter (6) of the ESIA.
- **Environmental and Social Management Plans** to ensure environmental protection and maintain efficient environmental and social performance and compliance with the relevant legislations, laws and international E&S standards.
- **Environmental Monitoring Plan** during project implementation to provide information of the key environmental aspects of the project.
- **Emergency Response Plan** is prepared as a guiding document by which project supervisors and staff identify hazards and act appropriately in response to emergency events.

### 7.1 Summary of Risks and Impacts, and Mitigation Measures

Table 37 below summarizes the social and environmental aspects, mitigation measures, and residual impacts as assessed for the different project phases.

Table 37: Summary of the social and Environmental Aspects, Mitigation Measures, and Residual risks and Impacts

Environmental and social Aspects	Expected Impacts	Mitigation Measures Summary	Residual Impacts
<b>Construction Phase</b>			
<b>Air Quality</b>			
• Air Quality	MINOR	<ul style="list-style-type: none"> <li>- Implementing policies to reduce idling times for vehicles and machinery;</li> <li>- Maintaining machinery and vehicles in good working conditions to minimize fugitive emissions and exhaust;</li> <li>- Speed restriction on site to minimize dust emissions;</li> <li>- Ensuring workers with awareness of safe driving and maintain good practices in machinery usage; and,</li> <li>- Conducting periodic measurements for stacks of generators to ensure their compliance with Law 4/1994</li> </ul>	INSIGNIFICANT
<b>Ambient Noise</b>			
<ul style="list-style-type: none"> <li>• Equipment and machinery</li> <li>• Vehicle Movement</li> <li>• Power Generators</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>• Ensuring regular maintenance of construction equipment and machinery to minimize noise emissions;</li> <li>• Use low-noise machinery and equipment, where possible;</li> <li>• Schedule high-noise activities to avoid simultaneous operations that could amplify noise levels;</li> <li>• Schedule high-noise activities to take place in morning hours, as possible; and,</li> <li>• Provide hearing protection equipment to workers exposed to high noise levels.</li> </ul>	INSIGNIFICANT
<b>Impacts on Soil</b>			
• Domestic wastewater tanks, material and wastes storage, and accidental spills	MINOR	<ul style="list-style-type: none"> <li>• Conduct maintenance of vehicles, trucks, and construction equipment off-site to reduce on-site emissions and spills;</li> <li>• Collect and dispose of spillages from tank filling or generator operation as hazardous waste;</li> <li>• Maintain good housekeeping practices to ensure a clean and organized construction site;</li> <li>• Collect and transport wastewater by authorized contractors to ensure proper disposal and prevent contamination; and</li> <li>• Implement precautionary measures to protect local wildlife from construction activities.</li> <li>• Develop spill prevention and management plan.</li> <li>• <b>Non-Hazardous Solid Waste:</b> <ul style="list-style-type: none"> <li>○ Collect waste at designated collection points and store it in appropriate containers following regulations; and</li> <li>○ Use licensed contractors for collection and disposal of non-hazardous waste.</li> </ul> </li> </ul>	INSIGNIFICANT

Environmental and social Aspects	Expected Impacts	Mitigation Measures Summary	Residual Impacts
		<ul style="list-style-type: none"> <li><b>Hazardous Waste:</b> <ul style="list-style-type: none"> <li>Establish marked and physically separated bunded storage areas for hazardous waste; and</li> <li>Use licensed contractors for the collection and disposal of hazardous waste.</li> </ul> </li> </ul>	
<b>Impacts on the Biological Environment</b>			
<ul style="list-style-type: none"> <li>Waste and wastewater generation</li> <li>Fence construction</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>Ensure proper housekeeping onsite and offsite;</li> <li>Ensure proper speed limits onsite and offsite; and</li> <li>Provide awareness to the workers.</li> <li>A visible fence to fauna and avifauna , and</li> <li>The lowest wires should provide some distance at different intervals to allow wildlife species to crawl under them without injury.</li> </ul>	INSIGNIFICANT
<ul style="list-style-type: none"> <li>Offsite driving</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>implement and update waste and wastewater management plans;</li> <li>Provide awareness to the workers;</li> <li>Ensure proper housekeeping practice;</li> <li>Ensure speed control and the prohibition of off-track driving; and</li> <li>Ensure the proper maintenance of construction equipment.</li> </ul>	INSIGNIFICANT
<ul style="list-style-type: none"> <li>Habitat disruption, flora, fauna, and avifauna</li> </ul>	INSIGNIFICANT	<ul style="list-style-type: none"> <li>Develop, implement, and update a solid waste management plan to include waste collection, storage, transport, and disposal in an environmentally sustainable manner to avoid the attraction of vermin.</li> </ul>	INSIGNIFICANT
<b>Impacts on the Social Environment</b>			
<ul style="list-style-type: none"> <li>Water Resources</li> </ul>	INSIGNIFICANT	<ul style="list-style-type: none"> <li>A water management plan will be developed</li> </ul>	INSIGNIFICANT
<ul style="list-style-type: none"> <li>Worker Influx</li> </ul>	Moderate	<ul style="list-style-type: none"> <li>Prioritize hiring local workers to reduce the number of incoming workers and minimize social disruption;</li> <li>Implement and maintain a community grievance mechanism; and,</li> <li>Selection of labour accommodation, as far away from existing communities as possible, and considering establishing a labour camp on site.</li> <li>Develop workers' code of conduct and provide awareness on GBV and SEAH related issues</li> </ul>	INSIGNIFICANT
<ul style="list-style-type: none"> <li>Cultural heritage</li> </ul>	INSIGNIFICANT	<ul style="list-style-type: none"> <li>Develop chance find procedures to indicate the actions to be taken in case of any finds during the construction activity excavations</li> </ul>	INSIGNIFICANT

Environmental and social Aspects	Expected Impacts	Mitigation Measures Summary	Residual Impacts
<b>Infrastructure</b>			
• Land use	INSIGNIFICANT	<ul style="list-style-type: none"> <li>No land ownership claims or other types of land uses exist at the project site. This was confirmed during stakeholders' meetings with local government representatives and nearby land uses and no risks are perceived in this regard</li> </ul>	INSIGNIFICANT
• Traffic	MODERATE	<ul style="list-style-type: none"> <li>Dandra shall develop Transportation Management Procedures that apply to Dandra projects and operations, as well as their contractors and subcontractors. The procedure defines the minimum safety requirements for Dandra's transportation activities. The requirements are supplementary to national regulatory specifications and project or business unit specifications and/or insurance requirements</li> </ul>	MINOR
<b>Occupational Health and Safety</b>			
• Impacts on workforce health and safety	Moderate	<ul style="list-style-type: none"> <li>The excavation sites will be surrounded with warning signs to prohibit access to these places;</li> <li>Contractors will ensure that construction workers will be continuously supervised, through the continuous presence of on-site supervisor(s) for close inspection and management of the construction activities;</li> <li>Ensure proper training for operators, regular maintenance of equipment, and implementation of safety protocols.</li> <li>Provide adequate hydration, schedule work during cooler parts of the day, and allow for regular breaks in shaded areas.</li> <li>Restrict vehicles speed so that they do not exceed the safety limit inside the site premises (15-20 km/h)</li> <li>All equipment will be inspected before the start of the job to ensure the safety of the workers;</li> <li>Use of personal protective equipment (PPE)</li> <li>Provide hearing protection, implement noise control measures, and schedule regular breaks for workers.</li> <li>Provide training on proper lifting techniques, and the use of mechanical aids.</li> <li>Implement fire prevention measures, maintain fire extinguishers on-site, and conduct fire safety training.</li> </ul>	MINOR
<b>Operation Phase</b>			
<b>Air Quality</b>			
• Emissions from emergency generator	MINOR	<ul style="list-style-type: none"> <li>Optimize the operation of backup generators to reduce usage and emissions.</li> </ul>	INSIGNIFICANT

Environmental and social Aspects	Expected Impacts	Mitigation Measures Summary	Residual Impacts
<b>Ambient Noise &amp; Vibration</b>			
<ul style="list-style-type: none"> <li>Operation of Transformers, and other operational components of battery energy storage systems.</li> <li>Use of backup generators during power outages</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>Potential noise generating machines and equipment are designed to meet statutory regulations concerning noise.</li> <li>Workers at noise generating machinery and equipment will be provided with suitable personal protective equipment (PPEs).</li> <li>A grievance mechanism will be adopted for assessing complaints, which would cover operation noise, if any</li> </ul>	INSIGNIFICANT
<b>Impact on the Biological Environment</b>			
<ul style="list-style-type: none"> <li>Waste and wastewater generation</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>Ensure proper housekeeping onsite and offsite;</li> <li>Ensure proper speed limits onsite and offsite; and</li> <li>Provide awareness to the workers.</li> </ul>	INSIGNIFICANT I
<ul style="list-style-type: none"> <li>Offsite driving</li> </ul>	MINOR	<ul style="list-style-type: none"> <li>implement and update waste and wastewater management plans;</li> <li>Provide awareness to the workers;</li> <li>Ensure proper housekeeping practice; and</li> <li>Ensure speed control and the prohibition of off-track driving.</li> </ul>	INSIGNIFICANT
<b>Impact on the Social Environment</b>			
<ul style="list-style-type: none"> <li>Water Resources</li> </ul>	INSIGNIFICANT	<ul style="list-style-type: none"> <li>Wastewater generated during the operation phase is minimal and will be collected by an approved contractor and discharged to designated treatment plants.</li> </ul>	No residual impact
<b>Impacts on Occupational Health and Safety</b>			
<ul style="list-style-type: none"> <li>Impacts on workplace</li> </ul>	INSIGNIFICANT	<ul style="list-style-type: none"> <li>A health and safety policy will be applied</li> <li>Abide by all national occupational health and safety regulations, Law 14/2025</li> <li>Provision of suitable PPE</li> <li>Sufficient drinking water supply</li> </ul>	INSIGNIFICANT



## 7.2 Environmental and Social Organisational Arrangements

### 7.2.1 Establishment of HSSE Department

The guidelines require appointing roles and responsibilities of the Health, Safety, Security, and Environment (HSSE) department. In this context, the company will assign at least five HSSE dedicated personnel for HSE issues.

The social aspects, including workers influx, water resources and wastewater management, and waste management, will be under the responsibility of the contractor (supervised by the company) during the construction phase and under Scatec's responsibility during the operation phase.

### 7.2.2 Staff Responsibilities

The HSSE personnel will be responsible for daily safety work (walks-over) at the site, for inspecting the safety, housekeeping, personal protection, controlling unsafe practices/conditions, updating environmental register, and assessing the environmental performance of the facility. When construction and operation work pose a high risk that threatens the workers' safety and health, the health and safety officer has the right to end the activity in order to prevent a potential hazard. The HSEE and the Labor Compliance Officer (LCO) will also be responsible for follow-up on compliance with labour issues as part of their role regarding contractors' monitoring and management.

- **Site Manager/HSSE personnel**

- Responsible for the implementation of the health, safety, and environment management system and to provide necessary resources for implementation of the system;
- Responsible for the implementation of correction plans.
- Reports on HSSE matters to company management and is part of the annual management review process
- Inclusion of HSSE / E&S requirements in contractor contracts

- **HSSE Team**

- Implementation of the health, safety, and environment management system.
- Ensures that contractors and subcontractors adhere to the HSE management system
- Provides training, help, and support for workers and ensures that contractors and subcontractors provide similar training to their workers;
- Provides the necessary support and determines any deficiency and disparity in the HSE procedures;
- Attends weekly and/or monthly HSE meetings;
- Updates and manages correction plans.
- Audits the implementation of the contractor's HSE plan;
- Analyses reports and corrects potential HSE issues;
- Organizes and completes all relevant HSE introductory training and awareness for workers;
- Reports any accident/incident on site and investigates the reason of accident/incident;
- Records and updates health and safety statistics, and submits monthly reports;
- Prevents and corrects potential safety risk behaviour;
- Update the environmental register;

- Resolves all environmental issues on site; and
- Plans and supervises all environmental monitoring aspects and proposes potential corrective actions.
- Responsible for attending and closing worker grievances
  
- **Community Liaison Officer**
  - Maintaining dialogue with the communities and relevant stakeholders as per the stakeholder engagement plan
  - Responsible for attending community grievances
  - Identification of local communities for sourcing of labour and contractors
  
- **E&S Corporate team**
  - Periodic reporting on E&S matters to lenders
  - Following up the closure of worker and community grievances
  - Auding the site during the construction and operation & maintenance phases
  - Provide on-site training on E&S matters

## 7.3 Institutional Arrangements

### 7.3.1 Risk assessment and hazard identification

The Contractor and the Subcontractors performing construction work shall carry out risk assessments prior to the commencement and during the construction works.

The risk assessments shall form part of the health and safety plan to be implemented on the site and shall include at least:

1. The identification of the risks and hazards to which workers may be exposed;
2. The analysis and evaluation of the risks and hazards identified;
3. A documented plan of safe work procedure to mitigate, reduce or control of the risks and hazards that have been identified;
4. A monitoring plan;

Hazards shall be eliminated when possible and can be minimized through awareness training, engineering controls, the use of personal protective equipment, and/or monitoring devices.

Workers shall be familiar with the risk assessment, use the existing controls and preventive measures while performing the tasks, and provide input to their supervisors to ensure that the risk assessment procedures reflect all hazards identified.

A pre-task risk assessment must be completed prior to the start of any job/task by those involved in the task.

### 7.3.2 Health, Safety, and Environment Policy

Dandra will develop comprehensive HSSE policies and procedures in accordance with the international requirements and national regulations, as available. The construction contractors will be required to abide by these policies and procedures and develop project-specific HSE management plans. The policies and procedures rely on the pollution reduction approach to protect the environment and community, as well as provide a safe and healthy work environment.

In this context, the outline of the HSSE policy requirements is summarized as follows:

- Ensuring the provision of appropriate institutional capacity with clearly defined roles and responsibilities for managing HS issues.
- Ensuring that all HS personnel are properly trained and competent to fulfill their respective duties.
- Ensuring the availability of adequate resources, and continuous support from top management.
- Communicating HS policy to all employees and other relevant stakeholders.
- Ensuring the provision of safe working conditions for all employees.
- Evaluating HS risks and taking appropriate action to minimize potential risks.
- Setting up objectives with the aim of reducing and eliminating HS related incidents.
- Ensuring that all labor rights stipulated in Egyptian laws, as well as the International Labor Organization (ILO) requirements and the international performance standards, are fulfilled for all employees. This in addition to implementing a grievance mechanism for all workers.
- Ensuring the continuous monitoring and assessment of HS performance, both internally and through third-party external audits/monitoring.

Dandra project company will require from the main construction contractors and the subcontractors the appointment of:

- A Health and Safety Officer
- An Environmental Control Officer,
- Risk Assessor
- Details and specifications of responsibility for all appointments shall be defined in the health and safety (HS) plan, and described in a suitable organizational chart.
- The company requires that contractors and subcontractors implement a system of reporting including workers attendance records, vehicles records, minute of meetings, audit reports and incident reporting.

### **7.3.3 Human Resources Policy**

A Human Resources (HR) policies and procedures will be developed in in line with local and international laws/legislation and best practice as well as Scatec's Diversity, Equity, Inclusion and Belonging (DEIB) Policy.

Under these policies, the company provides employees with information regarding their rights under national labour and employment law, including their rights related to wages and benefits. This policy will be clear and understandable to all employees. Accordingly, an HR policy will cover the following topics:

- Hiring policy
- Entitlement to and payment of wages; permissible wage deductions;
- Overtime payments; hours of work and any legal maximums;
- Entitlement to leave for holidays, vacation, illness, injury, and maternity and other reasons;
- Entitlement to benefits;
- The employees' right to form and join workers' organizations of their choosing without any interference or employment consequences and to bargain collectively with the employer;
- Disciplinary and termination procedures and rights;

- Conditions of work;
- Occupational safety, hygiene and emergency preparedness;
- Promotion requirements and procedures;
- Vocational training opportunities;
- Child labor and equal opportunity.
- Discrimination or favouritism due to race, ethnicity, nationality, gender, age, gender, disability, national origin, religious conviction or cultural belief
- Promoting inclusivity and cultural differences
- Develop workers code of conduct
- Human rights
- Female leadership
- Zero Tolerance for Gender-Based Violence (GBV) and Sexual Harassment: This policy encompasses forms of sexual harassment, including sexual exploitation, abuse, and harassment (SEAH).

With respect to contracted workers, the company will ensure that the third parties who engage these workers abide by the project's environmental and health and safety and social management requirements through a contractor management plan. This is to be included in the contractor's scope of work (contract). This is to include ensuring proper transportation, housing and accommodation conditions for workers during construction and/or operation, as relevant<sup>34</sup>. In this context, Dandra policies and procedures will ensure management and monitoring the performance of third-party performance.

## 7.4 Environmental Management Plans

Within its commitment to ensure environmental protection and maintain efficient environmental performance as well as social integrity, Dandra will develop various environmental and social management plans addressing the different environmental and social aspects and impacts of the project during its construction, operation and decommissioning phases.

Decommissioning considerations are integrated into the overall environmental and social management framework, ensuring that potential impacts are minimized throughout the project lifecycle, from initial construction to final site restoration.

These environmental and social dimensions will be incorporated throughout the project phases. In this regard, the environmental and social management plans to be developed will address:

### 7.4.1 Environmental Management Plans During the Construction Phase

The main objectives of the Construction Environmental and Social Management Plan (CESMP) are to:

- Address environmental, cultural and social issues identified as part of the present ESIA study and any additional issues considered to be important;

<sup>34</sup> Workers' accommodation: processes and standards A guidance note by IFC and the EBRD, 2009 and ILO Housing Standards  
[https://normlex.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100\\_ILO\\_CODE:R115](https://normlex.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:R115)

- Minimize the residual environmental impacts of construction activities;
- Prepare an achievable environmental management plan for implementation;
- Detail management and monitoring tasks to be completed;
- State the timing for implementation of each task;
- Provide details of reporting requirements;
- Identify roles and responsibilities for ensuring that relevant tasks are completed;
- Provide contingency plans that can be followed in an event of non-compliance or complaint; and
- Detail registers and standards reporting forms for documenting complaints, non-compliances, unplanned exceedances and discharges etc.

For each plan the following structure will be followed:

- Scope and objective of the ESMP
- Compliance Requirements and regulatory requirements
- Roles and Responsibilities,
- Communication, training and awareness
- Record Keeping,
- Monitoring,
- Reporting.

#### **7.4.1.1 Health, Safety and Environment Plan**

This includes developing detailed plans for HSE issues for the construction phase. The plan will ensure:

- Addressing HSE impacts during construction;
- Imposing HSE requirements on contractors and subcontractors;
- Workforce health and safety planning;
- Activities in close proximity to workers including storage and handling of hazardous substances; and
- Construction workforce.

Contractors will be informed of all procedures. Contractors will have to adhere to the various HSE plan requirements. The Project HSE Manager will be responsible for supervising the contractors' performance in relation to HSE aspects, and for ensuring safe and environmentally sound practices. In addition, contractors will be required to report their performance in relation to health, safety and environmental aspects as a part of the periodic reporting process on the progress of construction activities.

#### **7.4.1.2 Transportation Management Plan**

Scatec company has developed an overarching transportation policy and procedures that are to be adopted for all its projects. The purpose of this policy is to ensure the safety and security of all employees, contractors, and stakeholders while promoting sustainable and responsible driving practices. A project-specific transportation plan will be developed, including the following key components:

- Driver Requirements
- Requirements for vehicles and their use
- Maintenance program
- Local road transportation safety Requirements and additional Dandra safety requirements

- Driving time and rest period

#### **7.4.1.3 Noise Management**

- Compliance with the requirements of Law 4/1994 regarding the exposure period to different levels of noise, whether continuous or intermittent;
- Ensuring regular maintenance of construction equipment and machinery to minimize noise emissions.
- Schedule high-noise activities to avoid simultaneous operations that could amplify noise levels.
- Maximize the distance between noisy equipment and sensitive receptors;
- Workers shall be provided with adequate PPE (earplugs), and ensuring that workers are always wearing PPE while working near equipment that emit high noise levels.

#### **7.4.1.4 Solid waste management**

Domestic solid waste generated from the construction labour camp will be collected, properly stored according to the national regulations, and finally disposed of by a licensed waste contractor.

Construction waste will be collected in a separate onsite location and periodically disposed of off-site by the contractor. Demolition and construction waste will be safely transported to officially designated sites. Recyclable wastes will be reused by the contractor at other construction sites.

Solid waste management will be conducted in accordance with the requirements of laws 4/1994 and 202/2020.

#### **7.4.1.5 Hazardous waste management**

The following briefs the management plan concerning hazardous waste (HW) of the proposed project.

##### HW generation

Different hazardous wastes will be generated from the construction activities. The type of generated hazardous waste is mentioned in Chapter 2.

##### HW segregation and on-site storage

HW will be separated from other types of non-hazardous waste. Proper identification of hazardous waste forms a basis for waste segregation. It is therefore essential that all personnel are familiar with waste identification.

HW will be stored in the storage area in a specifically categorized zone (e.g. labelled HW zone, providing secondary containment where necessary), which would be provided with suitable fire extinguishers and other safety equipment. Furthermore, each HW type will have color-coding and will be labelled with the container's content and the required precaution instructions.

##### HW disposal

The HW will be transported to a WMRA/EEAA licensed facility, such as El Nassreya HW landfill in Alexandria, via a certified contractor. On the other hand, spent oils will be disposed of



through specialized contractors approved for the collection of oils, to send them for recycling to Petrotrade Company.

#### HW register

A HW register will be established, including information about the types and amounts of the generated waste and methods of its disposal.

#### **7.4.1.6 Water and wastewater management**

A project-specific water and wastewater management plans will be developed. The emergency response plan is to include responses to potential acute leakage scenarios. Wastewater will be collected in an isolated internal sewage system and will be periodically collected by an authorized contractor for disposal.

#### **7.4.1.7 Emergency Management Plan**

The contractors will have a written Emergency Response Plan to respond to and mitigate any incident to minimize its impact on employees, community, and environment. Employees will be trained on the implementation of the plan and on response activities that could be required in the event of an emergency.

Dandra will ensure that the contractors have developed preparedness program to respond to and mitigate any emergency situation to minimize the impact on employees, community, and environment according to national laws and the international EHS guidelines.

The contractor will be committed to the following:

- A knowledgeable, highly trained, and motivated employee group;
- A safety and accident record;
- Preparation and training for emergency response and mitigation measures; and
- Awareness among the workforce through education and training.

In addition, the written emergency plan will be prepared to address the following phases:

- Preparedness: the activities that are communicated for rescuing and minimizing damage.
- Response: the actions necessary to minimize loss of life and property damage and provide emergency assistance.
- Recovery: short- and long-term activities which restore the construction activities and help return it to its normal state.
- Mitigation: the activities that eliminate or reduce the probability of disaster.

#### **7.4.1.8 Biodiversity Management**

The Project will ensure that the contractors are aware of the importance of the biological environment and their compliance with the law and international regulations, and conventions. Contractors and subcontractors should be aware of species that are prohibited from being hunted, captured, or killed. In case of the presence of vagrant animals, Annex 4 of the Executive Regulations of law 4/1994, amended by Decree 1095 /2011, defines the wild animals and plants prohibited from being hunted, traded, killed or captured.

Awareness sessions on the impact of hunting, trading, or killing wild animals will be provided to workers. Strict measures will be taken by the Project in case of non-compliance with the laws and regulations (including taking legal action).

Additionally, the Project will ensure that contractors are following proper mitigation measures, including proper waste and wastewater management according to legal requirements, to avoid the attraction of pests and other alien/invasive species and the growth of marginal vegetation.

#### **7.4.1.9 Chance Find Procedure**

As indicated in section 4 above, there are no registered antiquities or cultural heritage sites within the project site based on the Egyptian Archeological Map (2022) and the UNESCO World Heritage List of Egypt. However, chance find procedures will be developed to address potential cases of encountering cultural heritage components during the project's construction activities.

The chance find procedure defines the actions to be taken in case of any finds during the construction activity excavations. Such finds could include Non-archaeological/Natural/Cultural Find, Insignificant Chance Finds, Potentially Significant Archaeological Finds or Human remains and/or Burial-related Material.

In general, the Ministry of Tourism and Antiquities (MOTA) has the responsibility for the discovery and exploration of antiquities across Egyptian territory. According to Law No. 117 of 1983, as amended by Law No. 3 of 2010, any person who discovers an unregistered archaeological artifact is obligated to notify the MOTA. The artifact shall be considered state property, and the MOTA must take the necessary measures to preserve it. Within three months, the MOTA must either remove the artifact found on private property or take the necessary procedures to expropriate the land on which it was found, or leave it in place and register it following the provisions of this law.

#### **7.4.1.10 Staff Training and Awareness**

Construction workers will be trained and educated according to their respective responsibilities and assigned tasks. A workers' training program will involve training staff on safe handling of equipment, wastes, and on the use of equipment. Moreover, they will be trained on the safe operation of equipment and spill clean-up. They will also be trained on the use of fire hose reels and fire extinguishers. The training program will also tend to increase workers' awareness of the potential environmental impacts of various construction activities. Awareness will also include issues related to GBVH / SEAH, and developing measures for reporting these cases needs to be established.

The project will undertake an induction program to advise contractors and site visitors of basic health, safety, and emergency procedures, such as emergency signals and evacuation routes. Contractors and vendors on short-term assignments that do not have safety and emergency response training will work under the supervision of the Company staff.

#### 7.4.2 Environmental Management Plans During the Operation Phase

Dandra will be responsible for the preparation, implementation, and monitoring of the environmental management plan during the operation phase. The management plan will also comply with the world Bank E&S "General Environmental, Health, and Safety Guidelines".

The following shows the minimum set of environmental management procedures that the facility operator will establish and follow.

- **Environmental Register**

During the operation phase, an Environmental Register will be developed for the project activities and the compliance status. The Environmental Register and the Hazardous Materials and Waste Register will be prepared in accordance with the requirements of Annex 3 of the Executive Regulations of Law 4/1994 and its amendments.

The Environmental Register as well as the Hazardous Materials and Waste Register will be updated on an annual basis. Dandra will make both registers available for inspection by competent authorities.

In general, the register will include data on the following topics:

- General information;
- General description of the establishment;
- Laws and regulations related to the project;
- Operation activities and utilities;
- Liquid waste;
- Solid waste;
- Work environment; and
- Self-monitoring plan.

##### 7.4.2.1 Hazardous Wastes (HW) Management

Hazardous wastes generated from various activities of the proposed project will be collected by an authorized contractor to be disposed of in designated safe disposal sites. HW will be stored in a specific storage area until safe disposal.

HW will be recorded in the hazardous wastes register in accordance with the legal requirements stipulated in Article 33 of the Environment Law 4/1994.

The project will endeavor to find sustainable means for the disposal of broken PV panels through recycling.

##### 7.4.2.2 Solid Wastes Management

The main source of solid waste is domestic activities from workers, as municipal solid waste will be generated from the warehouse, offices, and catering. In addition, it includes wooden pallets and PV panels plastic packaging materials. Other waste will be disposed of with the domestic solid waste by authorized waste contractors.

#### **7.4.2.3 Preventive and corrective maintenance**

The main objective of maintenance is to maximize the utilization of the equipment in its proper operating conditions.

##### Planned maintenance

Maintenance will be carried out in accordance with:

- Equipment manufacturers' suggested requirements.
- Scheduled inspections according to good maintenance practices.
- Maintenance programs and procedures developed by Dandra.

##### Preventive Maintenance

The preventive maintenance guidelines are based on:

- A general maintenance plan according to which all maintenance activities are scheduled.
- Regular visual inspections will be conducted for inspecting modules, inverters, structures, the electric system, weather stations, the monitoring system, and the security system to detect existing and potential defects. It is particularly important to inspect all plant equipment exposed to the weather.

##### Corrective Maintenance Plan and Response Times

Preventive maintenance reduces the frequency of breakdowns, but cannot avoid them. Unplanned maintenance involves corrective maintenance and emergency repairs resulting from equipment problems, required as a result of equipment breakdowns or deficiencies. Once a problem occurs, the plant maintenance staff is trained enough to carry out the repairs in a quick response time in order to return to normal operation levels. Corrective maintenance may involve the participation of specialized maintenance contractors.

#### **7.4.2.4 Wastewater Management Plan**

A wastewater management plan will be developed. The emergency response plan is to include responses to potential acute leakage scenarios. Wastewater will be collected in an isolated internal sewage system and will be periodically collected by an authorized contractor for disposal.

#### **7.4.2.5 Spill Prevention Management Plan**

The plan will address the spill prevention, preparedness, and response requirements to support the safe response to accidental spills, leaks, or releases of both hazardous and non-hazardous materials to the environment to eliminate or minimize the adverse effects should a spill occur and to protect the health and safety of employees.

#### **7.4.2.6 Training and Capacity Building**

To ensure the competence of the project's employees in undertaking the environmental management procedures and plans, training will be delivered to the personnel according to their particular responsibilities.

A workers' training program will involve training on safe handling of equipment, waste management, and the use of protective equipment. They will be informed of any potentially harmful health effects related to the PV plant operations. Moreover, they will also be trained on the use of fire reel hose and fire extinguishers. Training plans will be put in place to:

- Ensure that all visitors and site personnel undergo a site-specific HSE Induction training session;
- Ensure that all records of attendance are kept on file.
- Ensure that all visitors and personnel are issued with an access card as proof of site induction.
- Provide a list of site-specific hazards identified.
- Train, inform, communicate, and instruct all workers regarding World Bank Equator Principles, worker rights, as well as workplace hazards and risks before any work commences and thereafter at regular intervals as the risks change and as new risks develop. This training will be carried out in the form of risk assessment and toolbox talks. A record of attendance will be kept on file, and
- Ensure that Sub-Contractors will conduct their own task-specific risk assessments and keep records in the Health and Safety file.

#### **7.4.2.7 Housekeeping and Cleanliness**

About the housekeeping and cleanliness of the site, good housekeeping and cleanliness activities will be applied, such as:

- Obstacles should not be placed in front of emergency exits or firefighting equipment;
- Minimize water usage during cleaning to conserve resources;
- Regularly inspect the panels for dirt, bird droppings, and other contaminants that can affect performance; and
- Ensure that all personnel involved in cleaning and maintenance are properly trained in safe handling and cleaning techniques as well as waste management procedures.
- Keep the flood protection channels clear, especially before the rainy season

#### **7.4.2.8 Biodiversity Management**

The Project will ensure that personnel are aware of the importance of the biological environment. Awareness sessions on the impact of hunting, trading, or killing wild animals will be provided to workers. Strict measures will be taken by the company in case of non-compliance with the laws and regulations (including taking legal action). Moreover, the Project will ensure that waste management is done properly and according to the national regulations.

In order to raise the awareness of its onsite personnel with regard to issues relevant to the protection and preservation of biodiversity, the following is proposed:

- Display posters demonstrating the Project's commitment to the conservation of biodiversity throughout the site;
- Display throughout the site warning signs indicating that hunting or disturbance of wildlife is strictly prohibited;
- Display throughout the site signs prohibiting unauthorized wandering into the surrounding desert, outside the project boundaries;
- Good practice as related to protection of wildlife on the site should be included during toolbox talks or morning meetings; and
- Reminders of proper handling and disposal of food leftovers, as well as waste and material hazardous to wildlife, should be posted throughout the site.
- Install bird deterrents on the internal and external transmission lines at specific intervals along the transmission lines

- Increase the number of insulators where conductors that prevent birds from landing on them and forcing birds to perch on crossarms only.
- Cover the crossarms of pylons with insulating materials to ensure that birds are not earthed.
- Implement good housekeeping and waste/wastewater management to avoid the presence of water and the growth of marginal vegetation that would make the site “attractive” to birds.

#### **7.4.2.9 Emergency response plans**

##### Identify specific risks

The identification of risks includes potential risks related to equipment, devices, materials, buildings, and operation procedures. Risk identification is carried out to estimate the type, quantity, and magnitude of risks that could induce fire, personnel fatality, or building collapse.

These risks include the following:

- Activities that may pose risks to the workers;
- Quantities and types of hazardous materials/wastes used or stored; and
- Potential failure of the safety measures and procedures

##### Preparedness

Identify human, administrative, and organizational resources, as well as equipment and sites needed to combat risks. The following activities will be carried out:

- Identify the required training for staff and implementation schedule;
- Identify the essential tools/procedures for the protection of individuals and groups, and also determine the requirements for rescue and medical treatment;
- Prepare maps and detailed plans that include gathering points and escape routes, and evacuation plans in case of emergency, and determine the timeline for implementation;
- Identify the affected parties and stakeholders, provide the emergency support and services, and determine the type of assistance needed; and
- Determine fire prevention and control requirements.

##### Implementation

The plan should include the level of implementation carried out by individuals or groups according to the following steps:

##### *Warning and alarm plan*

The selected warning method should be effective in terms of communicating the warning message to all employees of the site and making sure that they are aware of the nature of the risk and provide them with the opportunity to confront or escape from it. The alarm must be visible and audible to reach all employees on the site.

##### *Response*

Responses are carried out according to the type, rate of spread, damages and consequences of the hazard through trained personnel, either directly or manually, using smart devices or through offsite control.

##### Medical assistance and services



A communication line for access to ambulance shall be available to provide medical care for the potential injured workers and transfer them immediately to hospitals, if needed.

#### Documentation

A record/report including time, duration of implementation, cost, expenditure, efficiency, effectiveness, and responsible personnel of each of the above measures shall be maintained. Dandra will develop a reporting system for accidents, including injuries, damage to property, and environmental damage. The information and records mentioned will be used to improve response procedures and to decrease and control potential hazards. General information to be recorded is as follows:

- Date, place of incident or emergency;
- The affected individual or groups;
- Description of the situation and conditions surrounding the site;
- Identify and assess the magnitude of injury, loss, damage or pollution;
- Actions taken to reduce the severity and degree of the situation; and
- Record the treatment or cleaning procedures that have been carried out.

#### Follow-up procedures

Once the hazard is managed, a throughout survey of the affected site must be carried out to ensure that the hazard is eliminated, and that the situation is restored to its original state. Follow-up procedures include the following:

- Identify the causes of the emergency.
- Assess the efficiency of emergency response procedures;
- Propose corrective action and remedial measures necessary to prevent recurrence of such incidents; and
- Identify the level of need to implement any treatment and/or monitor procedures to restore the site to its original state;

#### Update the emergency response plan and staff training program

The emergency plan will be updated every year or at the event that needs improvement of the plan and the staff training program.

### **7.4.3 Social Management Plan**

It is of key importance for Dandra to have close and proactive communication with the local community and to disclose the project information for transparency and to enhance credibility. A detailed stakeholder engagement and management plan (SEP) will be developed for the project. Main aspects of the plan are summarized in the following sections.

#### **a. Accommodation and Labour Influx Assessment and Management Plan**

The Dandra project will develop an accommodation and labour influx assessment and management plan. The plan aims to assess socio-economic baseline setup, identify areas fits for accommodation of non-local workers, highlight potential influx impacts and mitigation measures, and outline contractors' responsibilities.

The scope of the assessment will cover contractor(s) and subcontractor(s) workers' accommodation during the construction phase.

The accommodation will include on-site accommodation (camps), as well as off-site accommodation in several rented apartments/houses. Nearby local villages will be avoided, and accommodation will take place in larger urban centers, if possible.

Additionally, the plan will define accommodation requirements as per international standards (IFC/EBRD/ILO)

#### **b. Recruitment Procedure**

The recruitment instructions for Dandra's project will be developed for contractors for hiring workers, subcontractors, and equipment for the project. It will be guided by "equal opportunity" and a "transparent" approach, which maximizes the participation of the local community and increases female inclusion.

The procedure will clearly explain how the recruitment process works — from advertising the positions to selecting and approving candidates — and describe the criteria and documents required at each step.

Mainly, the job announcement and Ads, along with an official request letter, will be submitted to the Governor for approving publishing the Ads on Qena Governorate's Official Page on Facebook. The project CLO will share links with the contractors. The Youth Employment Office (YEO) within the governorate will handle applications for manpower.

#### **c. Dandra's SEAH and GBV Management Plan**

Diversity, Equity, Inclusion, and Belonging (DEIB) Policy: Dandra's DEIB policy encompasses the following key components:

- Zero Tolerance for Sexual Harassment: The policy strictly prohibits all forms of sexual harassment, including sexual exploitation, abuse, and harassment (SEAH).
- Gender-Based Violence (GBV): Dandra is committed to human rights and equal opportunities, with a comprehensive stance against all forms of GBV.

Integration with HR Policies: Dandra integrates its HR policies with the SEAH and GBV Management Plan to foster a safe and respectful workplace. This integration includes the establishment of clear protocols to prevent and respond to incidents. Implementation of this plan ensures non-discrimination and equal pay for all employees. To further address and resolve related issues, the project team will appoint a female Community Liaison Officer, providing a significant opportunity for female leadership within the project. The CLO will also participate in workers' awareness related to issues of GBVH / SEAH, and develop measures for reporting these cases.

#### **d. Labour and Working Conditions**

During construction, the project will ensure that contractors are implementing suitable health and safety measures, and that workers are not exposed to forced or compulsory labour including child labour. The project's hiring policies will ensure that priority employment would be for local hires.

During operation, the project will adhere to the requirements of the Labour Law 14/2025<sup>35</sup> and the general international workplace health and safety guidelines.

**e. On-going Consultation**

Dandra has already undertaken various activities to communicate and engage with key stakeholders and is willing to continue its engagement activities Annex 4 includes the stakeholders consultation activities.

As part of their CSR commitment, Scatec has an ongoing CSR programme that aims at supporting the community with specific focus on vulnerable groups in Nagaa Hammadi area.

**f. Information Disclosure**

Information regarding the Project shall be publicly available on an on-going basis and updated semi-annually as minimum. Information will be at an appropriate level of details and presented in an accessible mean (e.g., in Arabic with infographics used where beneficial).

This information is expected to include, but not be limited to, project progress updates; proposed future engagement and grievance mechanism; information about project activities; key contacts for the project; and other information, as needed.

**g. Grievance Management**

A grievance management plan will be developed to address the external and internal grievance mechanisms.

**h. Socio-economic Monitoring**

The project will monitor the following socio-economic aspects on a regular basis:

- Satisfaction of the local community with the project activities;
- Local community' needs (healthcare, water, etc.);
- Grievance mechanism is fully understood by the local community; and
- Any unsolved grievances;

**7.4.4 Project Decommissioning Plans**

Decommissioning is defined as the close down of operations, the removal of process equipment, buildings, and structures, and carryout site cleanup and remediation, if required. The expected lifetime of the project ranges between 25 to 30 years, which will be renewable as long as the proper predictive maintenance measures are taken, and all the necessary revamps and upgrades are done. The following are the main issues addressed by the facility's decommissioning plan:

- Development of the decommissioning plan according to international and best practices guidelines.
- Removal procedures for all above-ground structures
- Disassemble the PV Modules and batteries: The components of the plant will be disassembled and removed. Thereafter, they will be reused, recycled (where possible), or disposed of in accordance with regulatory requirements.

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<sup>35</sup>The new Labour Law has recently come into effect, the executive decrees of the previous labour law (law 12/2003) shall be applicable until issuance of the new executive decrees.

#### **7.4.5 Summary of ESMP**

**Error! Reference source not found.** below provides a comprehensive overview of the project management plan, including potential environmental aspects identified in the ESIA for both the construction and operation phases of the project, as well as the proposed mitigation measures designed to minimize these impacts.

Table 38: Overview of the ESMP Plan

Aspect	Issues of concern	Actions	Party Implementing the Action	Indicator of completion	Estimated Cost	Required Completion Date
<b>Construction Phase</b>						
Air Quality	Dust emissions	<ul style="list-style-type: none"> <li>- Reduce idling times for vehicles and machinery;</li> <li>- Maintaining machinery and vehicles in good working</li> <li>- Speed restriction on site s;</li> <li>- Ensuring workers with awareness of safe driving and maintaining good practices in machinery usage; and,</li> <li>- Periodic measurements for stacks of generators</li> </ul>	Construction contractor	<ul style="list-style-type: none"> <li>- Monitoring plan</li> <li>- Air quality measurements</li> </ul>	Cost of measurements in the monitoring plan below	Throughout the construction phase period
	working conditions of machinery	<ul style="list-style-type: none"> <li>- Ensure good working conditions through frequent inspection of all construction equipment</li> </ul>	Construction contractor	Maintenance logs	Cost of maintenance	
Noise Level	working conditions of machinery	<ul style="list-style-type: none"> <li>- Regular maintenance of construction equipment</li> <li>- Use low-noise equipment, where possible;</li> <li>- Schedule high-noise activities to avoid simultaneous operations that could amplify noise levels;</li> <li>- Schedule high-noise activities to take place in morning hours</li> </ul>	Construction contractor	Noise measurements and Maintenance logs	Cost of measurements in the monitoring plan + cost of maintenance	Throughout the construction phase period
	Provision of PPEs	<ul style="list-style-type: none"> <li>- Providing necessary PPEs for workers</li> </ul>	Construction contractor			
Soil	housekeeping practices	<ul style="list-style-type: none"> <li>- Develop and implement site management plan, solid waste management plan and spill prevention plan</li> </ul>	Construction contractor Developer (include provisions in the construction contracts. Developers to ensure contractors compliance)	<ul style="list-style-type: none"> <li>- Solid/hazardous waste and wastewater management contract</li> <li>- Contractor follow up documents</li> </ul>	<ul style="list-style-type: none"> <li>- Part of construction activities management</li> <li>- Cost of transportation and disposal of waste</li> </ul>	Throughout the construction phase period
	Waste/wastewater management					

Aspect	Issues of concern	Actions	Party Implementing the Action	Indicator of completion	Estimated Cost	Required Completion Date
<b>Construction Phase</b>						
Occupational Health and Safety	Site Staff and Workplace Safety	- Developing HSE procedures according to national requirements and international standards	Contractor	HSE provisions in the construction contracts	Construction cost	Before construction activities
Emergency Response plans	Site Staff and Workplace Safety	- Develop procedures for emergency control	Contractor	Emergency response plan		Before project commissioning
Waste management	Worker's health	- Developing a solid waste management plan	Construction contractor	Solid waste management contract	Cost of transportation and disposal	Throughout the construction phase period
Biological Environment	Pests and invasive species	- Good housekeeping and proper waste management	Construction contractor	Waste management contract		Throughout the construction phase
	Disturbance to wildlife	- Awareness (toolbox talks and awareness signs) - Implementation of mitigation measures - Supervision and implementation of deterring measures	Construction contractor	Requirements specified in contracts		Throughout the construction phase
Social Environment	Workers influx	- Prioritize hiring local workers - Implement and maintain a community grievance mechanism; and, - Selection of labour accommodation, away from existing communities, as possible, and considering establishing a labour camp on site. - Develop HR policies including GBV and SEAH plans	Developer/Construction contractors	Labour management plan, workers accommodation inspection checklist GBV and SEAH policies Workers Awareness		Throughout the construction phase period
	Cultural heritage	- develop chance find procedure	Developer/Construction contractors	Developed procedures	Management cost	Before construction activities



Aspect	Issues of concern	Actions	Party Implementing the Action	Indicator of completion	Estimated Cost	Required completion Date
<b>Operation Phase</b>						
Air quality	Backup generator emissions	- Optimize the operation of backup generators to reduce usage and emissions.	Developer	Emission measurements	Operation cost	Periodically Throughout operation stage
Noise	Transformers and BESS	- Provide workers at noise generating machinery and equipment will be provided with suitable (PPEs). - A grievance mechanism will be adopted for assessing complaints,	Developer	Noise measurements	Operation cost	Periodically Throughout operation stage
Biological Environment	Same as for construction phase	- Same as for construction phase	Developer	Reports	Operation cost	Throughout the project lifetime
Impact on social environment	Water consumption	- Wastewater generated during the operation phase is minimal and will be collected by an approved contractor and discharged to designated treatment plants	Developer	Wastewater management plan	Operation cost	Throughout the project lifetime
Labour rights and welfare	working conditions	Develop Human Resources policy	Developer	Contracts (with workers)	Operation cost	Throughout the project lifetime
Training and Awareness	competence of the project personnel	training for the personnel according to the particular responsibility	Developer	Training plans	Training cost	Throughout the project lifetime
Occupational Health and Safety	Site Staff and Workplace Safety	- Developing HSE procedures	Developer	Development of HSE policies	Operation cost	Before project commissioning
Emergency Preparedness and Response	Operation risk management	- Adopt a probabilistic risk assessment framework	Developer	Emergency response plan	Operation cost	Before project commissioning
Community health, safety and site security	- risk of road traffic accidents - Site security	- Develop site security and safety plan - Develop grievance mechanism	Developer	- security plan - SEP and grievance mechanism and register	Operation cost	Throughout the project lifetime

## 7.5 Environmental and Social Monitoring Plans

### 7.5.1 Environmental Monitoring

Although most potential impacts can be mitigated through management procedures, the monitoring plan is an essential element for the environmental management scheme of the project. It provides data for periodic review and necessary adjustments to the environmental management plan, ensuring environmental protection through the early detection of negative impacts.

The project will develop and implement a monitoring program for various environmental aspects during both the construction and operation phases. Monitoring results will inform the decision-making process, triggering corrective actions to maintain compliance with environmental laws and regulations, ensure environmental protection and workplace safety, and ensure the effective operation of mitigation measures and management plans.

According to Law 4/1994, establishments should maintain an environmental register to track the environmental aspects of their activities during the operational phase. This register will be updated annually. Moreover, a detailed monitoring plan will be made available by the company at the beginning of the operation phase.

It is worth mentioning that environmental monitoring is a dynamic process. Consequently, regular updates and modifications, as needed, shall be carried out based on the results of the first monitoring round. Moreover, as mentioned in Chapter (5), if different standards for the same parameter are mentioned, the project shall adopt the most stringent standard.

- **Air Quality Monitoring During Construction**

Workplace air monitoring of equipment exhaust will be performed quarterly. Emissions are generated from exhaust from construction equipment and motor vehicles and particulates during site works. Monitoring results will be compared with the allowable limits of Law 4/1994 provided in Chapter (5) of this study.

The following parameters shall be measured:

- Carbon monoxide, CO
- Sulfur dioxide, SO<sub>2</sub>
- Nitrogen oxides, NO<sub>x</sub>
- PM<sub>10</sub>

- **Workplace Monitoring**

#### ***Labour Audit***

Labour audits are the most common spot-check mechanism used to monitor labour standards during both the construction and operation phases. Essentially, they serve as tools to ensure and support the application of labour standards through a thorough formal examination of the labour practices at a specific workplace or company, based on corroborated evidence.

The purpose of an audit is to evaluate these practices against a defined standard, and it will extend to the supply chain" in accordance to Scatec Human Rights policy, EBRD PR2, ILO and relevant guidelines and Egyptian Labour law. Additionally, monitoring will include tracking

grievances received from workers and external stakeholders, as well as documenting how these grievances were resolved.

### **Workplace Noise**

#### *During Construction*

During construction, the project will ensure that the noise level from all construction equipment would not exceed the allowable limit set by Law 4/ 1994 for 8 hours duration shift (90 dB). In case the noise levels exceeded this limit, the exposure periods will be carried out according to those indicated in Annex (7) of Law 4/1994. Moreover, ear plugs will be provided for the workers at the locations generating increased noise levels. Noise level measurement will be carried out quarterly.

#### *During Operation*

Sources of noise result mainly from transformers and inverters. The measured noise levels will be compared to the levels set in Annex (7) of Law 4/1994. In case the noise exceeded the maximum limit of 90 dB, exposure periods will be proceeded as stipulated in Law 4/1994.

- **Solid and Hazardous Wastes**

Non-hazardous solid wastes will be recorded in the Environmental register of the plant. On the other hand, according to Law 4/1994, a register will be prepared for hazardous wastes. Information of the HW register should include types and quantities of hazardous wastes, storage means and disposal.

An independent consultant would be hired for carrying out the monitoring activities. The following Table 39 provides the proposed monitoring plan. The costs only cover analysis and field measurements. However, they do not include specific sample collection costs.

- **Biodiversity monitoring**

Visual inspection will be conducted on daily basis. This inspection will cover aspects related to status of biodiversity and the presence of potential hazards to wildlife and habitats. The inspection will also check to ensure proper implementation of measures outlined in this ESIA to minimize potential risks associated with day-to-day activities.

A basic fauna encounter procedure will be established and implemented to keep records of animal sightings, including dead animals due to vehicle collisions or other reasons. A Fauna Encounter Form will be developed and distributed to selected onsite staff. A form will be filled for each encountered species and will contain basic information, including:

- Name of the animal;
- Brief description;
- Sighting location(s) (including coordinates, if possible);
- Number of sightings;
- Number of sighted animals;
- Notable behaviour;
- Interaction with the project; and
- Photos of the animal.

All compiled forms will be kept in a register and used for the development of monthly reports.

Moreover, visual inspection carried out by onsite project staff will be sufficient to monitor aspects that could attract vermin and pests (such as water accumulation, unsafe disposal of solid waste and wastewater) and assess the potential presence of pests (rodents, insects, etc.).

In addition, the visual inspection and Fauna Encounter Procedure will also report the potential occurrence of any species alien to the area.

Table 39: Proposed Environmental Monitoring Plan

Receptors / Source of impact/risk	Type of monitoring		Monitoring location	Target / Indicators	Frequency of monitoring	Responsibility	Implementation	Approximate annual costs
Construction phase								
Workplace and neighbouring industrial area	Noise measurements		Project site and borders near the industrial zone	Compliance of noise intensity to standards	Measurement at two locations quarterly	All contractors and sub-contractors, supervised by Dandra	Third party (research entity or certified lab)	~10,000 EGP
	Air emissions		Project site and borders near the industrial zone	Compliance of air emission standards	Measurement at two locations quarterly	All contractors and sub-contractors, supervised by Dandra	Third party (research entity or certified lab)	~ 35,000 EGP
	Biodiversity	Habitats and biodiversity	Project site and Vicinity (Aol)	- Absence of hazards to wildlife and habitats - Proper implementation of mitigation measures	Daily	All contractors and sub-contractors, supervised by Dandra	Project personnel	Included in staff salaries
		Fauna		- Number of fauna encounters - No or reduced number of fatalities (such as road mortalities)	Chance encounters			
		Pests		- Good housekeeping - Absence of pests	Daily			
Operation phase								
Workplace	Noise measurements		Transformers and inverters area	Compliance of noise intensity to standards	Annually	Project	Third party (research entity or certified lab)	~10,000 EGP
Emergency generators stacks	Exhaust measurements		Stacks of emergency generators (SO <sub>2</sub> , NO <sub>2</sub> , CO, PM <sub>10</sub> )	Compliance with point source air emissions standards	Annually	Project	Third party (research entity or certified lab)	~ 25,000 EGP
Project site and vicinity	Biodiversity (same as for construction phase)		Same as for construction phase	Same as for construction phase	Same as for construction phase	Project	Project personnel	Included in staff salaries

### 7.5.2 Social Management Plan

The main aspects of the social management plan are summarized in the following sections.

- **Labour and Working Conditions**

During construction, the project will ensure that contractors are implementing suitable health and safety measures, and that workers are not exposed to forced or compulsory labour, including child labour.

During operation, the project will adhere to the requirements of Law 14/2025 and the general international workplace health and safety guidelines.

- **On-going Consultation**

Dandra has already undertaken various activities to communicate and engage with key stakeholders and is willing to continue its engagement activities (Annex 4).

- **Information Disclosure**

Information regarding the Project shall be publicly available on an on-going basis and updated semi-annually as minimum. Information will be at an appropriate level of details and presented in an accessible mean (e.g., in Arabic with infographics used where beneficial).

This information is expected to include, but not be limited to, project progress updates; proposed future engagement and grievance mechanism; information about project activities; key contacts for the project; and other information, as needed.

- **Grievance Management**

A project grievance management plan will be developed will include external and internal grievance mechanisms.

Handling grievances related to Gender-based Violence (GBV), Sexual Exploitation and Abuse and Harassment (SEAH) will be undertaken in accordance with the requirements set within the AfDB36 ISS Best Practice Note addressing SEAH and GBV and EBRD37 good practice Addressing Gender-Based Violence and Harassment. For grievances related to the above, the steps to be undertaken will be in compliance with the project SEP.

- **Socio-economic Monitoring**

The project will monitor the following socio-economic aspects on a regular basis:

- Satisfaction/concerns of the neighbouring communities/activities with the project;
- Local community' needs (healthcare, water, etc.);
- Grievance mechanism is fully understood by local community; and
- Any unsolved grievances;

<sup>36</sup> [https://www.afdb.org/sites/default/files/borrower\\_guidance\\_note\\_on\\_gender\\_in\\_es\\_safeguards.pdf](https://www.afdb.org/sites/default/files/borrower_guidance_note_on_gender_in_es_safeguards.pdf)

<sup>37</sup> EBRD, Emerging Good Practice for the Private Sector Addressing Gender-Based Violence and Harassment, <https://www.ebrd.com/news/2020/new-guidance-for-private-sector-on-addressing-risks-of-genderbased-violence-and-harassment.html>



The grievance mechanism will also entail process for monitoring community grievances related to: Gender-based Violence (GBV), Sexual Exploitation and Abuse and Harassment (SEAH).

- **Management Plan Review**

The ESMPs will be reviewed to reflect any potential E&S changes and procedures will be re-issued, as/if needed. The Site Manager will be responsible for ensuring that the workforce is complying with procedures, informing the staff of any changes and ensuring that the personnel are aware of changes before starting any works.

## 8. Stakeholders Consultation

Consultation with the community and stakeholders is an important element in the ESIA process. The current chapter presents the details of the individual consultations carried out during preparation of the ESIA.

The consultation methodology is addressed in the ESIA Procedures Guidelines, issued by EEAA in January 2010, as follows:

- Identification of the stakeholders at an early stage of the ESIA; and
- Consultation during the preparation of the ESIA.

A phone scoping meeting took place with the head of the energy project department - EEAA on the 6<sup>th</sup> October 2025 to present the project, confirm its categorization and obtain their requirements and concerns regarding the ESIA.

In addition, a set of scoping consultation meetings took place with different stakeholders. Including a meeting with Qena governorate in July 2025.

The meetings took place on 27<sup>th</sup> to 28<sup>th</sup> of October 2025 with the purpose of scoping the ESIA activities and identifying potential additional stakeholders.

The scoping meetings took place with various categories of stakeholders including:

- Nagaa Hammadi Local Council
- The Nagaa Hammadi Industrial area management, investors, and employees. This was necessary as the closest activity to the project.
- Nearby farms and local communities to the projects, to investigate whether there are perceived impacts.
- Local Women NGO as opportunities for their participation in public meeting might be limited.
- The health unit of El-Baraka village as a critical service provider in the closest residential settlement to the project

The main topics discussed during the meeting included:

- **General feedback on the project**
  - The project is highly welcomed, not only because of its benefits on the national level, but will also contribute to reducing power outage in the region.
  - It will also add to the area another advantage in addition to the industrial area, and the high-speed train.
  - The project is at a considerable distance of other activities in the region (residential, agricultural, etc.) except for the industrial area.
  - The noise impact, which is the most significant during construction, was seen not to highly affect the neighbouring industrial area due to its temporary and intermittent nature. It is only relevant during works in a limited part, closest to the industrial area, of the large area of the project.

- **Possibility of mutual support and synergies**

Especially with the neighbouring industrial area regarding areas of potential cooperation and/service provisions in the future.

- **Concerns about pressure on local resources**

- Lessons learned related to issue of rise in apartment rentals as result Obelisk project of and the measures already implemented to solve the issue. The same mitigation measures will be implemented for the proposed Dandara project to avoid such issues as result of workers influx.
- The trucking of water should be from water plants having excess capacity.
- The supply of other commodities will be through suppliers who will not acquire these resources from the local outlets.
- The measures undertaken for the ongoing Obelisk project resulted in minimising the impacts on traffic, which will also apply to the proposed Dandara project.

- **Local Employment**

There is obviously a keen interest in the community in this respect.

- Although some parties might be specifically interested in security jobs, there is a conviction that the community at large can provide most of the qualifications needed for the project.
- Process of job announcement, and that it will be mainly through the governorate labour office.
- It was clarified that the contractors will be encouraged to continuously increase percentage of local workforce.

Annex 4 presents the detailed minutes of meetings of the stakeholders' consultation process.

## **Annex 1: Hydrological assessment of Dandara Solar Project**

**ONSHORE SUBSURFACE INVESTIGATION,  
DANDARA (EGYPT ALUM) SOLAR PROJECT –  
QENA, EGYPT**

**APPENDIX -K**

**HYDROLOGICAL STUDY**

**PREPARED FOR**

**Scatec**

**PREPARED BY**

**HA** ENGINEERING CONSULTING **إنش إيه للاستشارات الهندسية**

**November 2025**

**Rev. 4**

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## 1 INTRODUCTION

This report presents a comprehensive hydrologic assessment of a 23.19 square kilometer area located in South of Egypt. This assessment aims to provide a detailed analysis of the hydrological characteristics and dynamics within the specified region, which is crucial for informed land development and management.

Solar Project - Nagaa Hammadi, situated in the South part of Egypt, experiences a predominantly arid climate, which significantly influences the hydrologic patterns and water resource availability. The assessment includes an evaluation of precipitation patterns, surface runoff, groundwater recharge, and potential flood risks. It also considers the impact of existing and planned developments on the hydrological regime.

Through the integration of field data, remote sensing, and hydrological modeling, this report aims to offer actionable insights and recommendations to support sustainable development practices in the area.

### 1.1 Project Location

The study area is geographically positioned on the South side of Egypt Next to Nagaa Hammadi village, Qena city.

Between 25.40° , 25.82° Lat and 32.15° , 32.30° Long.

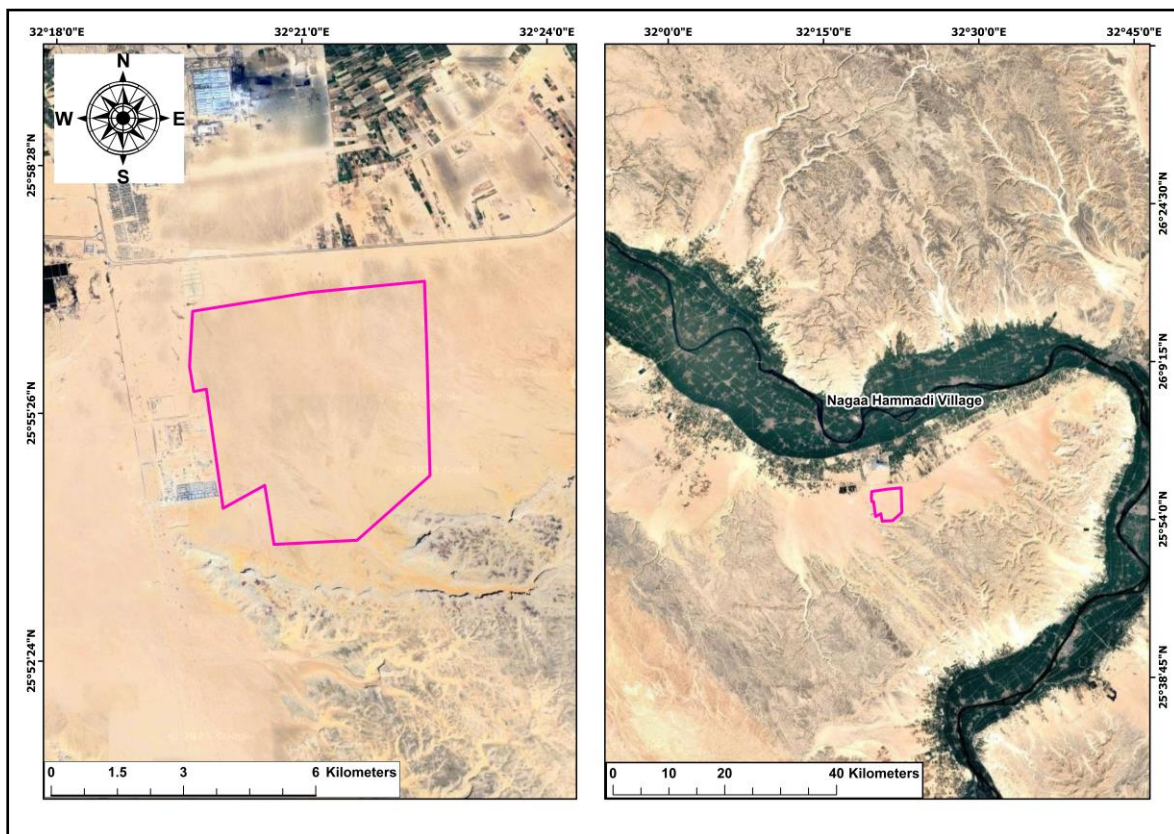


Figure 1-1: project location

## 1.2 Scope of work

The scope of work for the project will include the Hydrology assessment study for the project Location. The deliverable of the above-mentioned scope shall be a final design report (the document at hand) which includes.

- Design guidelines & methodology (hydraulic and hydrologic design criteria).
- Collected data for the project.
- The existing conditions are based on both sites' information.
- Analytical studies and assessment of the collected data.
- Runoff peak flow estimation for effective watersheds.
- The Final results and models' outputs.
- Risk assessment

## 2 Data Collection

This section presents the study area location and description, besides the data collected such as topographic maps, satellite images and rainfall data. In addition, the principles and design criteria used in the hydrological study of the project are also provided.

All data and information on the study were collected from official bodies. The following is a list of the most important information and data collected for analysis and used in the hydrological study of the project:

- Project boundary.
- Digital Elevation Model (DEM) SRTM 30\*30 meters.
- Topographic Survey (4.5\*4.5) m
- Topographic maps of the study area.
- Soil and Land formation maps for the study area.
- Rainfall station data affecting the study area from Egyptian Meteorological Authority

## 2.1 Topographic Data

### 2.1.1 Digital Elevation Models (DEM)

Digital Elevation Models (DEM) for the whole study area were collected and obtained from the freely available SRTM satellite imaging results - satellites for imaging and Earth observation - and the model is a grid matrix image in the horizontal projection at a resolution of 30 meters. The SRTM data are widely used in the identification of drainage basins for hydrological analysis work in many research and advisory bodies. Figure 2-1 presents the Study Area on the digital elevation model of the SRTM data

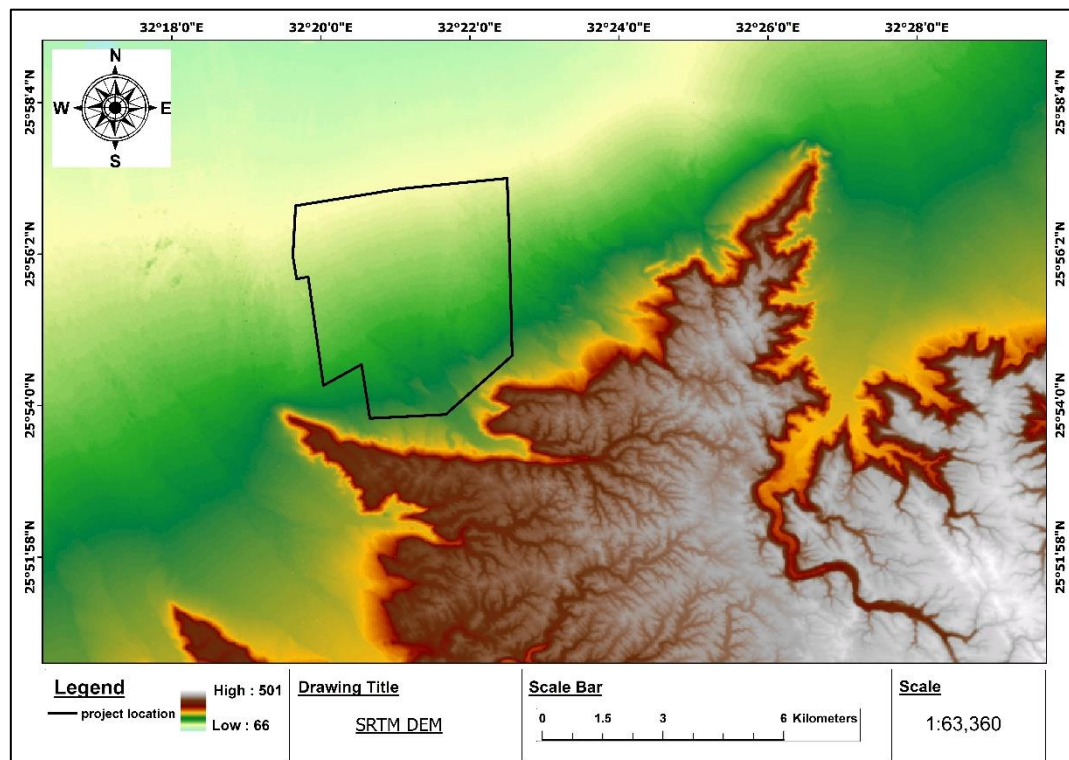


Figure 2-1: Digital Elevation Model (DEM) of the SRTM data for the study area

### 2.1.2 Topographic survey

As part of the data provided, we obtained a high-resolution topographical map (DEM) with a spatial resolution of 4.5 m x 4.5 m, which proved to be highly accurate and reliable. This map was used extensively in terrain modeling and to determine the drainage volumes affecting the project.



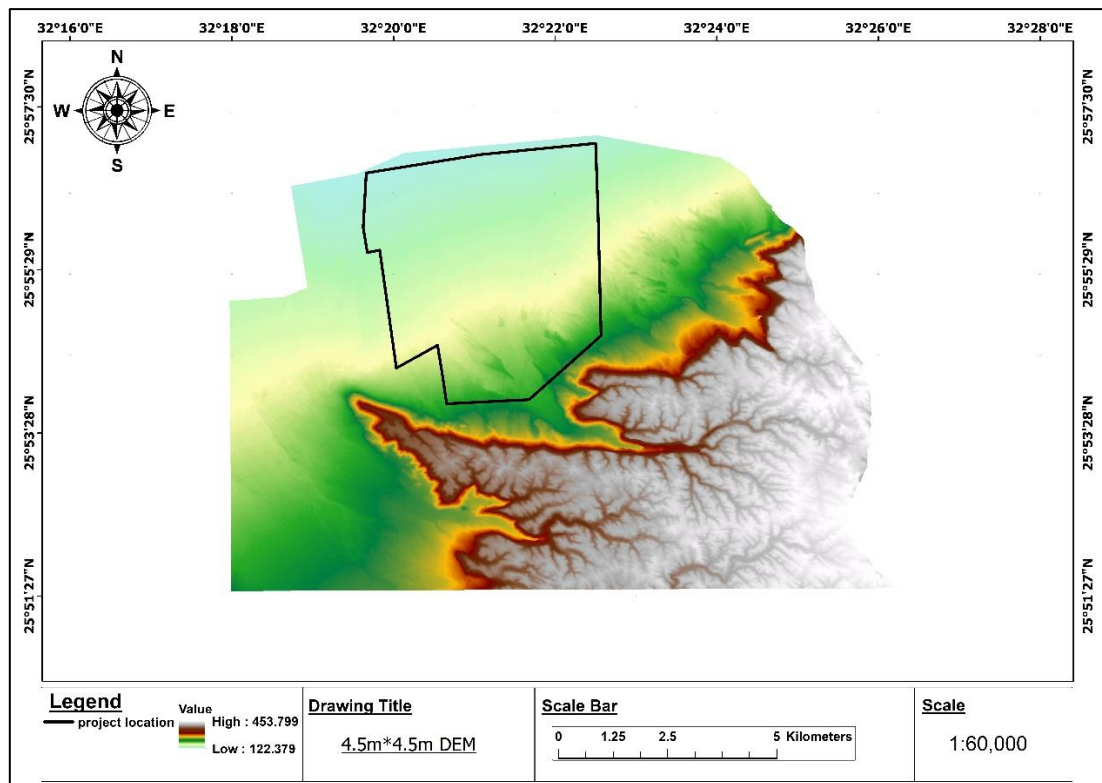


Figure 2-2: Topographic Survey with resolution (4.5\*4.5) m

### 2.1.3 Topo Maps

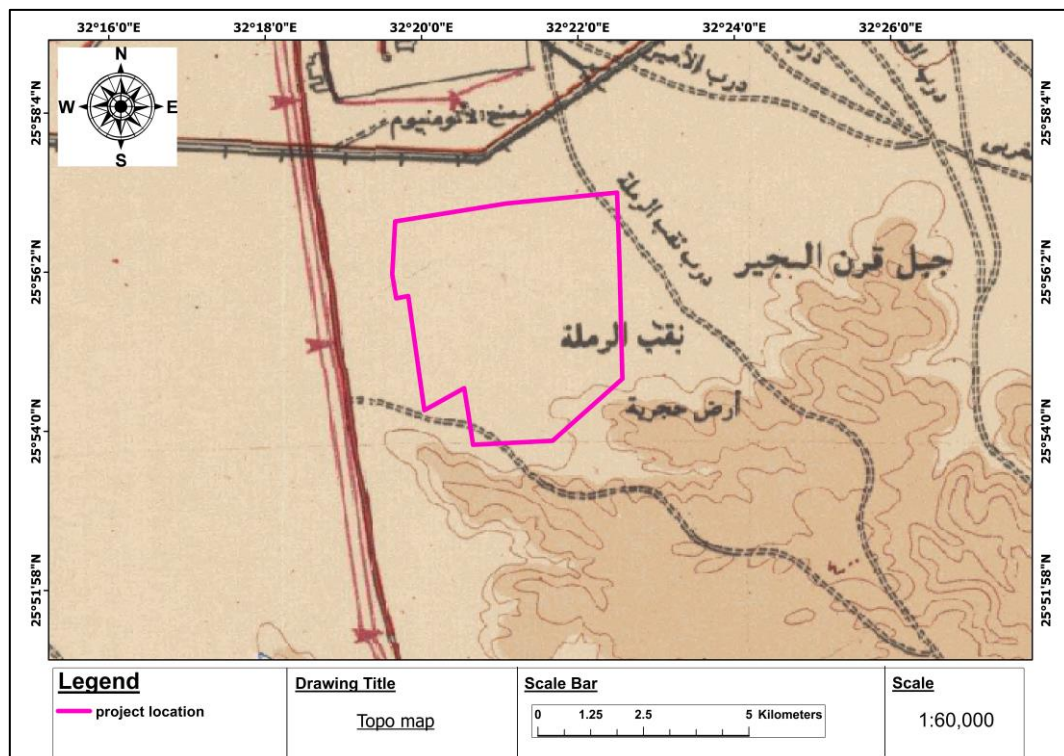


Figure 2-3: Topo map showing the streams and main wadis in the study area

## 2.2 Soil Information

Figure 2-4 demonstrate the prevailing geological conditions around the study area from information collected from the Egyptian Geological Survey and Mining Authority with a scale of 1:2000000

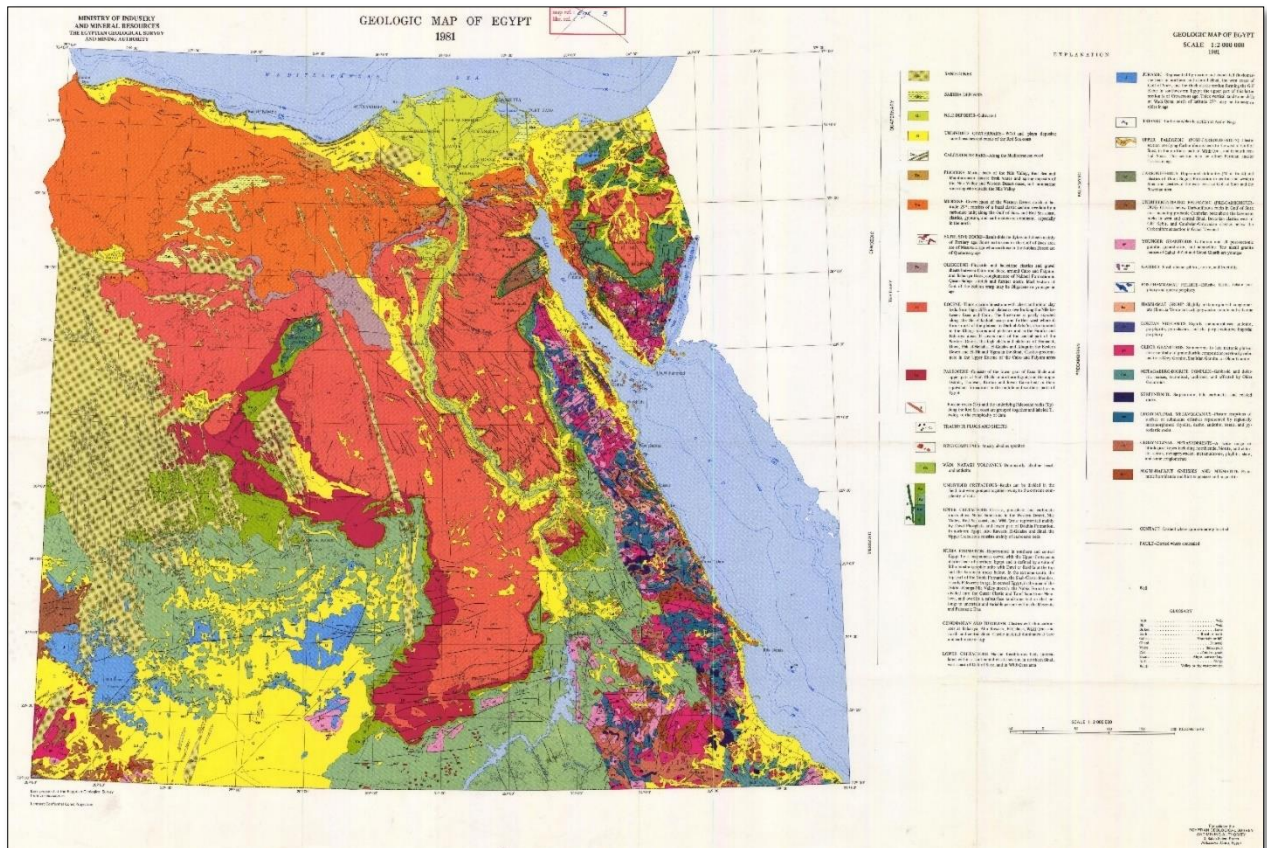


Figure 2-4: Geological map of the study area

### 3 Principles and design criteria

This chapter outlines the principles and design criteria that guided the hydrological analysis conducted for this project. It details the specific methodologies and approaches employed to assess the flood risk and proposed mitigations. In addition, the chapter provides an overview of the software tools utilized to perform the necessary calculations and simulations.

#### 3.1 Standards and Codes

In general, the hydrologic study is based on the design criteria conforming to the following professional standards and codes:

- Highway Drainage Guidelines, 4th ed., AASHTO, USA, 2007.
- DEFRA, E. (2006). R&D outputs: Flood risks to people. Phase 2. FD2321/TR1 The flood risks to people methodology. Department for Environment Food and Rural Affairs and the Environment Agency, London.
- Hydraulic Engineering Circular (HEC) no. 22, Third edition, Urban Drainage Design Manual, Federal Highway Administration, U.S. Department of Transportation, 2009.
- Urban Hydrology for Small Watershed, Technical Release 55, TR55, NRCS, 1986.
- United States Dept. of Agriculture (USDA) (1986) Urban Hydrology for Small Watersheds Technical Release TR 55, Washington, DC.

#### 3.2 Computer Models and Software Packages

The most advanced programs and numerical models were used in the calculation and hydrological and hydraulic analysis of catchment areas and proposed protection work. The following are the main programs and models that are usually used:

- GIS Environment (Arc-Hydro Tools, Spatial Analyst, etc.): to delineate the watersheds, estimate watershed characteristics and develop runoff coefficient maps.
- HEC-SSP software was used to conduct a frequency analysis for the collected rainfall data records.
- HEC-HMS (by USACE) and some developed in-house spreadsheets (MS Excel) are used to estimate the peak flow and to estimate the other hydrologic parameters whenever needed.
- Flow Master or Culvert Studio in the hydraulic design of the proposed protection works such as channels and dikes, and to determine the different hydraulics parameters.
- Civil 3D for developing corridors and surface of Existing and proposed structures.
- HEC-RAS 2D 6.3 (by USACE) in determining the floodplain boundaries of the main streams that affect the study area.



### 3.3 Rainfall-runoff calculations

There are several methods for estimating and calculating the peak flows and runoff hydrographs resulting from the catchment areas affecting the project boundary. The most common methods used are (Rational Method) and (SCS Unit Hydrograph). **Table 3-1** shows the limitations of using these methods according to the area of the catchment affecting the proposed project location. The following sections give a brief explanation of both methods, and how they are applied to estimate peak flows and runoff hydrographs for catchment areas affecting the project boundary.

Table 3-1: Limitations for the rainfall-runoff calculation methods

Catchments Area	Proposed Equation
$A \geq 80 \text{ Ha.}$	SCS Method
$A < 80 \text{ Ha.}$	Rational Method

#### 3.3.1 SCS Unit Hydrograph Method

The United States Soil Conservation Service (SCS – now the Natural Resource Conservation Service "NRCS") method estimates runoff using in addition to rainfall, catchment characteristics such as antecedent soil moisture conditions, types of soil, initial abstraction of rainfall, slope, length of the longest channel, and surface treatment and land cover. These characteristics are reflected by a Curve Number (CN) value. This number typically ranges from 35 (for low runoff depressions) to 98 (for paved impervious areas).

The maximum loss or storage that may occur in the soil of drainage basin (S) as well as the initial abstraction value (Ia) expected to occur in the drainage basin are typically related using an initial abstraction of  $0.2S$ , where S is a maximum soil storage depth (in mm) and CN = Curve Number. The soil storage is calculated from the equation below (other values may be used).

$$S = \left( \frac{1000}{CN} - 10 \right) * 25.4$$

Whereas:

S - Maximum soil storage depth, mm.

CN - Curve number according to the nature of the drainage basin.

Ia - Initial abstraction (at the beginning of rainstorm) mm.

As mentioned in **Table 3-1**, this method will only be utilized for catchments equal to or more than 80 ha (or 0.8 km<sup>2</sup>).

This method can account for the following hydrological processes of the design storm:

- Storm distribution over time (Hyetograph).
- Initial abstraction losses of rainfall and initial storage of the drainage basins (Ia) related to the quantity of water stored in ponds and low areas of the basin as well as those depleted in the process of initial saturation of the surface of the basin.
- Infiltration Rate, which gradually decreases with time from the beginning of the storm until it reaches a fixed value that depends mostly on the physical properties of the soil and its structural formation and the proportion of organic matter in it.

The values of the curve number are estimated according to the geological maps and the aerial photographs and according to Tables mentioned in Technical Release No. 55 (TR-55) issued by The U.S. Department of Agriculture (USDA).

Runoff Depth (R), which is expected to occur on a unit area of the drainage basin (mm), is calculated using the following equation:

$$R = \frac{(P - I_a)^2}{(P + 0.8S)}$$

Whereas:

P - Maximum daily rainfall rate corresponding to design return period, mm.

The runoff hydrograph resulting from (the SCS-Unit hydrograph method) depends on the area of the drainage basin and the Lag time (T lag).

Lag Time: It is the time between the center of mass of the storm ordinate and the peak discharge or it can be defined also as the time from the start of the excess runoff until the inflection point (the point between the falling limb on the hydrograph and the recession limb), and it can be estimated as follows:

$$TL (min.) = 0.6 Tc (min.)$$

The shape of the SCS flood hydrograph is standard and depends on the watershed area and the lag time of the basin. The peak flow for one unit of rainfall excess is given by:

$$Q_{peak} = \frac{2.08 \times A}{T_R}$$

Where:

Q peak: the unit peak discharge in (m<sup>3</sup>/s/mm);

A: the drainage area in (km<sup>2</sup>)

TR: the time of the rise of the flood hydrograph, which equals the lag time plus one-half of the storm duration in (hours). The SCS flood hydrograph calculations are performed by the available computer software such as HEC-HMS.

### 3.3.2 Rational Method

This method is one of the best-known and most widely used for the determination of peak flows from small catchments (area less than 80 ha). Further information can be derived from the Highway Hydrology, Hydraulic Design Series No. 2 (HDS-2) NHI-02-001. The peak flow is obtained from the following peak flow formula:

$$Q = \frac{CIA}{3.6}$$

Where;

- Q* = peak flow (m<sup>3</sup>/s)  
*C* = runoff coefficient  
*I* = average rainfall intensity over catchment (mm/h)  
*A* = effective area of the catchment (km<sup>2</sup>)

### 3.6 = conversion factor

The application of the formula is based on the following:

- (1) The rainfall has a uniform area distribution across the catchment.
- (2) The rainfall has a uniform time distribution during the time of concentration.
- (3) The peak discharge occurs at the end of the time of concentration.
- (4) The runoff coefficient C remains constant throughout the duration of the storm.
- (5) The return period of the peak flow is the same as that of the rainfall intensity.

The Terms of the Peak Flow Formula:

**Runoff coefficient (C):** It represents the many factors influencing the rainfall/runoff relationship. It is a measure of that part of the storm rainfall contributing to the peak flood runoff at the point of discharge of the catchment. There is no theoretical method for determining the runoff coefficient (C); experience and engineering judgement plays an important part in the successful application of the method.

In an industrial area with a high proportion of impermeable surfaces such as roads and paving the runoff coefficient could be as high as 0.95, while in a flat rural area, well-treed with a permeable sandy formation the runoff coefficient may be 0.10. Recommended values of the runoff factor for use in the rational formula are provided in **Table 3-2**, (as per MOT standards).

Table 3-2: Recommended Values of the runoff coefficient (C) (Source: MOT Design Manual)

Watershed Characteristics			
A Relief	B Soil Infiltration	C Vegetal Cover	D Surface Storage
<b>0.40</b> Steep rugged terrain; average slopes greater than 30%	<b>0.20</b> No effective soil cover; either rock or thin soil mantle negligible infiltration capacity	<b>0.20</b> No effective plant cover; bare or very sparse soil cover	<b>0.20</b> Negligible; Surface depression few and shallow; drainage ways steep and small no ponds or Marshall
<b>0.30</b> Hilly with average slopes of 10 to 30%	<b>0.15</b> Slow to take up water; clay, or other soil of low infiltration capacity such as heavy gumbo	<b>0.15</b> Poor to fair; clean cultivated crops or poor natural cover; less than 10% of the area under good cover	<b>0.15</b> Low; well-defined system of small drainage ways, no ponds of marches.
<b>0.20</b> Rolling with average slopes of 5 to 10%	<b>0.10</b> Normal, deep loam	<b>0.10</b> Fair to good; about 50% of the area is in good grassland, woodland or equivalent cover.	<b>0.10</b> Normal; considerable surface depression storage; typical of prairie lands; lakes ponds, and marshes less than 20% of the area.
<b>0.10</b> Relatively flat land average slopes 0 to 5%	<b>0.05</b> High, deep sand or other soil that takes up water readily and rapidly.	<b>0.05</b> Good to excellent; about 50% of the area is in good land; woodland or equivalent cover.	<b>0.05</b> High; surface depression storage high; drainage system not sharply defined, large flood plain storage; a

Watershed Characteristics			
A Relief	B Soil Infiltration	C Vegetal Cover	D Surface Storage
			large number of ponds and marshes.

In the case of variable-type areas then the average areal runoff coefficient is calculated as follows:

$$C = \frac{C_1 A_1 + C_2 A_2 + \dots + C_n A_n}{A_1 + A_2 + \dots + A_n}$$

Whereas:  $C_1, \dots, C_n$  are the runoff coefficients for the sub-catchment areas  $A_1, \dots, A_n$  respectively.

**Rainfall Intensity, I:** The intensity of a design storm increases as the return period increases and as the duration of the storm decreases. To obtain the largest possible peak flow for a given return period, using the rational method, the storm rainfall must have a duration equal to the time of concentration. If the storm lasts longer than the time of concentration it will have a low intensity, IDF curves will be developed for the rainfall stations in the vicinity of the study area.

**Time of Concentration,  $T_c$ :** The time of concentration is the time required for runoff from the most distant point of the catchment to contribute to the peak discharge. In the context of the Rational Method, the duration of storm rainfall must be equal to the time of concentration.

### Watershed Lag Method

The SCS method for watershed lag was developed by Mockus in 1961. It spans a broad set of conditions ranging from heavily forested watersheds with steep channels and a high percent of runoff resulting from subsurface flow to meadows providing a high retardance to surface runoff, to smooth land surfaces and large paved areas.

Various researchers (Mockus 1957; Simas 1996) found that for average natural watershed conditions and approximately uniform distribution of runoff:  $T_{lag} = 0.6 T_c$

$$T_c = 0.01944 L^{0.77} S^{-0.385}$$

$T_c \rightarrow$  Time of concentration (min.).

$L \rightarrow$  Longest Flow Path (m) Flow length can be measured using aerial photographs, quadrangle sheets, or GIS techniques.

$S \rightarrow$  average watershed land slope.

The hydraulic design aims to provide a drainage structure of adequate capacity that can safely convey the design flow without significant damages or inconveniences. The hydraulic design process consists of establishing design criteria, developing alternatives, and selecting the alternative that best satisfies the design criteria.

### 3.4 The Design Return Period

The frequency of storms within a specified period and the frequency of the storm reflects the degree of flood risks. The choice of return period depends on the importance and

location of the proposed protection structure. **Table 3-3** shows the adopted design return period for the different elements of flood protection that can be used for the project.

*Table 3-3: Design Return Period for Different Protection Elements*

Drainage Element	Design Storm RP (1: Yrs.)
Dams	200/100
Wadi Bridges	100
Crossing Culverts	100
Diversion Channel	100
Dikes	100
Side Slope Protection works	100

#### Design Concept:

During the planning and design phase of this project, floodwater drainage problems will be carefully considered. Every possible effort will be implemented to define the natural watercourses, preserve their integrity, and maintain the natural drainage paths.

Flood protection works will be provided to prevent any possible attack of the Solar Project by external watersheds according to the velocity of flows. Flood protection structures in this project may include the following elements:

- Raised Roadway to act as a dike.
- Open channel

### 3.5 Aggradation and Degradation Analysis (Scour calculation)

Aggradation and degradation are the vertical raising and lowering, respectively, of the streambed over relatively long distances and time frames. Such changes can be the result of both natural and man-induced changes in the watershed. The sediment continuity concept is the primary principle applied in both qualitative and quantitative analyses of bed elevation changes. After an introduction to the concept of sediment continuity, some factors causing a bed elevation change are reviewed. Figure 3-1 shows Definition Sketch of Sediment Continuity Concept.

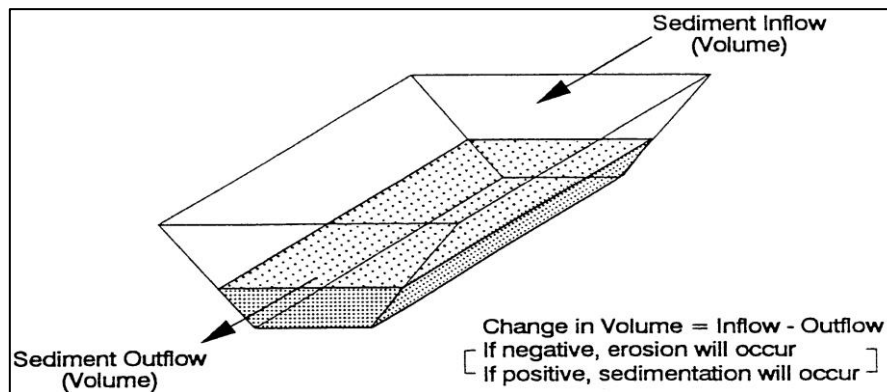


Figure 3-1 Definition Sketch of Sediment Continuity Concept

### Inception motion

Incipient motion is the condition where the hydraulic forces acting on a sediment particle are equal to the forces resisting motion. The particle is at a critical condition where a slight increase in the hydraulic forces will cause the particle to move.

Incipient motion conditions can be analyzed using the Shields diagram or by the following equation developed from the diagram: (HEC-20)

$$D_c = \frac{\tau_0}{k_s (\gamma_s - \gamma)}$$

Where.

$D_c$  → Diameter of the sediment particle at the critical condition, ft

$\tau_0$  → Boundary shear stress  $lb/ft^2$

$\gamma$  → Specific weight of Water  $lb/ft^3$

$\gamma_s$  → Specific weight of sediment  $lb/ft^3$

$k_s$  → Dimensionless coefficient often referred to as the Shields parameter

The Shields parameter can range from 0.03 to 0.10 for natural sediments based on particle shape, angularity, gradation and imbrication. (0.05 for and sizes provides reasonable results, 0.03 for gravel and cobble sizes).

$$\tau_0 = \frac{\gamma n^2 v^2}{1.486^2 R^{1/3}}$$

Where.

$n$  → Manning roughness coefficient

$v$  → Average channel velocity, ft/s



$R \rightarrow$  Hydraulic radius, ft (approximately equal to the flow depth ( $y$ ) for many natural channels.)

Armoring occurs when the hydraulic forces are sufficient to move a portion of the bed material but insufficient to move the larger sizes. Under these conditions, the smaller material is transported and removed from the bed leaving the coarse material or an armor layer. Armor layers often form in gravel bed rivers during the recession of floods. These armor layers may be disturbed during the next major flood and re-form during the flood recession.

The incipient motion equation can be used to determine the critical size of material that can resist a particular hydraulic condition. If at least five percent of the material is larger than the critical size ( $D_{95}$  or smaller), armoring can occur.

$$y_s = y_a \left( \frac{1}{P_c} - 1 \right)$$

$y_s \rightarrow$  Depth of degradation or scour required to form the armor layer, ft

$y_a \rightarrow$  Thickness of the armor layer, ft

$P_c \rightarrow$  Percent of material coarser than the critical particle size expressed as a decimal fraction

The thickness of the armor layer ranges from one to three times the critical size ( $D_c$ ) determined from the Shields incipient motion relation. A minimum of two times the critical size is required for a relatively stable armor layer.

## 4 ANALYTICAL STUDIES

The statistical analysis of rainfall data is one of the most important analytical studies to be carried out in any flood protection and storm drainage project, where rainfall is the main element causing the flow in streams, and this is why this study was given maximum priority from the compilation of data, study and detailed analysis, conducting a series of statistical tests on them using the best means to deduce the design storms, and developing the IDF curves, for which design flows will be calculated. **Figure 4-1** shows the average distribution of the maximum daily rainfall depth values in Egypt.

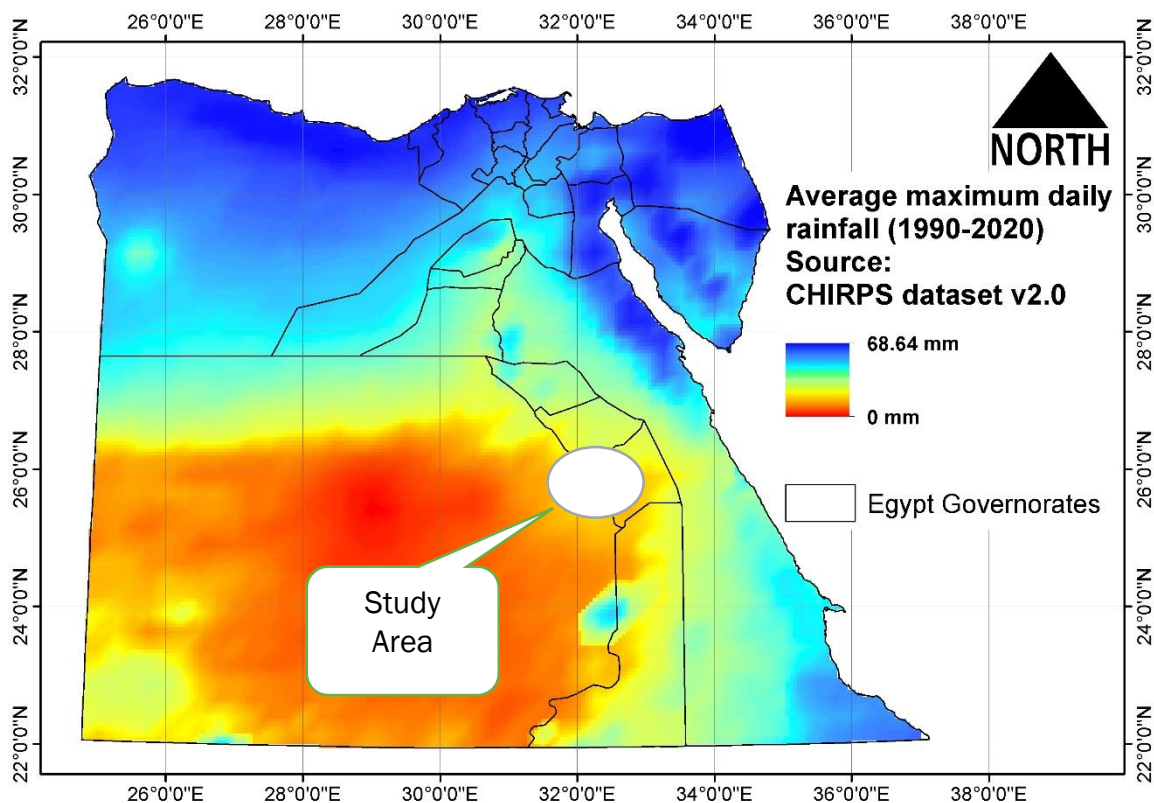


Figure 4-1: Distribution of average annual rainfall depth values over Egypt

#### 4.1 Meteorological Analysis

According to project location, the Station (Qena) is found near the study area as shown in **Figure 4-2** the records of this station will be utilized in further analysis. The maximum recorded daily rainfall depth at Qena Station is 55.3 mm, which occurred in 1949.

**Figure 4-3** present the maximum daily rainfall values recorded at Qena Station.

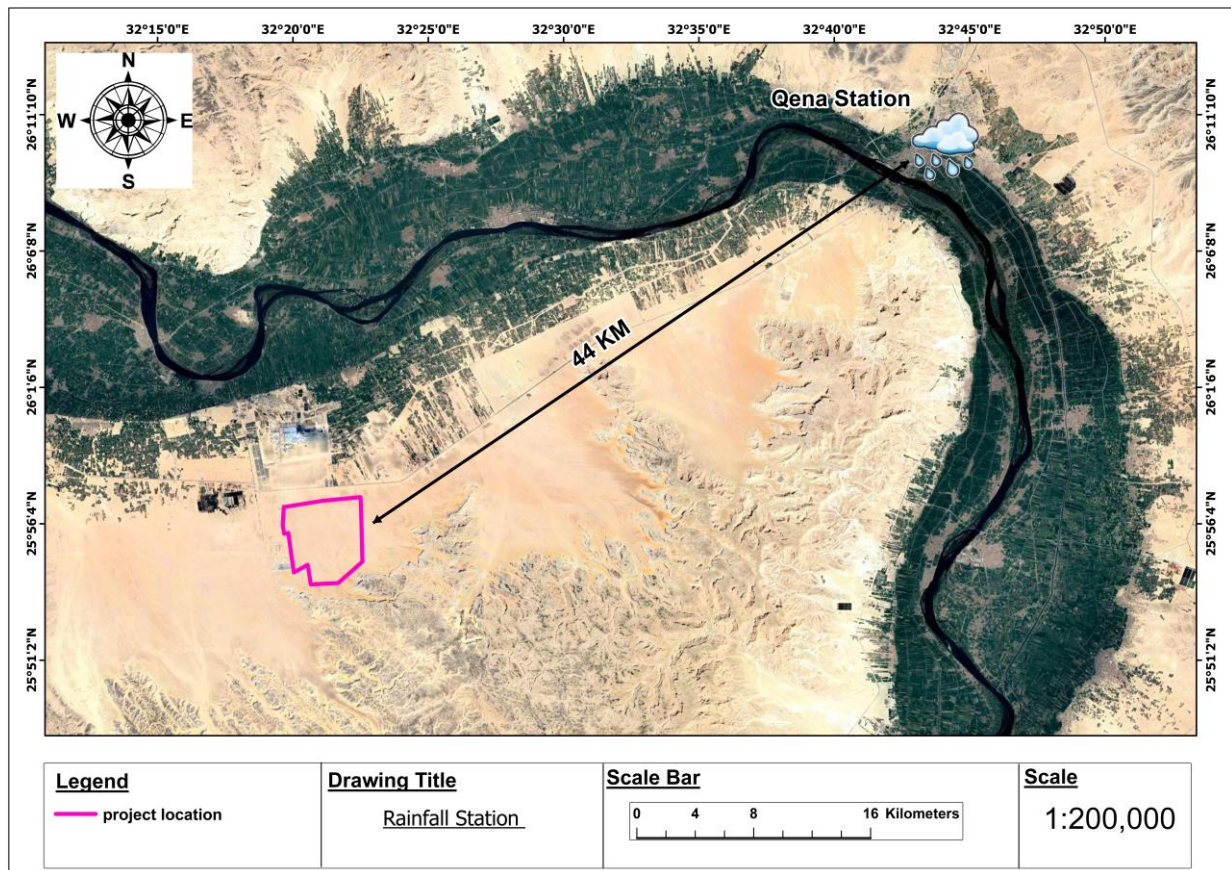


Figure 4-2: Location of adjacent the rainfall station

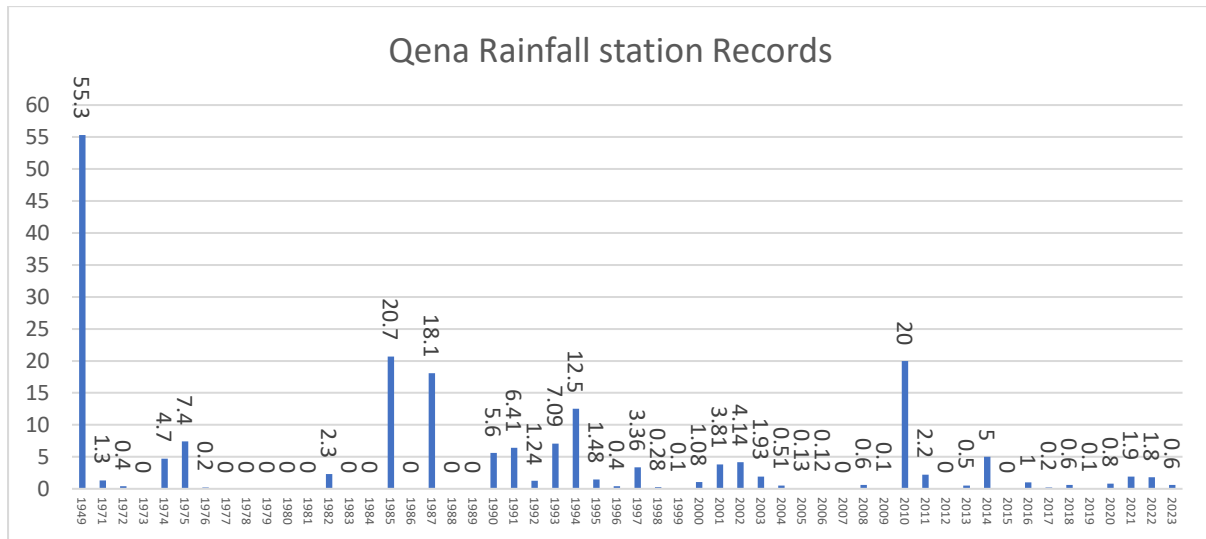


Figure 4-3: Maximum daily Rainfall during each year

- Bulletin 17 C was taken as a reference to analyses the station records.
- HEC-SSP software was used to apply the steps provided in the Bulletin 17 C and identify the low outliers and the required depths for each return period.
- Log Pearson III fitting was used to identify the Depths for each return period.
- This approach was taken to deal with the record gap from 1950 to 1970 and to consider the 1949 historical event.

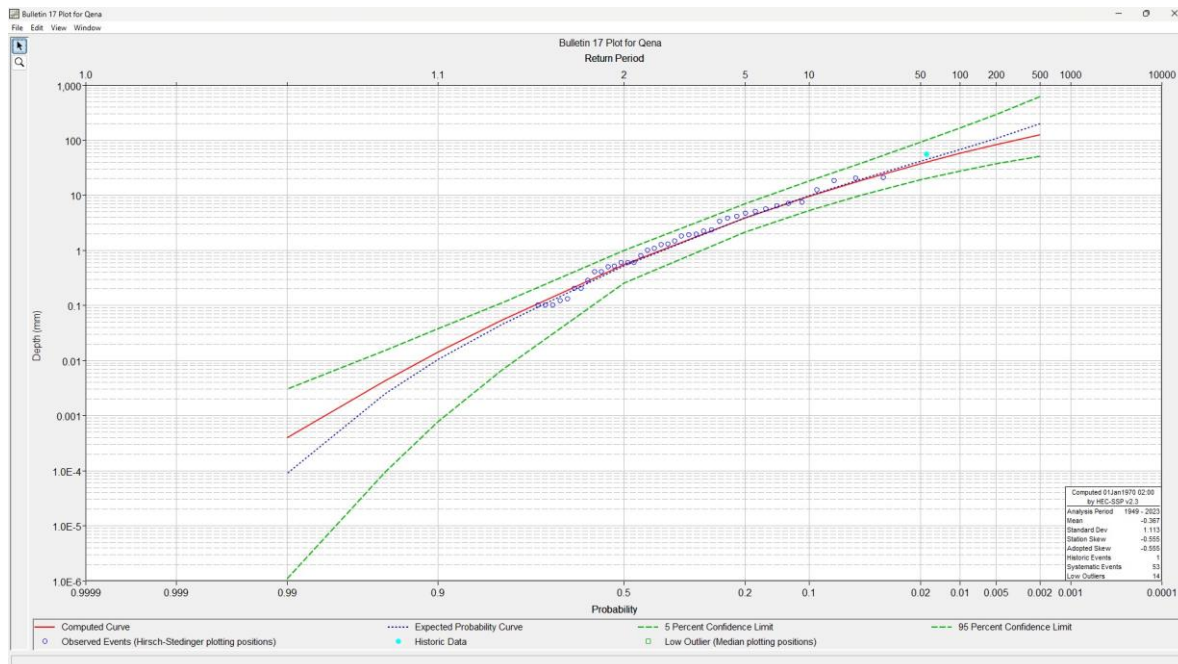


Figure 4-4: Log Pearson III fitting Curve for Qena Rainfall Station.



Table 4-4-1: Rainfall Statistical Analysis Results for Qena Rainfall Station.

Returned Periods.	Rainfall Depth (mm)	Rainfall Depth with 20% climate impact (mm)
P 200 yr.	84.0	100.8
P 100 yr.	58.1	69.72
P 50 yr.	37.8	45.36
P 25 yr.	22.6	27.12
P 10 yr.	9.50	11.4
P 5 yr.	3.90	4.68

#### 4.1.1 IDF curves

Intensity–Duration–Frequency (IDF) curves are fundamental tools in hydrologic and hydraulic design, providing a statistical relationship between rainfall intensity, storm duration, and frequency (return period). They are typically derived from long-term rainfall records and are used to design stormwater infrastructure, flood protection measures, and hydraulic structures.

In this study, IDF curves were developed using Bell's ratios method, which provides a simplified empirical approach for estimating rainfall intensities across multiple durations based on a known 24-hour depth. The Bell ratio technique relates shorter-duration rainfall depths to the 24-hour depth through dimensionless ratios, ensuring consistency across durations and allowing for practical application where continuous high-resolution data may be limited.

Recognizing the potential impacts of climate change on extreme rainfall, an additional set of IDF curves has been developed by applying a 20% increase to the design storm depths. This adjustment reflects projected intensification of rainfall extremes and provides a more conservative basis for design, ensuring resilience of hydraulic and stormwater systems under future climatic conditions.

Accordingly, two sets of IDF curves are presented:

1. Baseline IDF curves – derived using Bell ratios and historical rainfall data. (Figure 4-5)
2. Climate-adjusted IDF curves – developed by applying a 20% increment to storm depths, to account for climate change impacts. (Figure 4-6)

These parallel curves enable comparison between current design standards and future-resilient design considerations, supporting decision-makers in adopting robust and adaptive stormwater management solutions.

Table 4-2: Bell's Ratio

Duration (min.)	10	20	30	60	120	180	360	720	1440
Bell's Ratios	0.28	0.39	0.46	0.60	0.77	0.81	0.87	0.93	1.00

Table 4-3: Tabulated IDF Values for baseline Curves

	Duration (min.)								
Return period	10	20	30	60	120	180	360	720	1440
100 yrs	96.27	67.14	53.25	34.96	22.44	15.60	8.38	4.50	2.42
50 yrs	62.63	43.68	34.65	22.75	14.60	10.15	5.45	2.93	1.58
25 yrs	37.45	26.11	20.71	13.60	8.73	6.07	3.26	1.75	0.94
10 yrs	15.74	10.98	8.71	5.72	3.67	2.55	1.37	0.74	0.40
5 yrs	6.46	4.51	3.57	2.35	1.51	1.05	0.56	0.30	0.16

Table 4-4: Tabulated IDF Values for Modified Curves with climate impact

	Duration (min.)								
Return period	10	20	30	60	120	180	360	720	1440
100 yrs	115.52	80.56	63.90	41.95	26.92	18.72	10.06	5.40	2.91
50 yrs	75.16	52.41	41.57	27.30	17.52	12.18	6.54	3.52	1.89
25 yrs	44.94	31.34	24.86	16.32	10.47	7.28	3.91	2.10	1.13
10 yrs	18.89	13.17	10.45	6.86	4.40	3.06	1.64	0.88	0.48
5 yrs	7.75	5.41	4.29	2.82	1.81	1.26	0.68	0.36	0.20



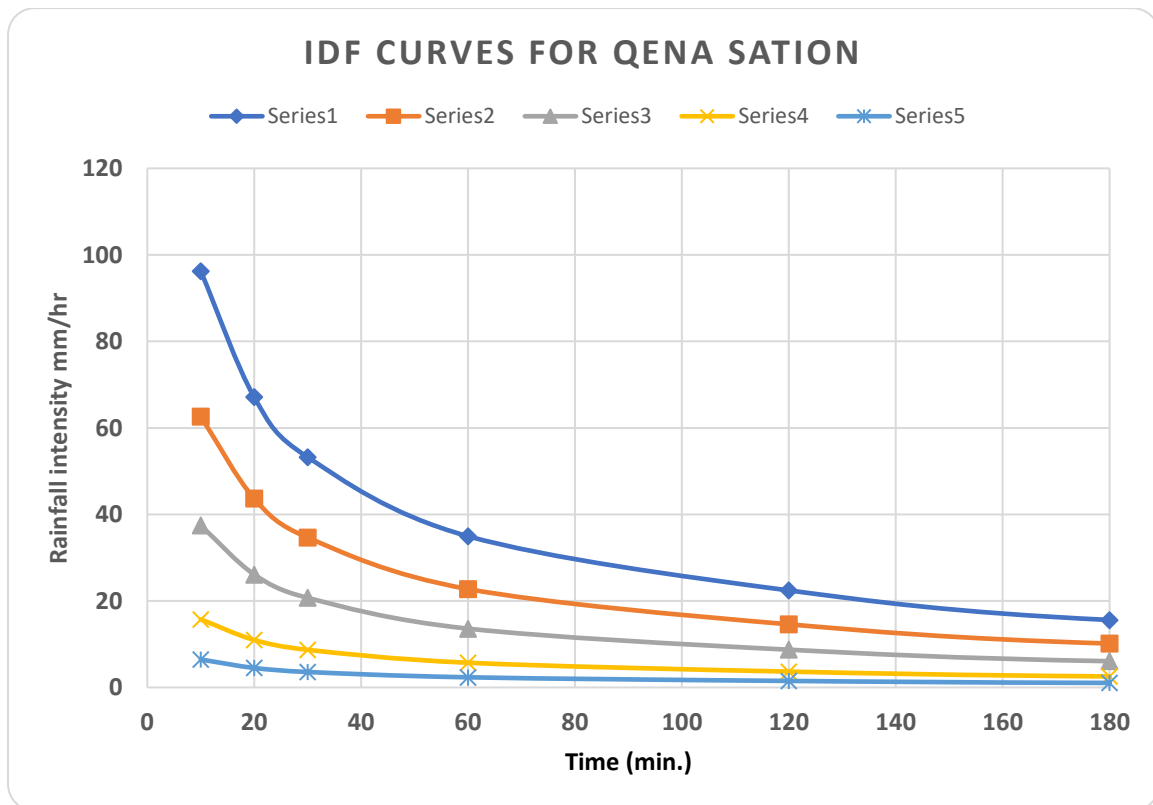


Figure 4-5: 1. Baseline IDF curves – derived using Bell ratios and historical rainfall data

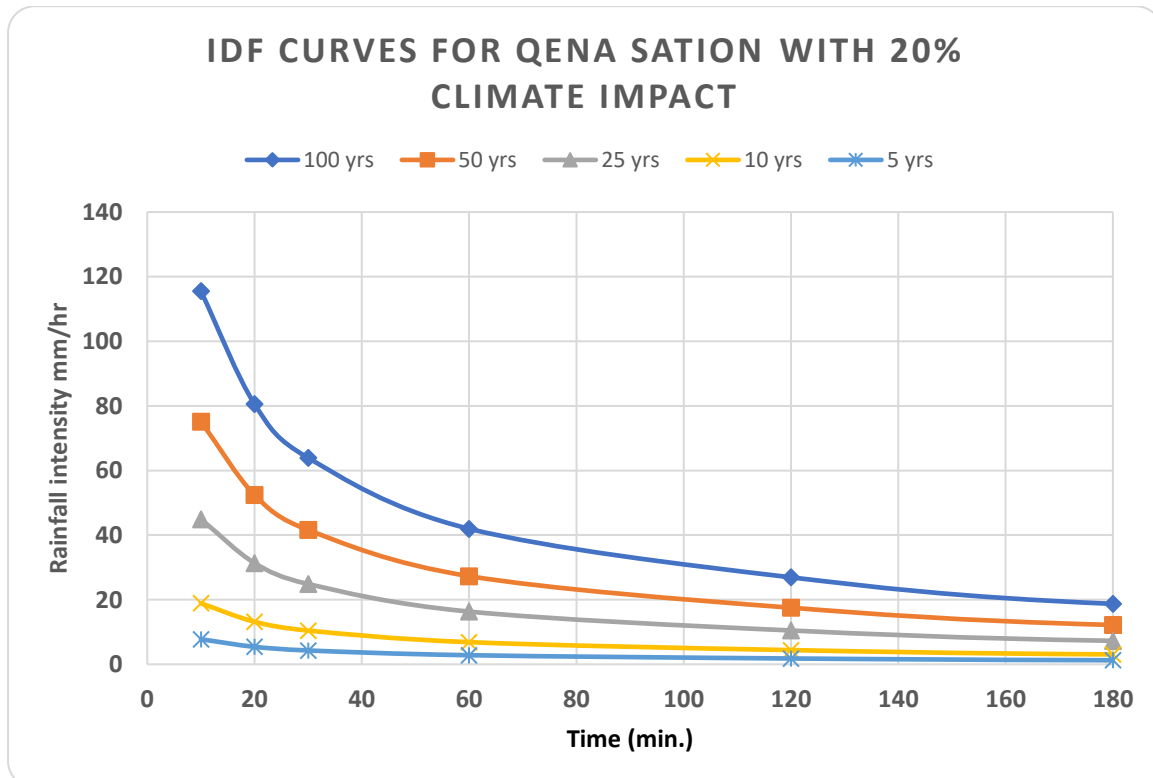


Figure 4-6: 2. Climate-adjusted IDF curves – developed by applying a 20% increment to storm depths

## 4.2 MORPHOLOGICAL ANALYSIS

Morphological studies and identification of streams and drainage basins affecting the boundaries of the study area were performed using the SRTM reviewed previously in this report on ArcGIS software. *Figure 4-7* shows a general overview of the streams affecting the whole project area and from which the effective watersheds will be determined, while *Figure 4-8* shows the effective watersheds in the study area projected on a Satellite image.

The topographic maps and recent satellite images were used to check the results of the software and determine the main effective watersheds. Topographic maps are widely used in determining the paths of streams in various areas, especially in areas that are not accessible. The names of major streams can be identified through the maps showing the names in each region and also the topographic maps show the elevations and contour lines, which are used in the identification of streams and watercourses in areas where there is no clear stream path and also used to determine the different morphological characteristics of all catchments (boundary, area, longest flow path, slope, shape, time of concentration, ... etc.).

Also, the topographic maps show some important elements such as roads, power lines and others.

*Figure 4-9* shows the main streams and the main watersheds affecting the study area verified using topographic maps, while *Table 4-4* shows the morphological characteristics of the watersheds affecting the project boundaries.

*Table 4-5: Morphological parameters of watersheds affecting the project boundary*

Watershed Name	Area (km2)	LFP (m)	Time of concentration (min)	Lag time (min)
Subbasin-1	1.94	5966	86	51
Subbasin-2	0.23	1643	36	21
Subbasin-3	0.93	3575	63	38
Subbasin-4	7.86	8328	95	57
Subbasin-5	0.35	2332	42	25
Subbasin-6	2.34	5623	62	37
Subbasin-7	0.22	1707	28	17
Subbasin-8	0.81	2682	34	20
Subbasin-9	0.25	1430	15	9
Subbasin-10	1.03	2803	31	18
Subbasin-11	15.98	11367	140	84
Subbasin-12	0.45	2395	26	16
Subbasin-13	0.31	1955	22	13
Subbasin-14	0.60	2221	25	15
Subbasin-15	0.46	2437	29	18
Subbasin-16	1.34	3695	43	26

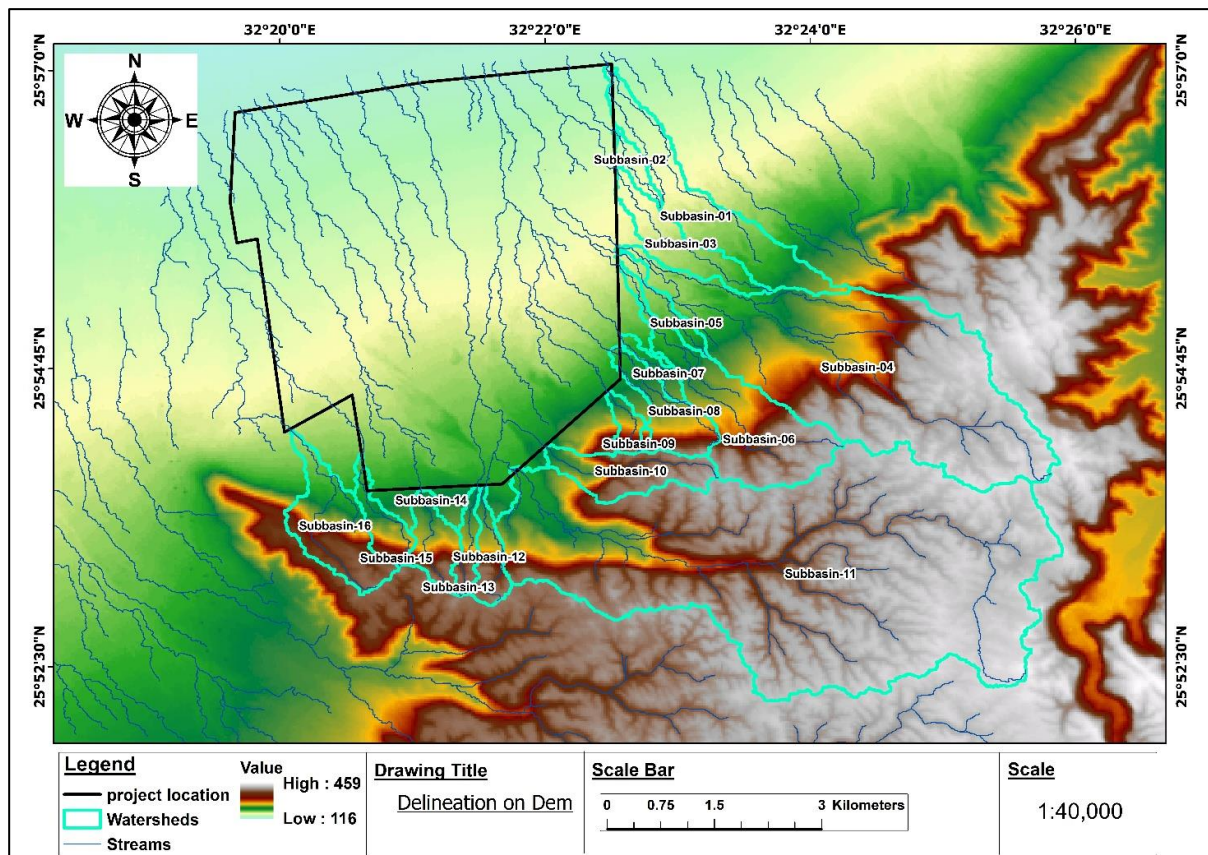


Figure 4-7: Streams and Watersheds affecting the study area draped over DEM

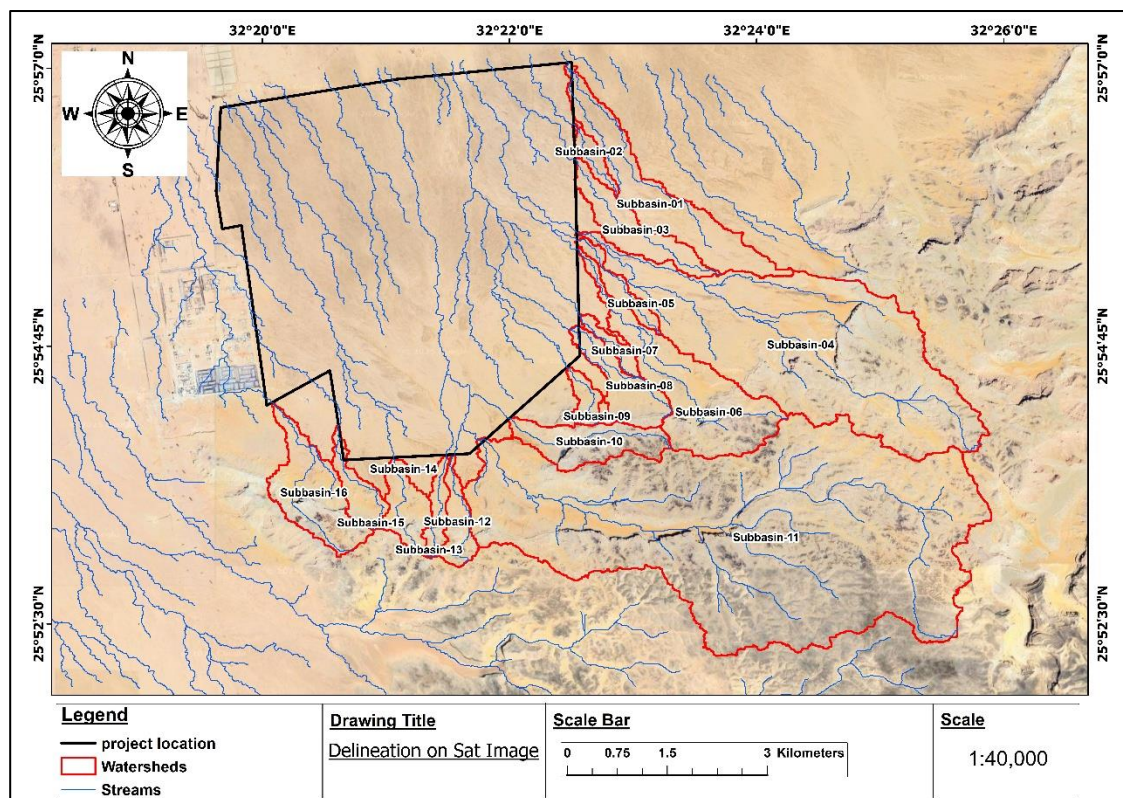


Figure 4-8: Streams and Watersheds affecting the study area draped over a satellite image



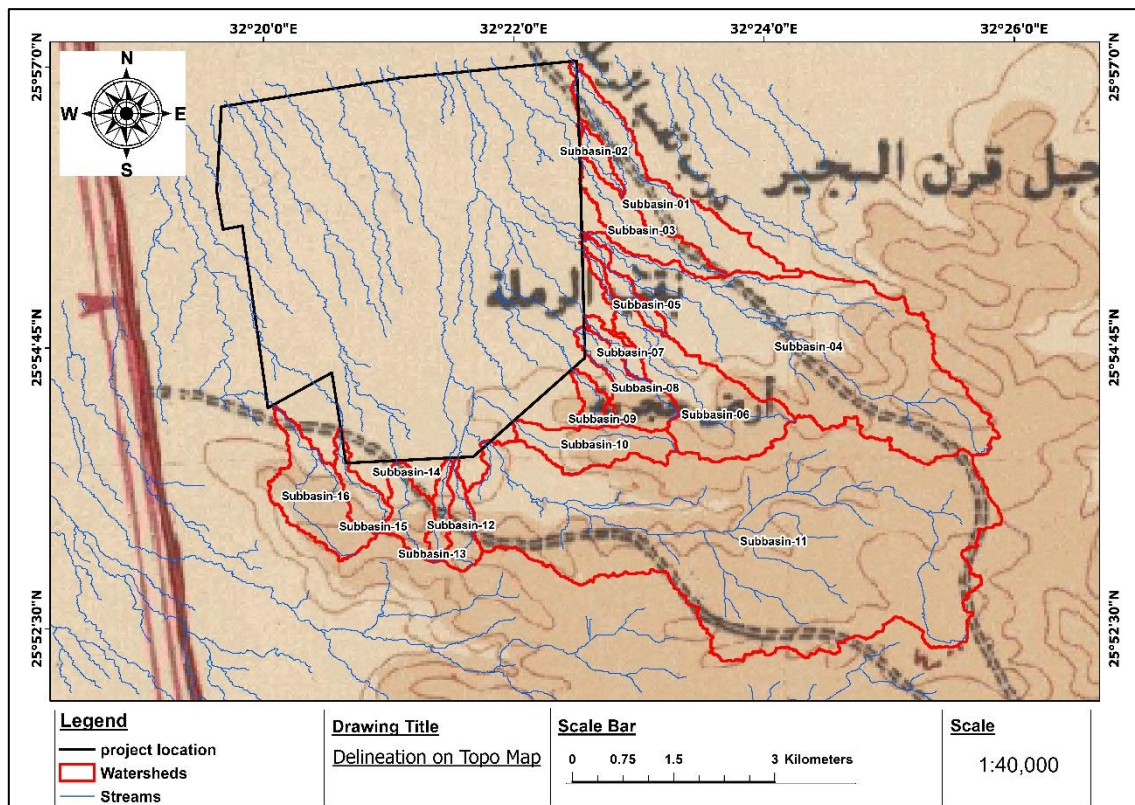


Figure 4-9: Main watersheds and Streams affecting the study area draped over topographic maps

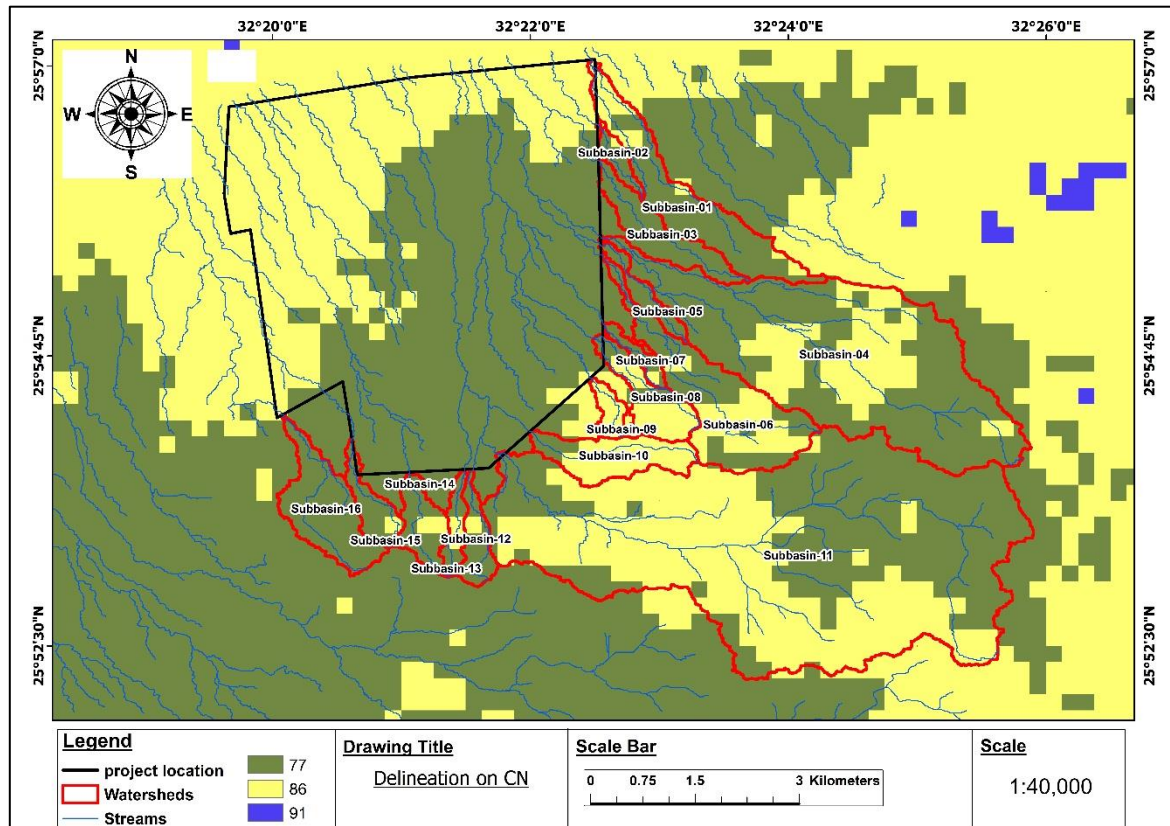


Figure 4-10: Main watersheds affecting the study area draped over the CN grid

### 4.3 HYDROLOGICAL ANALYSIS

Hydrological studies represent the foundation for the selection of Flood protection works. Meteorological, morphological, geological and by considering design storms and their distribution are considered as the input to the hydrological study, the maximum flow and flow hydrograph is the main output of the hydrological study, which is used in the hydraulic design of flood protection works.

#### 4.3.1 Design Storm

SCS Storm Type II has been used extensively worldwide, providing logical and safe maximum discharge values, as it relies on concentrating the bulk of precipitation in a short time. **Figure 4-11** shows the Distribution of a storm in an SCS Storm type II method for 24 hours.

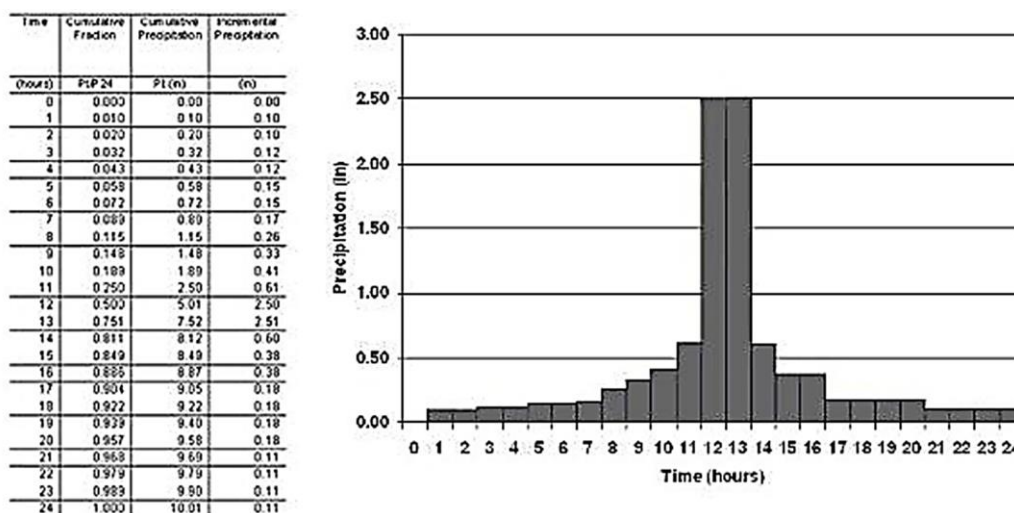


Figure 4-11: Distribution of SCS type II storm for 24 hours

To calculate the maximum discharge of the flood the SCS Method was used for watersheds with areas greater than or equal to 100 hectares to avoid the high discharges resulting from the use of the Rational method for the large watersheds, so don't lead to large the flood protection works than necessary.

The HEC-HMS program will be used to calculate the peak discharge from drainage basins larger than 0.8 km<sup>2</sup>, based on a 100-year return period with an additional 20% climate change allowance. The analysis will apply a 24-hour design storm using the SCS Type II distribution, which is considered most suitable for dry regions. For watersheds smaller than 0.8 km<sup>2</sup>, the Rational Method (implemented via Excel) will be used to estimate the peak discharge for the 100-year return period. **Table 4-3** presents the results of the hydrological analysis.

In the absence of a universally agreed-upon multiplier, planning and vulnerability assessments often use predetermined scenarios to test the resilience of infrastructure. A  $\pm 10\%$  and  $\pm 20\%$  change in rainfall is a standard range used in some major assessments. The "Development and Climate Change in Egypt: Focus on Coastal Resources and the Nile" report (and related documents which is part of the UNDP-

GEF/SCCF Project) mentions that for the Egypt Country Study, climate change scenarios were examined for changes in rainfall of  $\pm 10\%$  and  $\pm 20\%$  alongside temperature changes. This demonstrates that a  $\pm 20\%$  change is **recognized and accepted**.

While general annual rainfall may be projected to decrease in some areas of Egypt (like the north coast) or remain uncertain, many climate models and studies agree on an increase in the intensity and frequency of extreme rainfall events, which are critical for design storm calculations.

➤ Nashwan and Shahid (2022) ([Source](#))

This study, focusing on the future precipitation changes in Egypt using CMIP6 multimodel ensemble for  $1.5^{\circ}\text{C}$  and  $2^{\circ}\text{C}$  warming scenarios, projected a significant regional increase. It showed an increase in precipitation in the northern high precipitation region by 37% and 54% for the SSP1-1.9  $1.5^{\circ}\text{C}$  and SSP1-2.6  $2.0^{\circ}\text{C}$  scenarios, respectively, at the end of the century (2081–2100). The 20% value is an intermediate, more conservative value compared to the maximum projected increases for the northern regions which are prone to flash floods.

➤ Alexandria-Specific Analysis ([Source](#))

A study assessing the impact of climate change on urban heavy rainfall extremes in Alexandria (which is particularly vulnerable) found that for a return period of one year, the variation in daily extreme rainfall intensities ranged from a 12% decrease to a 22% increase, suggesting that an increase in the 20% range is within the model-predicted variability for extreme events in a critical area.

Following a visual inspection of the watersheds affecting the study area—using satellite imagery, landform maps, topographic maps, and land cover data—the runoff curve number (CN) was determined by calculating a weighted average, interpolated from **Figure 4-10**.

Table 4-6: Results of hydrological study for catchments affecting the project boundary

Watershed Name	Area (km <sup>2</sup> )	LFP (m)	Time of concentration (min)	Lag time (min)	Calculation method	CN/C	discharge (m <sup>3</sup> /sec)
Subbasin-1	1.94	5966	86	51	SCS	79	5.70
Subbasin-2	0.23	1643	36	21	Rational	0.45	1.63
Subbasin-3	0.93	3575	63	38	Rational	0.45	4.69
Subbasin-4	7.86	8328	95	57	SCS	79.5	22.00
Subbasin-5	0.35	2332	42	25	Rational	0.45	2.26
Subbasin-6	2.34	5623	62	37	SCS	80.5	9.60
Subbasin-7	0.22	1707	28	17	Rational	0.45	1.80
Subbasin-8	0.81	2682	34	20	Rational	0.45	6.05
Subbasin-9	0.25	1430	15	9	Rational	0.45	2.89



Watershed Name	Area (km <sup>2</sup> )	LFP (m)	Time of concentration (min)	Lag time (min)	Calculation method	CN/C	discharge (m <sup>3</sup> /sec)
Subbasin-10	1.03	2803	31	18	SCS	84.6	8.90
Subbasin-11	15.98	11367	140	84	SCS	81.5	37.80
Subbasin-12	0.45	2395	26	16	Rational	0.55	4.72
Subbasin-13	0.31	1955	22	13	Rational	0.55	3.60
Subbasin-14	0.6	2221	25	15	Rational	0.55	6.60
Subbasin-15	0.46	2437	29	17.54	Rational	0.55	4.53
Subbasin-16	1.34	3695	43	26	SCS	77	5.60

The figures below show the generated hydrographs for each catchment corresponding to the 100-year return period.

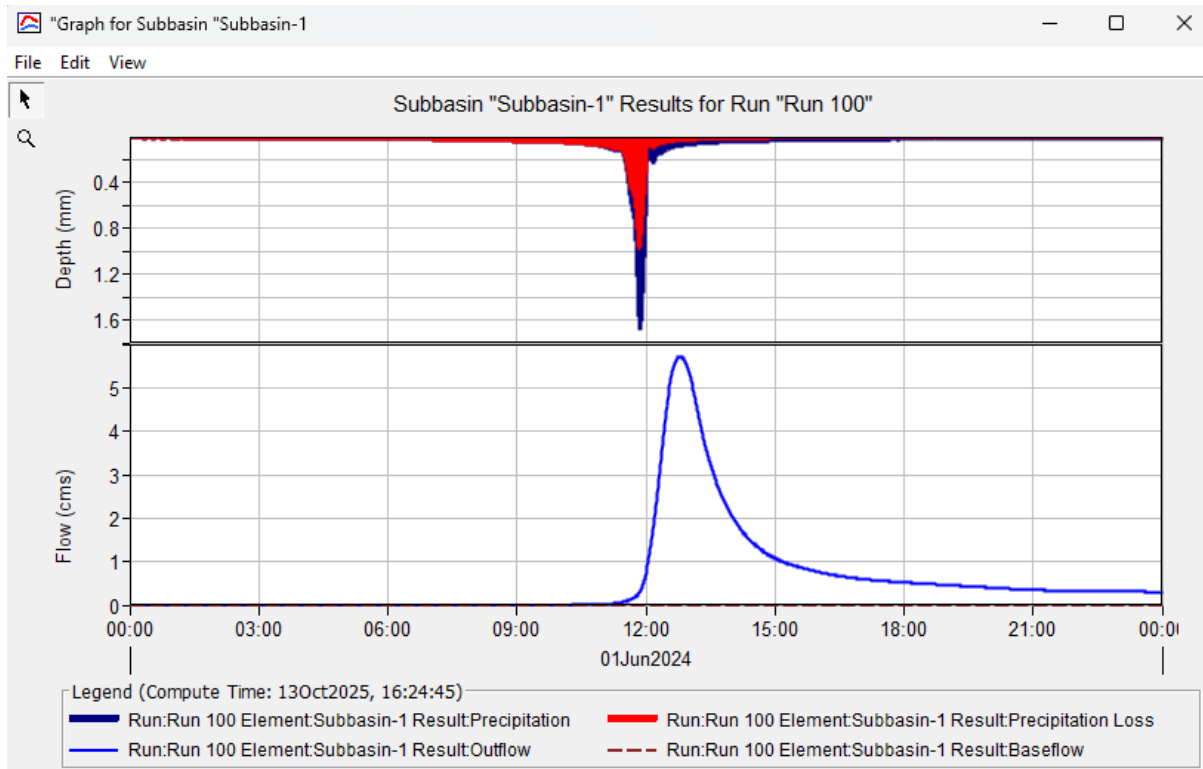


Figure 4-12 Hydrograph for Subbasin- 1

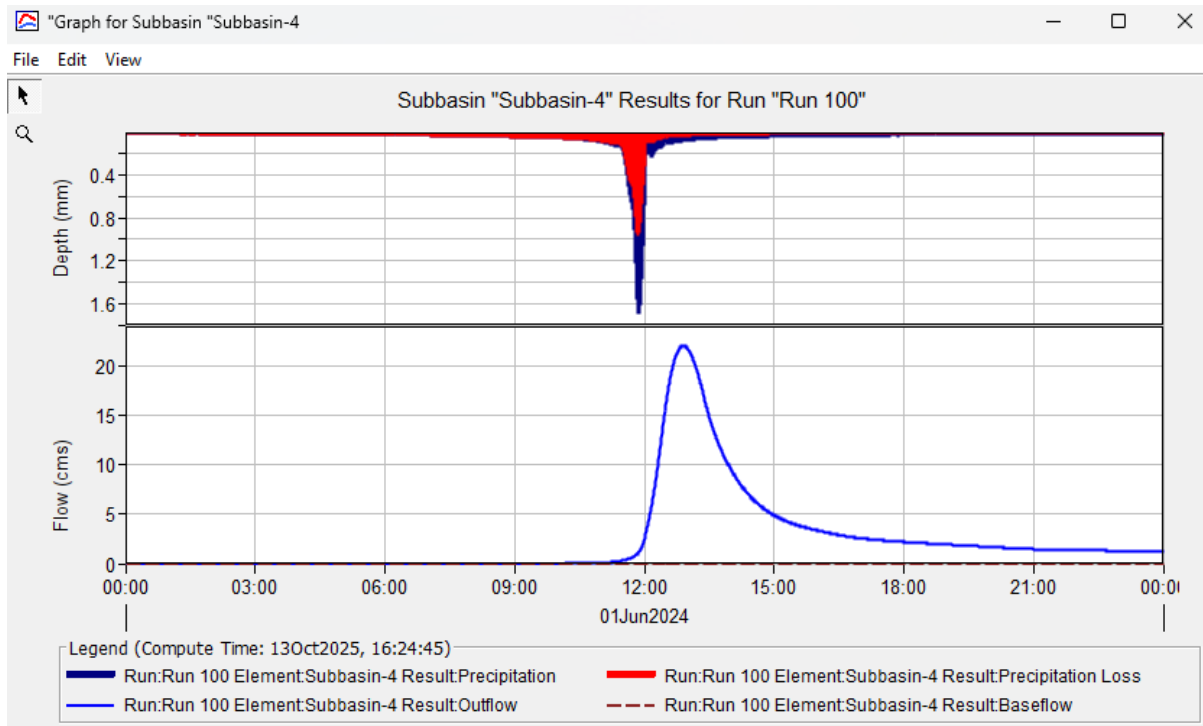


Figure 4-13 Hydrograph for Subbasin-4

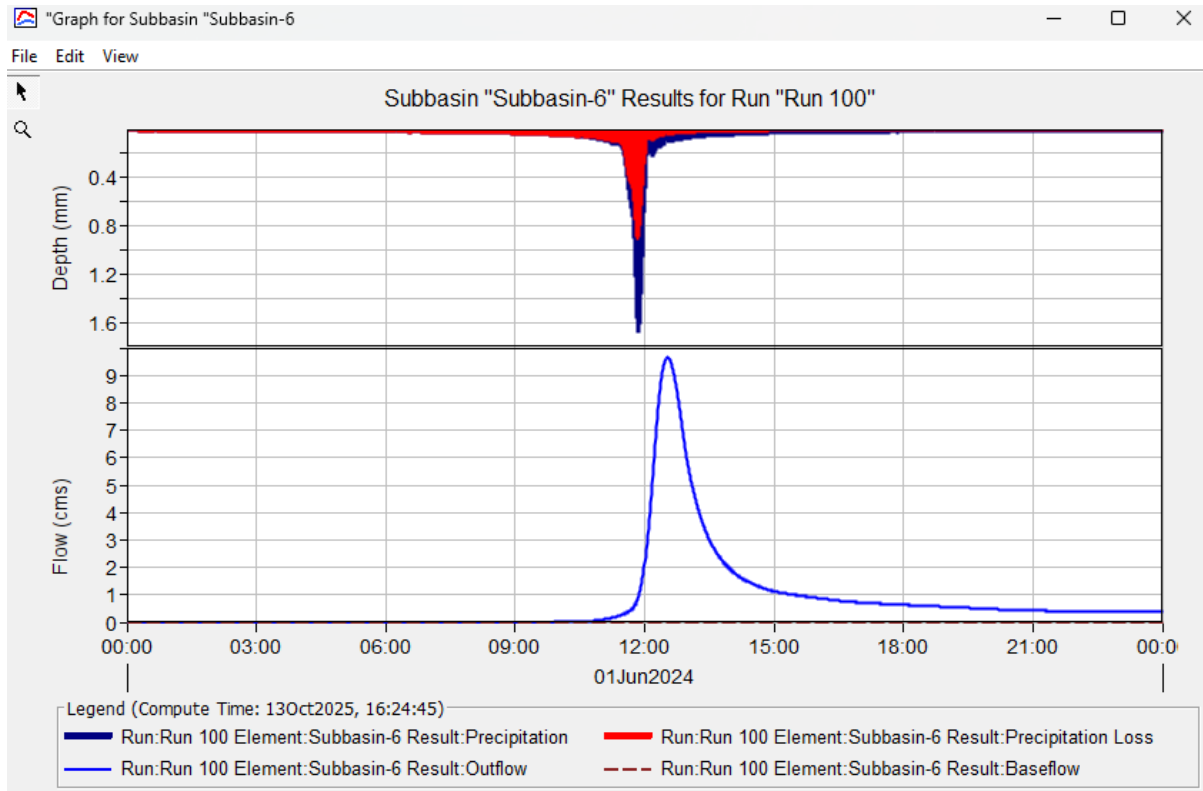


Figure 4-14 Hydrograph for Subbasin-6

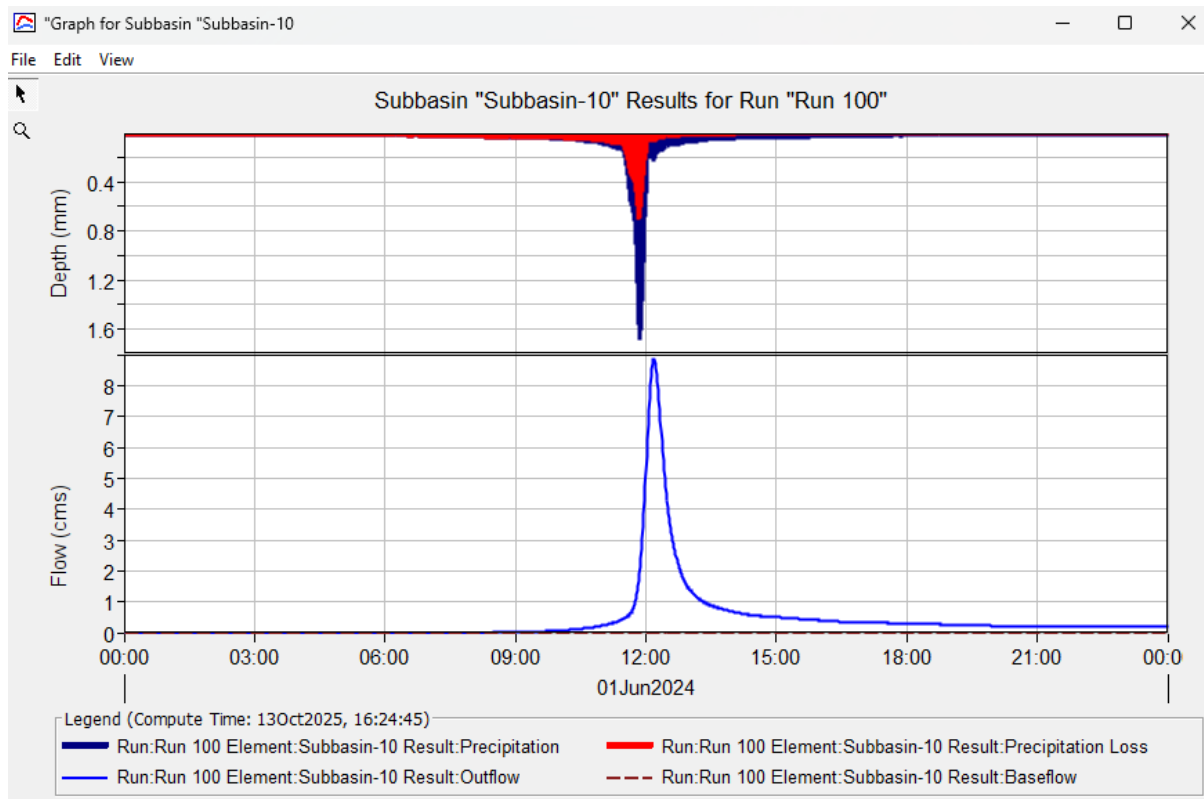


Figure 4-15: Hydrograph for Subbasin -10

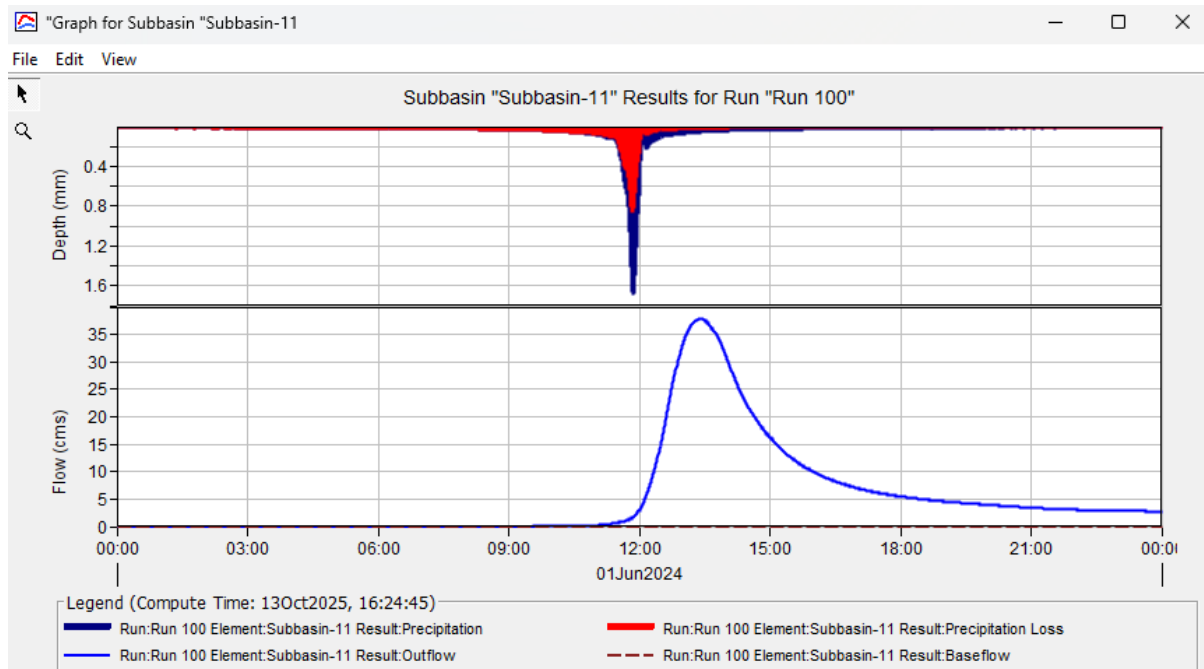


Figure 4-16Hydrograph for Subbasin-11

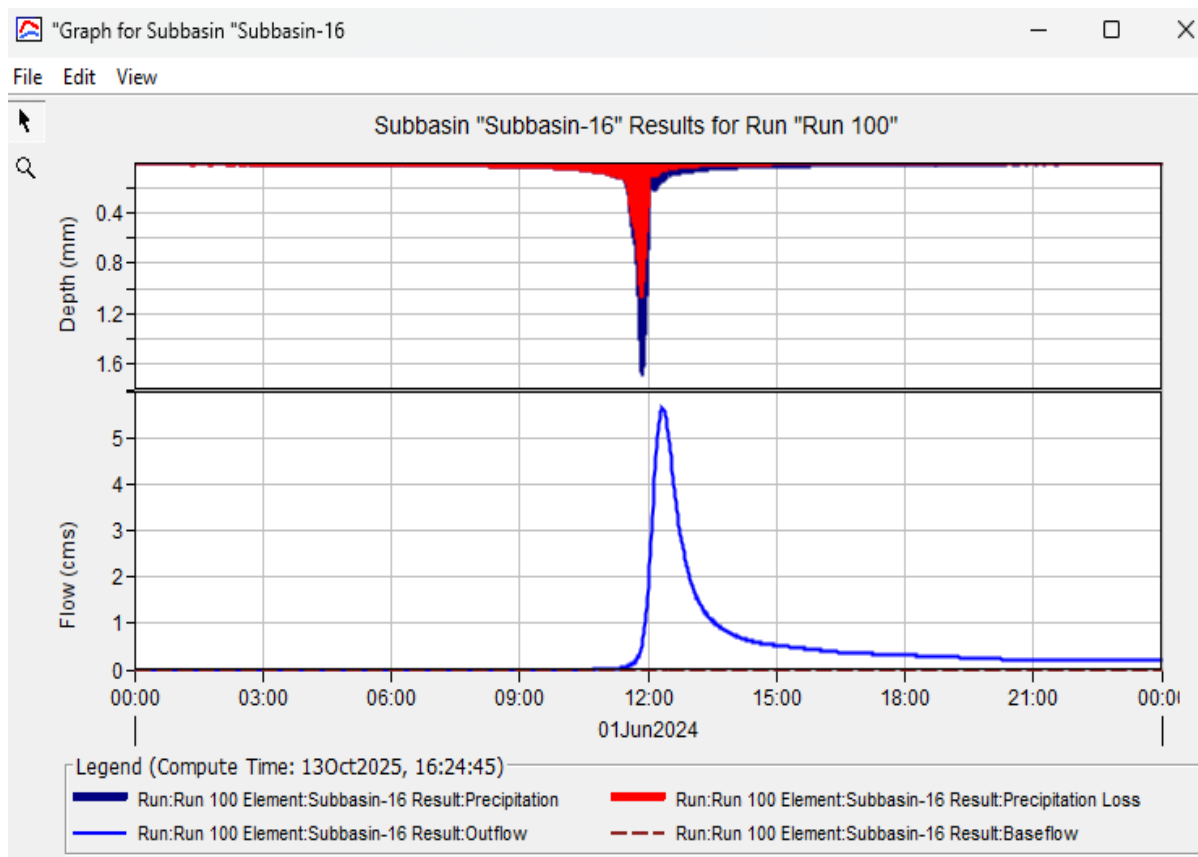


Figure 4-15 Hydrograph for Subbasin-16

#### 4.3.2 HYDRAULIC ANALYSIS

HEC-RAS 2D 6.3 software was used to build up a complete 2D hydrodynamic model to perform the flood inundation analysis required to identify the inundated locations which are subjected to the risk of flood hazards using the discharge hydrographs produced from the hydrological analysis.

The HEC-RAS software is a powerful tool for performing 2D simulations of water behavior across various terrains. It incorporates two main sources of water:

1. External inflow – generated from streams entering the study area, represented as line-source boundary conditions that produce inflow hydrographs.
2. Direct precipitation – rainfall applied over the model domain, which then moves across the terrain, following natural drainage paths and accounting for elevation changes as well as potential outflows beyond the domain boundaries.

Using the results of these simulations, optimal protection and mitigation solutions for the study area can be developed.

For this study, a 2D hydrodynamic model was developed using the available terrain data for the study area. The model was built on a high-resolution DEM with a grid size of 4.5 m × 4.5 m, covering the study area with the surrounding catchments. This resolution was sufficient to capture the accurate flow paths and to assess the effectiveness of the proposed mitigation measures.

The DEM was processed within HEC-RAS Mapper, where an appropriate mesh size in Cartesian coordinates was defined. To account for spatial variability, landcover and Curve Number (CN) data were incorporated into the model, allowing differentiation of soil infiltration characteristics and Manning's roughness coefficients between wadis and floodplains.

The results of the 100-year return period simulation show the distribution of water depths within and around the study area are shown in *Figure 4-17*, *Figure 4-18*, *Figure 4-19*, and *Figure 4-20*. These results confirm that there is no extreme risk from surrounding streams bypassing the site. The simulations also provide a reliable representation of the floodwater flow paths and validate the proposed mitigation measures.

### 4.3.3 Results analysis and discussion

The hydrological and hydraulic modeling results provide a comprehensive understanding of the flood behavior within the Dandarah solar farm area. Both HEC-HMS and HEC-RAS models were utilized to assess runoff generation and flood propagation, respectively. The comparison between the two models highlights the influence of local terrain features, particularly the presence of natural depressions, on the resulting flood discharges and flow patterns.

The HEC-HMS rainfall-runoff model was applied at the sub-basin scale to estimate peak discharges for different return periods. The model assumes idealized overland flow with limited consideration of local storage or depression effects within the catchments. Consequently, the simulated peak discharges from HEC-HMS are relatively high, especially for the upper sub-catchments where micro-topographic storage plays a significant role in attenuating flows.

In contrast, the hydrodynamic model (HEC-RAS 2D) integrates the actual terrain characteristics derived from the processed high-resolution DEM, which explicitly represents local depressions, flow constrictions, and minor undulations. These features act as natural detention zones, reducing the runoff volume and attenuating the flow peaks as water is temporarily stored before propagating downstream. Therefore, the discharges simulated by HEC-RAS are notably lower and are considered more representative of the actual flood response under existing topographic conditions.

To quantify this difference, the most critical sub-basins (*Figure 4-21*)—selected based on their relative size and peak discharge magnitude—were compared. As shown in *Table 4-7*

, HEC-HMS consistently predicts higher peak discharges than HEC-RAS, emphasizing the role of topographic storage in moderating the flood hydrographs.

The HEC-RAS hydrodynamic model was further used to simulate flood depths and velocities for various return periods at the project boundary. The results (summarized in *Table 4-8*) show that:

For low to moderate return periods (5, 10, and 25 years), no significant surface flow reaches the project boundary, confirming that the upstream catchments have limited runoff potential under typical storm conditions.

For extreme flood events (50 and 100 years), localized shallow flow accumulation is observed mainly along the natural drainage paths, with limited spatial extent and low hydraulic energy.

For the extreme 200-year return period, the maximum simulated water depth and velocity at the project boundary are approximately 1.26 m and 1.6 m/s, respectively. These values represent the upper bound of potential flood impacts under highly conservative rainfall assumptions.

The comparative analysis indicates that HEC-HMS provides conservative upper-limit discharge estimates, while HEC-RAS offers a more realistic representation of the actual floodplain behavior. The presence of natural depressions significantly mitigates flood risk to the project area. Consequently, the site does not require a positive (channels or dykes) drainage system, as the modeled overland flow dissipates naturally within the existing topography.

Instead, flood hazard and risk maps will be developed to delineate the potential flow paths and identify critical low-lying locations that may be exposed during extreme events. These maps will guide the planning of infrastructure layout, equipment platforms, and access roads to ensure flood-resilient design.

In summary, the hydrological and hydrodynamic analyses confirm that:

- Local depressions play a key role in attenuating runoff and reducing flood peaks.
- The 200-year event represents the threshold for minor inundation at the project boundary.
- The site is generally safe from external flood hazards under realistic design conditions.
- Future design considerations should focus on avoiding localized low points and maintaining natural flow paths for effective surface drainage.



Table 4-7: HEC HMS Discharges Vs. HEC RAS discharges

Discharges comparison												
Return period	5		10		25		50		100		200	
Watershed Name	Q from HMS	Q from RAS	Q from HMS	Q from RAS	Q from HMS	Q from RAS	Q from HMS	Q from RAS	Q from HMS	Q from RAS	Q from HMS	Q from RAS
Subbasin-4	0.00	0.00	0.00	0.00	0.40	0.00	4.40	0.50	22.00	6.10	31.80	8.10
Subbasin-6	0.00	0.00	0.00	0.00	0.20	0.00	2.10	0.15	9.60	2.60	13.70	5.50
Subbasin-10	0.00	0.00	0.00	0.00	0.50	0.02	2.60	0.55	8.90	4.10	12.00	8.90
Subbasin-11	0.00	0.00	0.00	0.00	1.30	0.01	9.00	0.60	37.80	7.80	53.30	25.50

Table 4-8: HEC RAS insights

HEC RAS insights												
Return period	5		10		25		50		100		200	
Watershed Name	Depth	Velocity	Depth	Velocity	Depth	Velocity	Depth	Velocity	Depth	Velocity	Depth	Velocity
Subbasin-4	0.00	0.00	0.00	0.00	0.30	0.24	0.54	0.36	0.78	0.86	0.89	0.79
Subbasin-6	0.00	0.00	0.00	0.00	0.10	0.15	0.20	0.80	0.35	1.20	0.40	0.96
Subbasin-10	0.00	0.00	0.00	0.00	0.40	0.41	0.57	0.47	0.88	0.61	1.18	1.00
Subbasin-11	0.00	0.00	0.00	0.00	0.71	0.32	0.91	0.45	1.10	0.87	1.38	1.30

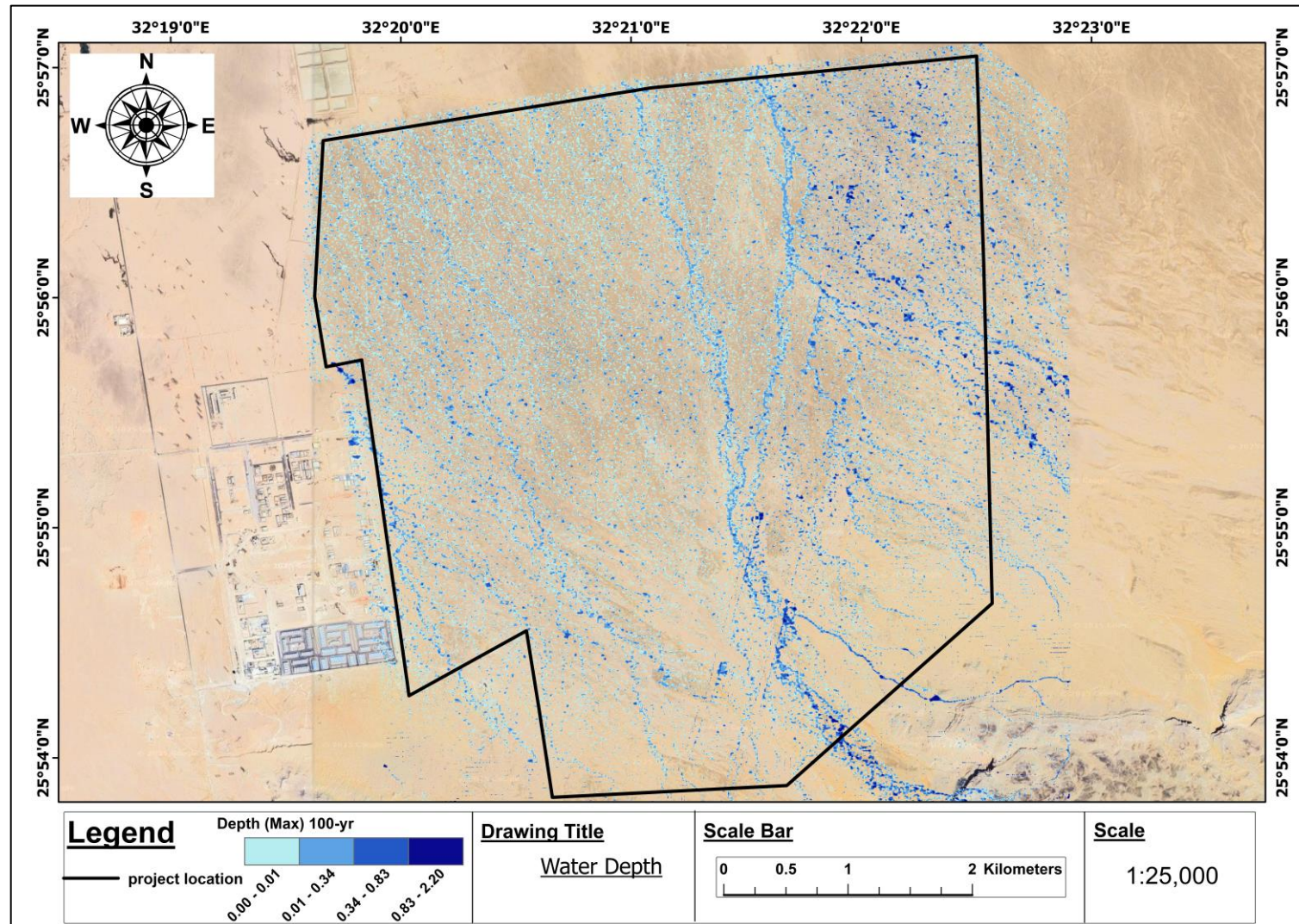


Figure 4-17: Flood inundation and Water depth In Study Area for existing conditions from the detailed model



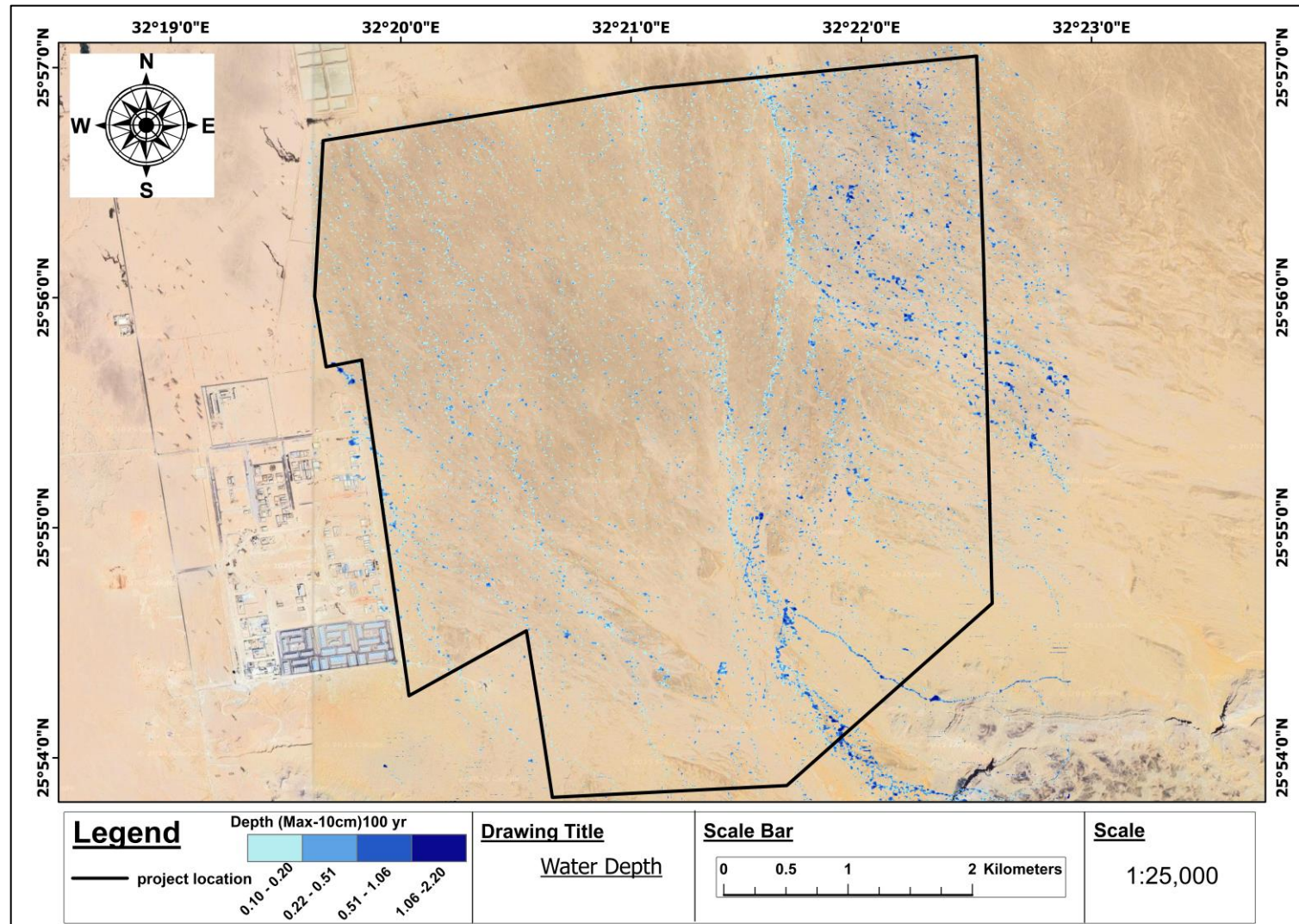


Figure 4-18: Flood inundation and Water depth greater than 10cm In Study Area for existing conditions from the detailed model

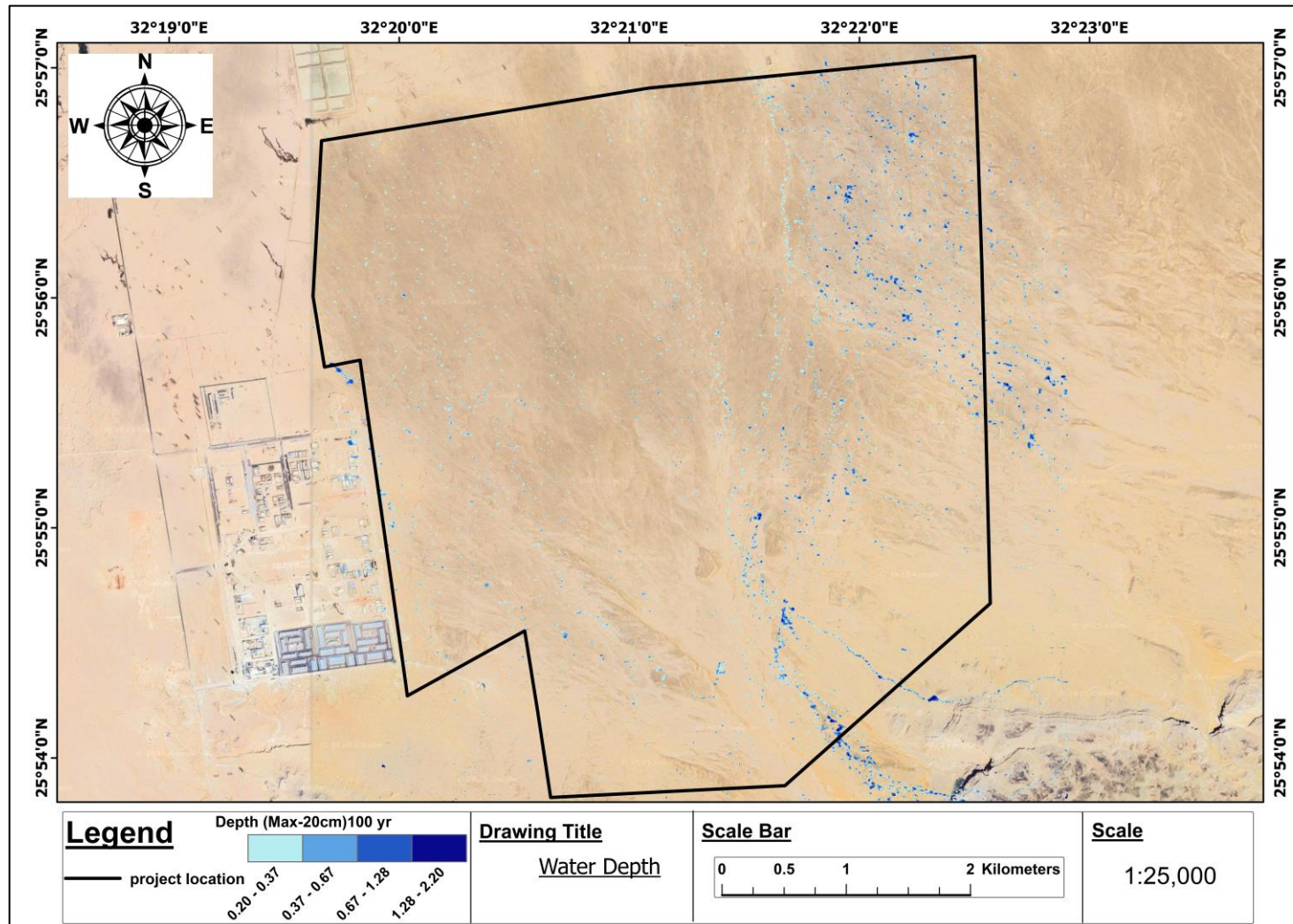


Figure 4-19: Flood inundation and Water depth greater than 20cm In Study Area for existing conditions from the detailed model.



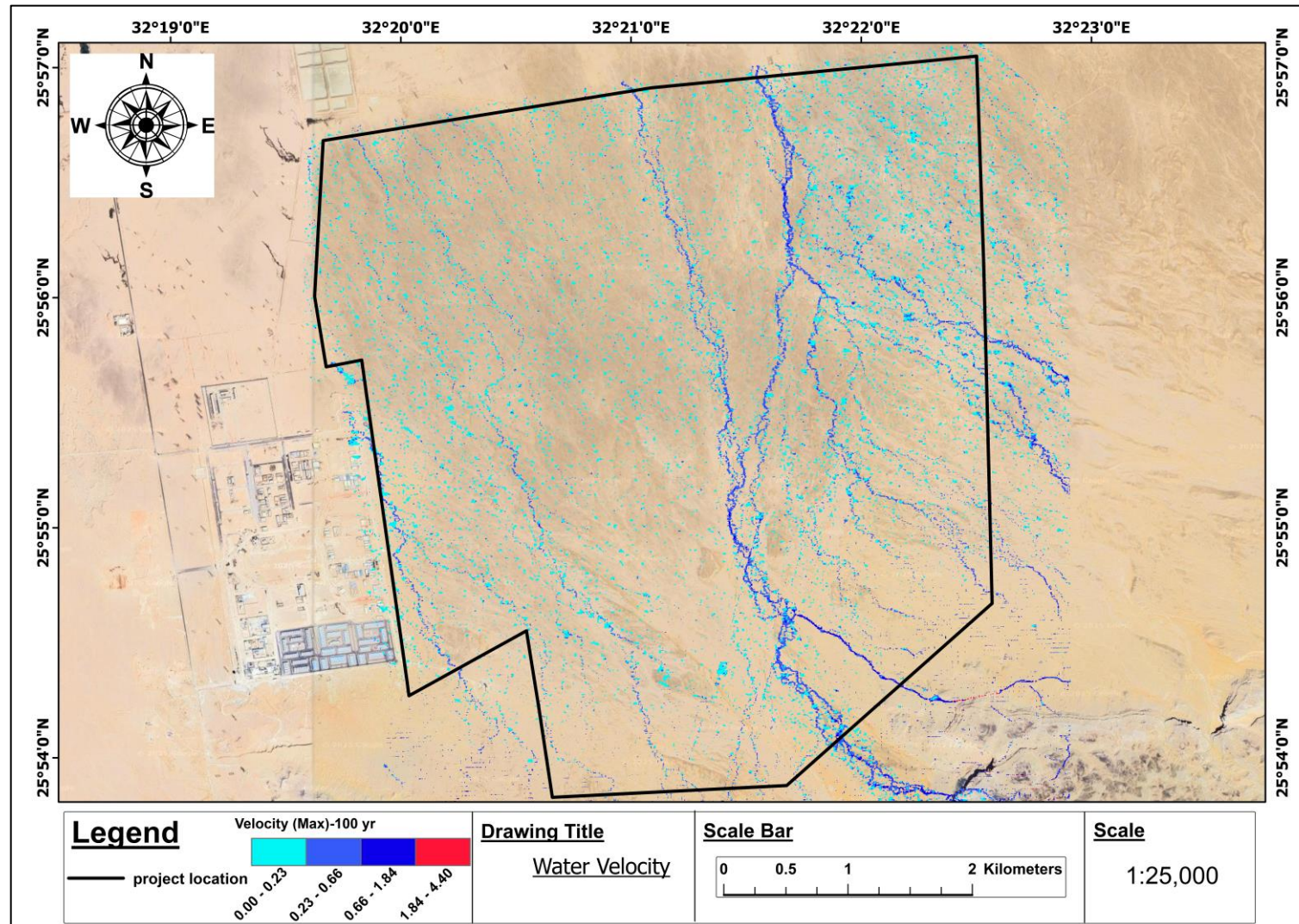


Figure 4-20 Water Velocity in Study Area for existing conditions from the detailed model



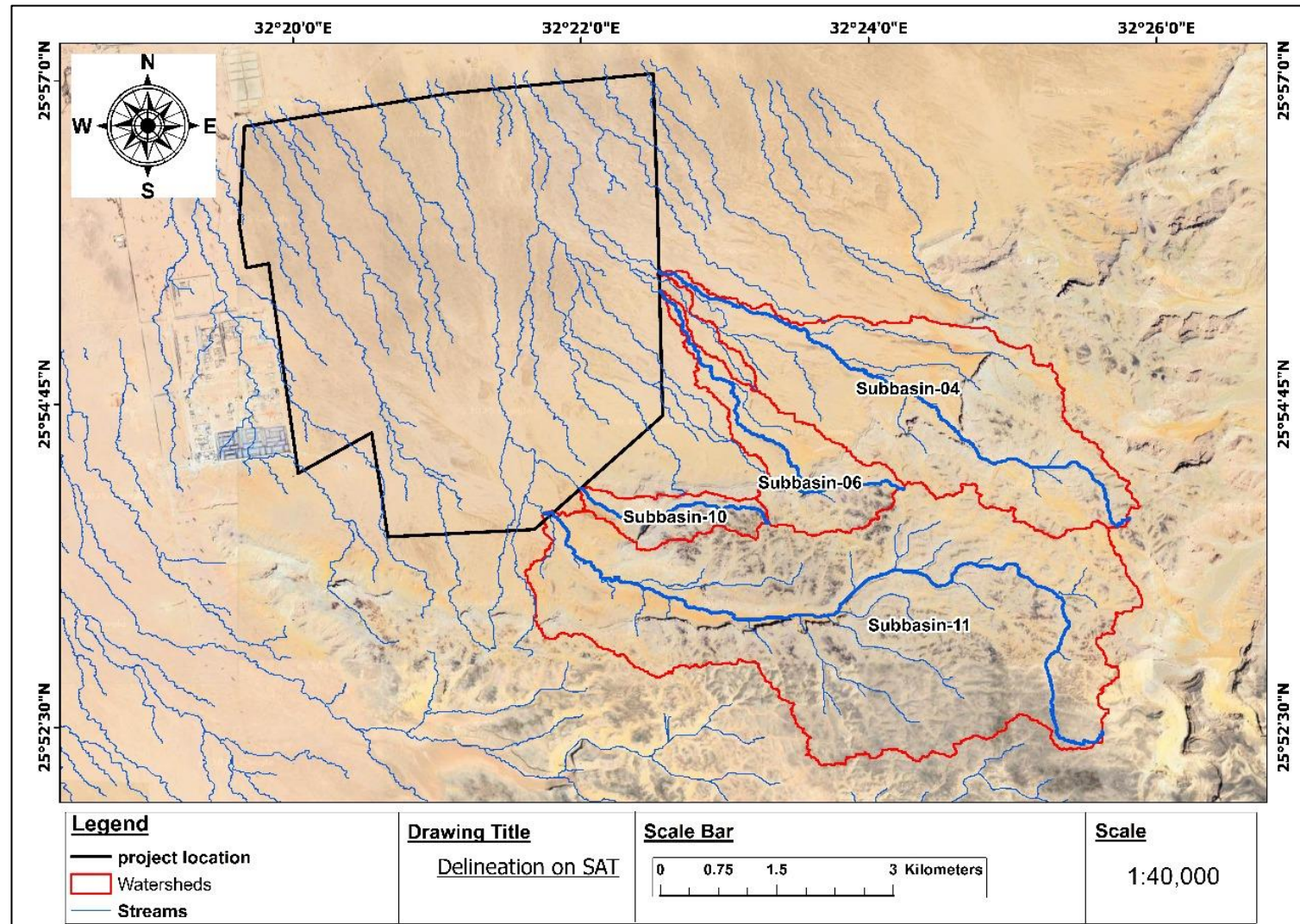


Figure 4-21 Most critical sub-basins for quantify assessment



## 5 CONCLUSION & RECOMMENDATION

In order to promote sustainability and cost efficiency, no structural protection works are planned for the Solar Project site. Such works would be financially costly and environmentally intrusive. Instead, a hazard mapping study will be carried out to identify areas with potential risks (e.g., flooding, erosion, or other hazards). Based on this hazard map, the placement of Solar Panel will be carefully optimized to avoid high-risk zones, ensuring both safety and long-term sustainability of the project.

### 5.1 HAZARD ASSESSMENT

The guidelines produced by the Department for Environment, Food & Rural Affairs (DEFRA) entitled 'Flood and Coastal Defense Assessment Guidelines' have been used to conclude hazard maps according to the following equation:

$$HR = d \times (v + 0.5) + DF$$

Where.

(v): Velocity of flow water (m/sec)

(d): Depth of flow water (m)

(DF): A factor that expresses the percentage of suspended solids in stream water, determined from the Table 5-1

*Table 5-1: Guidance on the factor (DF) for various flood depths, velocities and prevailing land uses*

Depth (m)	Bushes	Forests	Urban
0 to 0.25	0	0	0
0.25 to 0.75	0	0.5	1
d>0.75 &/or v>2	0.5	1	1

DEFRA FD2321/TR1 does not provide a specific class for all land uses; therefore, the debris factor (DF) has been adapted by analogy to the predominant land cover in the study area. Open desert and cultivated floodplain are treated as Pasture/Arable (open terrain with limited debris potential), while palm groves and shelterbelts correspond to Woodland. Built-up areas, storage yards, and bridge or culvert buffers are assigned Urban values. Wadi corridors and crossings are considered high-debris pathways, with DF values reaching 1.0 when depths exceed 0.75 m or velocities exceed 2 m/s. This approach captures the characteristic debris sources in Qena—such as cobbles and boulders in wadis, agricultural residues on the floodplain, and movable objects in urban and industrial areas—while remaining consistent with the DEFRA hazard rating framework. Accordingly, the debris factors for the study area land uses are summarized in Table 5-2.

Table 5-2: DF factor for the study area

Depth / Velocity Band	Open Desert / Cultivated Floodplain (Pasture/Arable equivalent)	Palm Groves / Orchards (Woodland equivalent)	Wadi Channels / Gullies (High- debris corridors)	Urban / Villages / Roads / Yards (Urban equivalent)
0 – 0.25 m	0.0	0.0	0.0	0.0
0.25 – 0.75 m	0.0	0.5	0.5	1.0
d > 0.75 m and/or v > 2 m/s	0.5	1.0	1.0	1.0

Table 5-3: hazard rating values (HR) classification according to DEFRA guidelines

Hazard Rating (HR)	Category	Description
< 0.75	Low Hazard	Caution – generally safe for people, minimal impact on structures
0.75 – 1.25	Moderate Hazard	Dangerous for some (children, elderly), risk to light structures
1.25 – 2.0	Significant Hazard	Dangerous for most people, potential for asset damage
> 2.0	Extreme Hazard	Dangerous for all, major risk to safety and infrastructure

For Solar Project context, the hazards category translates into:

- Low: Panel foundations remain stable, minor nuisance flooding to access roads.
- Moderate: Some access disruption, potential minor scour at cable trenches.
- Significant: Risks to substation platforms, scour around panel foundations and access tracks.
- Extreme: Threat to structural stability of panel foundations, substations, and buried power cables.

This classification was used to produce hazard maps for 100 years return period event and to guide the selection of suitable locations for Solar panel, ensuring avoidance of high-risk zones and supporting the project's sustainability objectives.

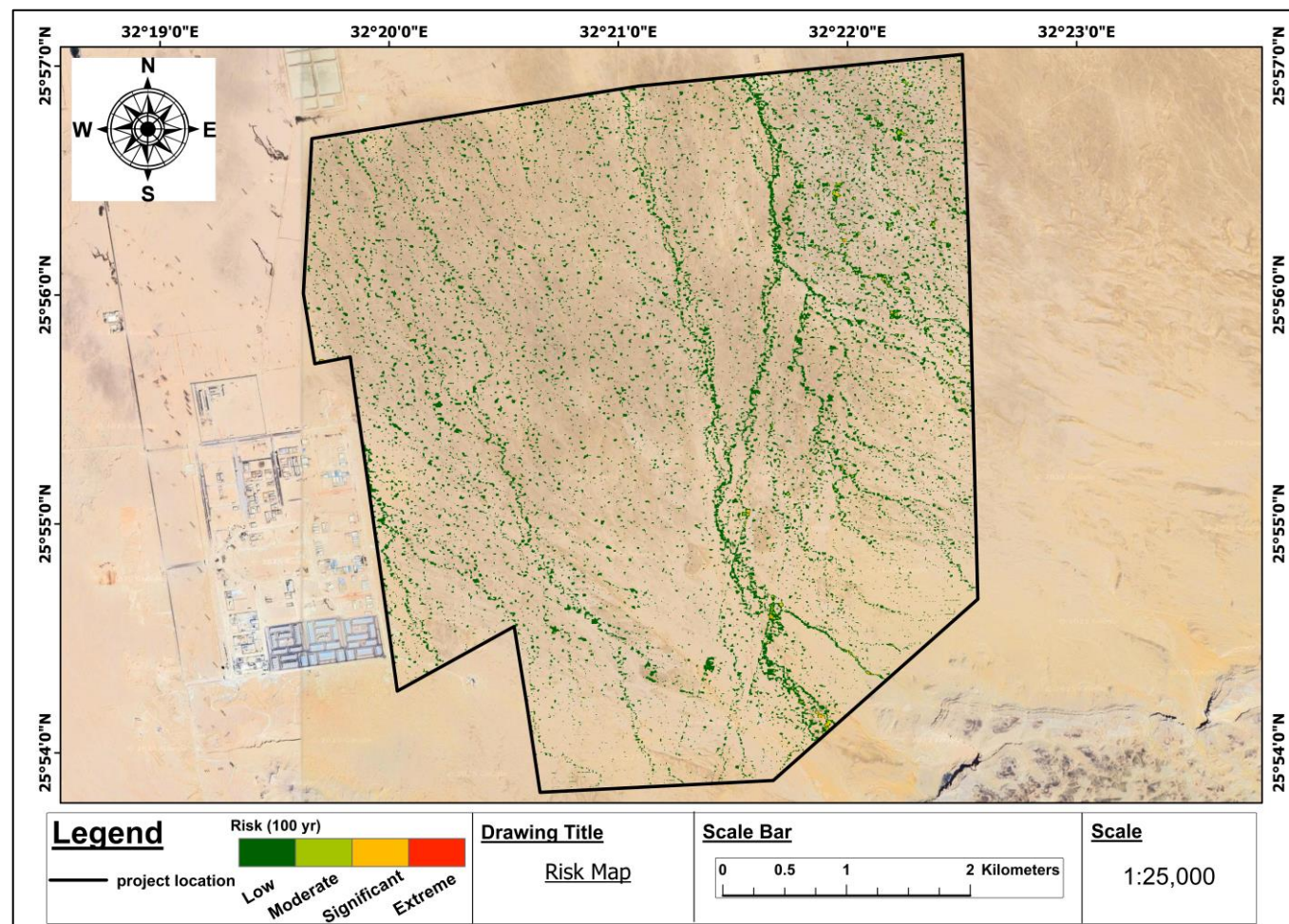


Figure 5-1: Risk Map of 100 year return period event based on DEFRA risk classification system

## 5.2 SCOUR CALCULATION

Scour depth is one of the most critical parameters in assessing erosion hazards around hydraulic and structural works. It refers to the vertical lowering of the bed level caused by flowing water removing soil or sediment. In risk assessments, scour depth is often expressed relative to the foundation depth of a structure, since this ratio directly indicates the potential for structural instability. Shallow scour may pose limited concern, but when scour depth approaches or exceeds the embedment depth of foundations, the risk of structural compromise rises significantly. For solar projects, this parameter is particularly important for panel foundations, substations, and buried cable crossings, where excessive scour could undermine stability, expose utilities, or lead to costly failures. By categorizing risk levels according to relative scour depth, engineers can evaluate where protective measures such as riprap armoring, bed stabilization, or deeper foundation design are necessary.

For solar installations, scour risk is mainly associated with erosion of soil around panel foundations, substations, access roads, and buried cable routes. The risk is governed by::

- Hydraulic conditions (flow depth, velocity, turbulence, shear stress).
- Soil properties (cohesive vs. non-cohesive, grain size, erodibility).
- Foundation design (shallow vs. deep, armoring).
- Channel geometry (culverts, crossings, drainage features).

Several studies (Chow 1959; Melville & Coleman 2000; Lagasse et al. 2001 – HEC-18, and HEC 20; Breusers & Raudkivi 1991) classify scour based on flow velocity relative to critical velocity, scour depth relative to foundation depth, or shear stress relative to critical shear stress.

Scour depths were calculated based on HEC 20 equations as illustrated in section 3.5 by assuming the following parameters:

$\gamma \rightarrow$  Specific weight of Water =  $62.4 \text{ lb/ft}^3$

$\gamma_s \rightarrow$  Specific weight of sediment =  $2.65 * 62.4 = 165.36 \text{ lb/ft}^3$

$k_s \rightarrow$  Dimensionless coefficient often referred to as the Shields parameter = 0.05 for sand according to Hydraulic Engineering Circular (HEC) no. 20

$n \rightarrow$  Manning roughness coefficient = 0.04 as scour area at culvert alignment consists of sand and gravel

$y_a \rightarrow$  Thickness of the armor layer, ft ( $=2D_c$ )

$P_c \rightarrow$  Percent of material coarser than the critical particle size ( $D_c$ ) = 20%

Table 5-4: Scour Depth-Based Risk

Scour Risk	Relative Scour Depth ( $y_s / D_f$ )	Description
Low	< 0.25	Scour shallow compared to foundation embedment.
Moderate	0.25 – 0.5	Scour depth may expose parts of shallow foundations or cable trenches.
High	0.5 – 1.0	Scour depth approaches foundation depth; structural risk possible.
Critical	> 1.0	Scour exceeds foundation embedment; severe failure risk.

The scour risk was mapped in [Figure 5-3](#) by considering the typical foundation depth ( $D_f$ ) of 2–3 meters (critical depth shall be 2m) used for Solar panels.



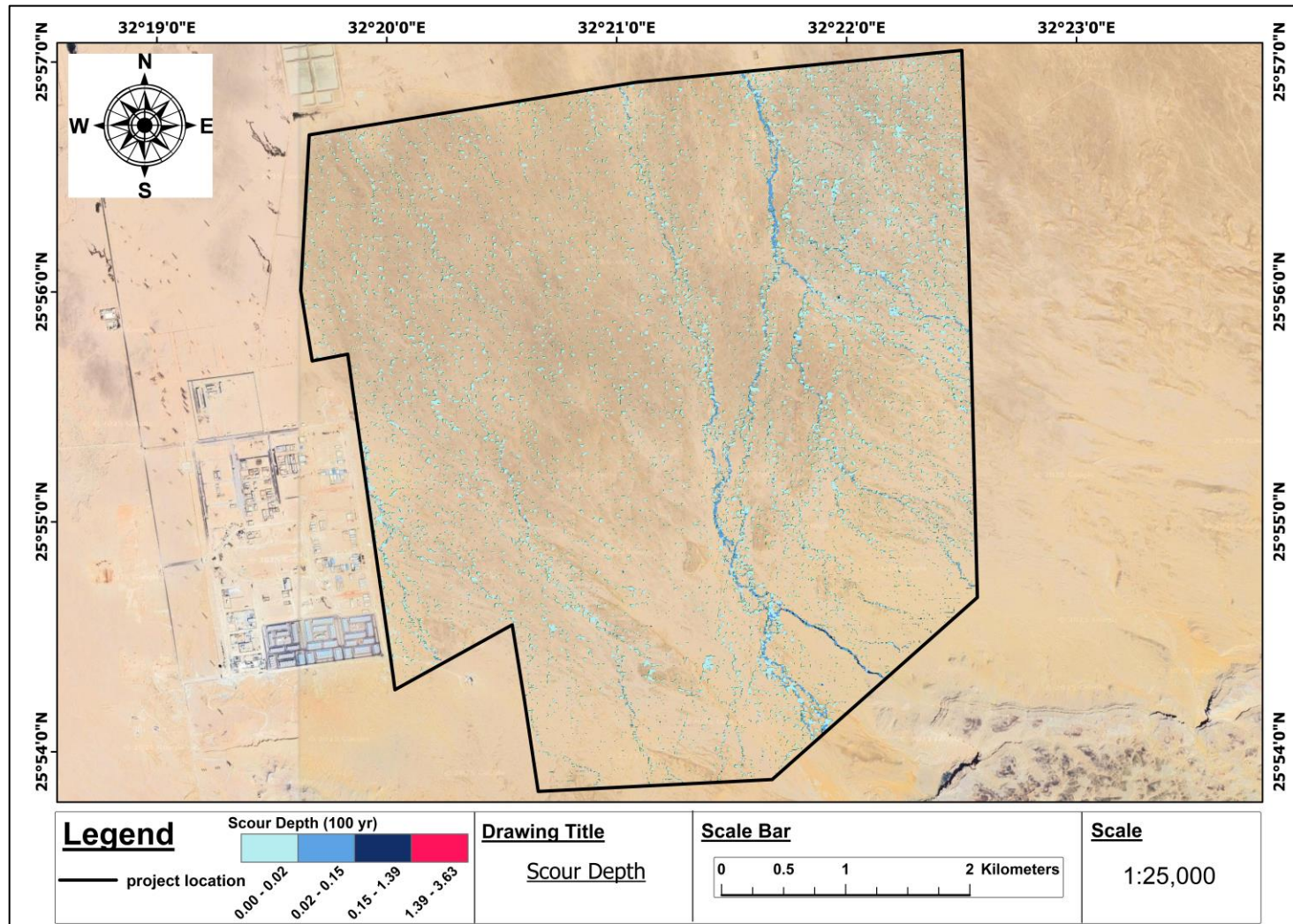


Figure 5-2: Scour Map of 100 years return period event



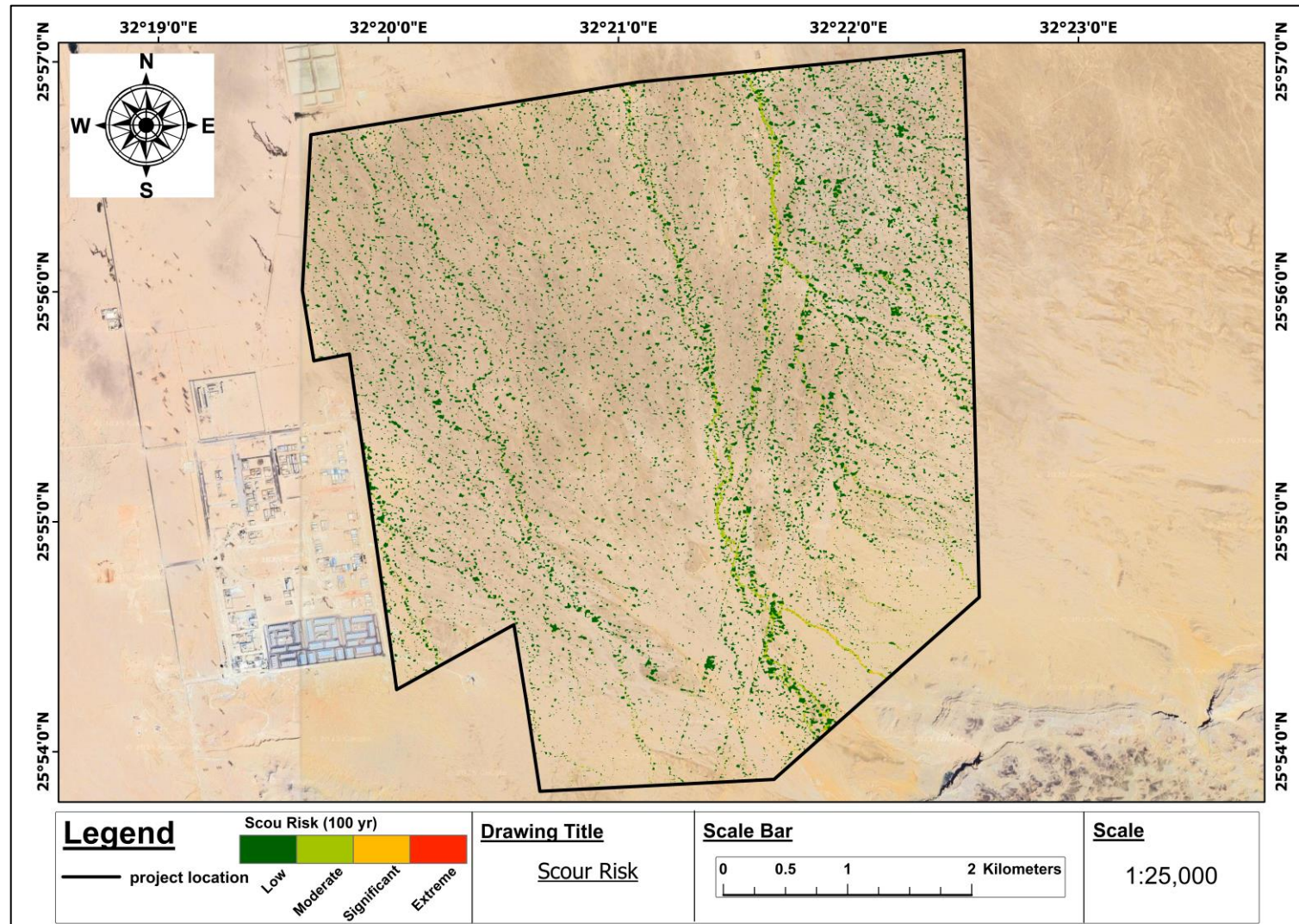


Figure 5-3: Scour Risk Map for the 100-Year Return Period Event

### 5.3 Conclusion

The hydrological assessment indicates that local topography and hydraulic conditions influence flood hazard and scour potential across the project area. In this case, the hazard severity ranges from low to moderate. Terrain variations and concentrated surface flows cause slight increases in water depths and velocities, which correspond to low–moderate hazard ratings under the DEFRA classification system. These zones pose limited threats to public safety and infrastructure resilience.

Based on the hazard category and project element, the recommendations are as follows:

- **Solar Panel Foundations (Array Pads):** Can be installed within low–moderate hazard areas with basic precautions (e.g., adequate foundation embedment, localized drainage).
- **Inverter Stations & Substations:** May require minor flood protection such as surface grading, drainage improvement, or modest elevation in moderate hazard zones.
- **Access Roads & Service Tracks:** Standard crossings are acceptable, but regular inspection and maintenance are necessary to prevent localized scour.
- **Buried Cables & Transmission Lines:** Should be installed at appropriate depths with protective layers (e.g., sand bedding, warning tape, or armoring) in zones with moderate flow velocities.

From a scour perspective, relative scour depth remains an indicator of structural stability. In this case, observed scour depths are less than typical foundation embedment depths, which means the **scour risk is low to moderate** and unlikely to significantly affect solar farm components such as panel foundations, inverter/substation platforms, access roads, or buried cables.

Thus, scour depth-based risk assessment suggests **good infrastructure stability**. The classification links flow velocity, shear stress, and relative scour depth to practical risk levels, which fall in a low to moderate range suitable for the solar project's conditions.

Table 5-5: scour risk category

Risk Zone	Flow Velocity (m/s)	Shear Stress (N/m <sup>2</sup> )	Relative Scour Depth ( $y_s / D_f$ )	Interpretation
Green – Low	< 0.5	< 2	< 0.25 (25%)	Stable conditions; minimal scour risk to panel foundations and cables.
Yellow – Moderate	0.5 – 1.0	2 – 5	≤ 0.5 (50%)	Localized scour possible at access roads, culverts, and shallow cable trenches.
Orange – High	1.0 – 2.0	5 – 10	≤ 1.0 (100%)	Significant scour around foundations and substations; mitigation (e.g., riprap, armoring) required.
Red – Critical	> 2.0	> 10	> 1.0 (>100%)	Severe scour exceeding foundation embedment; siting of panels/substations should be avoided.

By combining DEFRA hazard ratings with scour risk categories, the assessment provides a robust framework for identifying critical risk zones. Mitigation measures—such as improved drainage around solar pads, adequate foundation embedment, protective armoring for substations, bed stabilization for service crossings, and careful siting of major electrical infrastructure—will be essential to safeguard the solar project’s assets and ensure long-term resilience.

## **Annex 2: Critical Habitat Screening**

**Scatec**

**Environmental Impact Assessment for  
Dandara PV Project and BESS in Naga  
Hammadi  
*Critical Habitat Screening***

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## 1. Background and Methodology

Critical habitat (CH) refers to the most sensitive biodiversity features in a defined area, regardless of whether these habitats are natural or modified. Both EBRD PR6 and IFC PS6 have similar criteria for defining critical habitat.

In this respect, a CH is an area with high biodiversity value, which meets at least one of the following criteria (EBRD, 2019):

- (i) Highly threatened or unique ecosystems;
- (ii) Habitats of significant importance to endangered or critically endangered species;
- (iii) Habitats of significant importance to endemic or geographically restricted species;
- (iv) Habitats supporting globally significant migratory or congregatory species; or
- (v) Areas associated with key evolutionary processes.

The occurrence of the above features does not automatically qualify a habitat as critical, and this is dependent on the proportion of such a CH-triggering species/feature being present in a project area. Numerical thresholds are applied to the first four critical habitat criteria to determine whether any of the species/features are likely to qualify habitats as critical, while there are no numerical thresholds for Criterion v. In this respect, the best available scientific information and expert opinion should be used to guide decision-making with respect to the relative “criticality” of a habitat in these cases.

EBRD PR6 also considers Priority Biodiversity Features (PBF), which are features that are considered particularly irreplaceable or vulnerable, but at a lower priority level than critical habitats. On the other hand, PBF are not considered in IFC PS6. PBF include:

- (i) Threatened habitats;
- (ii) Vulnerable species;
- (iii) Significant biodiversity features identified by a broad set of stakeholders or governments; and
- (iv) Ecological structure and functions needed to maintain the viability of priority biodiversity features.

The list of all features identified should be tested against the criteria/thresholds described in Table 1 to determine whether they satisfy the criteria and conditions to be deemed priority biodiversity features or critical habitat.

**Table 1: Criteria and conditions for identifying priority biodiversity features and critical habitats**

Criterion	Priority Biodiversity Feature	Critical Habitat
<b>Priority ecosystems</b>		
<i>Threatened ecosystems</i>	(PR6 para. 12-i)	(PR6 para. 14-i)
(a) Habitats listed in Annex 1 of EU Habitats Directive (EU members only) or Resolution 4 of Bern Convention (signatory nations only)	(a) EAAA is habitat type listed in Annex 1 of EU Habitats Directive or Resolution 4 of Bern Convention	(a) EAAA is habitat type listed in Annex 1 of EU Habitats Directive marked as “priority habitat type
(b) IUCN Red-List EN or CR ecosystems	(b) EAAA < 5% of the global extent of an <i>ecosystem</i> type with IUCN status of CR or EN	(b) EAAA ≥ 5% of global extent of an ecosystem type with IUCN status of CR or EN
		(c) EAAA is ecosystem determined to be of high priority for conservation by national systematic conservation planning
<b>Priority Species and their Habitats</b>		
<i>Threatened species</i>	(PR6 para. 12-ii)	(PR6 para. 14-ii)
(a) Species and their habitats listed in EU Habitats Directive and Birds Directive (EU members only) or Bern Convention (signatory nations only)	(a) EAAA for species and their habitats listed in Annex II of Habitats Directive, Annex I of Birds Directive, or Resolution 6 of Bern Convention	(a) EAAA for species and their habitats listed in Annex IV of the Habitats Directive (See EU restrictions)
(b) IUCN Red List EN or CR species	(b) EAAA supports < 0.5% of global population OR < 5 reproductive units of a CR or EN species.	(b) EAAA supports ≥ 0.5% of the global population AND ≥ 5 reproductive units of a CR or EN species
(c) IUCN Red List VU species	(c) EAAA supports VU species	(c) EAAA supports globally significant population of VU species necessary to prevent a change of IUCN Red List status to EN or CR, and satisfies threshold (b)
(d) Nationally or regionally (e.g., Europe) listed EN or CR species	(d) EAAA for regularly occurring nationally or regionally listed EN or CR species	(d) EAAA for important concentrations of a nationally or regionally listed EN or CR species
<i>Range-restricted species</i>	(PR6 para. 12-ii)	(PR6 para. 14-iii)
	(a) EAAA for regularly occurring range-restricted species	(a) EAAA regularly holds ≥ 10% of global population AND ≥ 10 reproductive units of the species
<i>Migratory and congregatory species</i>	(PR6 para. 12-ii)	(PR6 para. 14-iv)
	(a) EAAA identified per Birds Directive or recognized national or international process as important for migratory birds (esp. wetlands)	(a) EAAA sustains, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population at any point of the species’ lifecycle
		(b) EAAA predictably supports ≥ 10 percent of global population during periods of environmental stress

Some criteria have no predetermined conditions (that is, PR6 paragraphs 12-iii “significant biodiversity features identified by a broad set of stakeholders or governments”, 12-iv “ecological structure and functions needed to maintain the viability of priority biodiversity features”, and 14-v “areas associated with key evolutionary processes”). For these criteria, the assessment must rely on expert judgement.

## 2. Ecologically Appropriate Area of Analysis

The scale at which a CH determination takes places depends on underlying ecological processes for the habitat in question and is not limited to the project site boundaries or its Area of Influence (AoI).

Paragraph GN59 of IFC Guidance Note 6 (IFC, 2019) states: *“the project should identify an ecologically appropriate area of analysis (EAAA) to determine the presence of critical habitat for each species with regular occurrence in the project’s area of influence, or ecosystem, covered by Criteria 1-4. The client should define the boundaries of this area taking into account the distribution of species or ecosystems (within and sometimes extending beyond the project’s area of influence) and the ecological patterns, processes, features, and functions that are necessary for maintaining them”.*

Accordingly, the potential presence of CHs is assessed based on an EAAA, which extends beyond the project footprint and its AoI. The EAAA (Figure 1) is delimited as follows:

- It includes the project footprint and its AoI;
- It includes the extension of the site’s single habitat type;
- It extends northwards to the Giza – Luxor Road;
- It extends eastwards within the same habitat for a distance of 4 km from the borders of the project’s AoI ; and
- It extends westwards to the main road and includes the nearby modified habitats (wastewater treatment plant, power sub-station and industrial areas); and
- It extends southwards to the mountain foothills (excluded).

Excluding the industrial area, power sub-station and the wastewater treatment plant, the EAAA is entirely composed of a natural desert habitat and covers a large area of around 63.37 km<sup>2</sup>. This area is wide enough to determine the presence of critical habitat for each species with regular occurrence in the Project’s AoI or ecosystems (including those extending outside the boundaries of the project’s AoI) covered by Criteria 1-4, as stated in paragraph GN59 of IFC Guidance Note.

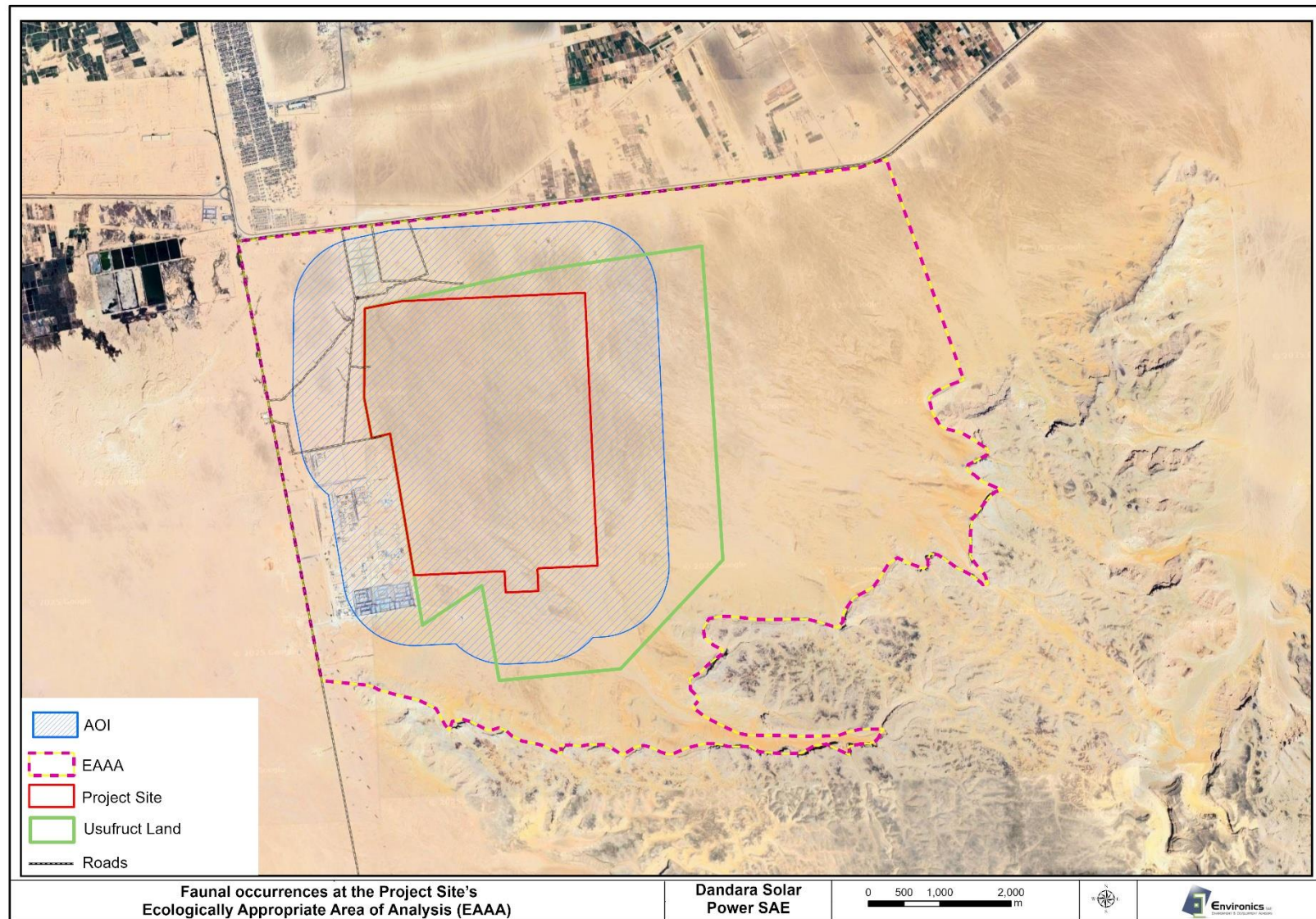


Figure 1: Ecologically Appropriate Area of Analysis (EAAA) for the PV Project Site

### 3. Priority Biodiversity Features

#### 3.1 Identification of Potential PBF Triggering Species and/or Features

##### 3.1.1 Criterion i: Threatened habitats

The EAAA does not include any IUCN Red-List EN or CR ecosystem and therefore this criterion does not apply.

##### 3.1.2 Criterion ii: Vulnerable Species

The following species might qualify the area as PBF;

- The Desert Monitor (*Varanus griseus*) is globally listed as LC and nationally categorized as a NT species. However, it could currently possibly qualify as VU as the NT status was assessed by Baha El Din in 2006. Therefore, it is herein considered using the precautionary approach;
- The Egyptian Vulture (*Neophron percnopterus*), which is threatened both at the regional (Mediterranean) level (VU) and the global level (EN); and
- Rüppel's Pipistrelle (*Pipistrellus rueppellii*), which is globally classified as LC but is VU at the national level (Basuony et al., 2010).

##### 3.1.3 Criterion iii: Significant Biodiversity Features identified by a Broad Set of Stakeholders or Governments

The EAAA does not include any biodiversity features (such as Protected Areas, Key Biodiversity Areas, Important Bird Areas or any other significant feature) and, therefore, this criterion does not apply.

##### 3.1.4 Criterion iv: Ecological Structure and Functions needed to maintain the Viability of Priority Biodiversity Features

The biodiversity features that trigger PBF are part of ecosystems that are underpinned by ecological patterns, processes, and functions, which need to be maintained in order for those features to persist.

Birds and other VU species are thus not dependent on any specific ecological functions or processes in the EAAA. Therefore, this criterion does not apply.

#### 3.2 PBF Screening Exercise

Identified potential PBF triggering species/features have been evaluated to verify if they qualify the EAAA (or part of it) as PBF. To facilitate decision-making, thresholds have been defined for the first two PBF criteria (see Table below), while there are no thresholds for Criteria III and IV.

In Criterion II, the PBF thresholds also consider CR and EN species, although the criterion mentions VU species only. These thresholds are less stringent than those applied to qualify an area as CH. In this respect, in addition to VU species, CR and EN species are also screened against the PBF thresholds.



Accordingly, the Fennec Fox (*Vulpes zerda*), categorized as LC at the global and Mediterranean levels, but nationally classified as EN (Basuony et al., 2010) is also screened against the PBF thresholds.

Results of the screening process for each of the PBF criteria are shown in Table 2.

### 3.3 Results of the PBF Screening Exercise

Four species have been identified as PBFs. Although the EAAA cannot be considered to “support” these species, they might occur in the area (at least as vagrants) and are herein considered PBFs using a precautionary approach. These are:

- The Desert Monitor (*Varanus griseus*);
- The Egyptian Vulture (*Neophron percnopterus*);
- Rüppel's Pipistrelle (*Pipistrellus rueppellii*); and
- The Fennec Fox (*Vulpes zerda*).

Table 2: Screening of PBF triggering species and features potentially present within the project's EAAA

Relevant thresholds	Species / feature	Rationale	Habitat type within the EAAA	Qualifies as PBF (Yes/No)
<b>CRITERION I – THREATENED HABITATS</b>				
(a) EAAA < 5% of the global extent of an ecosystem type with IUCN status of CR or EN	No IUCN Red-List EN or CR ecosystem is present	The ecosystems of the EAAA do not meet the definition for this criterion and therefore, the threshold is not applicable.	Barren desert land	No
<b>CRITERION II – VULNERABLE, ENDANGERED AND CRITICALLY ENDANGERED SPECIES</b>				
(a) EAAA supports < 0.5% of global population OR < 5 reproductive units of a CR or EN species. (b) EAAA supports VU species (c) EAAA for regularly occurring nationally or regionally listed EN or CR species	Desert Monitor ( <i>Varanus griseus</i> ) - IUCN global status: LC - National status NT (Basuony et al., 2010); VU (expert opinion)	<p>Widespread throughout much of the country, avoiding extensive mountainous areas, as well as the Nile Valley and Delta proper. Particularly common along the Red Sea and the Mediterranean coastal plains, at the margins of the Nile Valley and Delta, in the oases and depressions of the Western Desert. In Sinai, it is widespread in the north, but in the south it is largely confined to the Gulf of Suez coast.</p> <p>The species is mostly found in desert plains and large wadis with some vegetation cover. Although the species prefer areas with fairly good vegetation, it can be found in regions almost completely devoid of vegetation, but where food can be readily found.</p> <p>Accordingly, the EAAA is neither located within its main regions of occurrence, nor includes suitable habitat type. However, although the EAAA cannot be considered to “support” the species, the Desert Monitor is considered a PBF due to its potential national status as a VU species, using a precautionary approach.</p>	Barren desert land	Yes

Relevant thresholds	Species / feature	Rationale	Habitat type within the EAAA	Qualifies as PBF (Yes/No)
	Egyptian Vulture <i>(Neophron percnopterus)</i> - IUCN global status: EN - IUCN regional status (Mediterranean): VU	A very preliminary estimate of the global population size is 12,400-36,000 mature individuals, roughly equating to 18,600-54,000 individuals, although further validation of this estimate is needed (BirdLife International, 2021). The total population in Egypt was estimated at 10–100 pairs in the 1980s but recent reports suggest there are currently fewer individuals (Arkumarev et al., 2019), with recorded populations in Halayeb, Shalateen and Aswan and Gabal Elba (ElSafoury, 2020). The species' distribution overlap with the EAAA, but there is no expected intersection with the project footprint, as the area would not provide any feeding or resting advantage to the bird. Accordingly, the EAAA does not support < 0.5% of global population OR < 5 reproductive units of Egyptian Vulture and is not an area where the species regularly occurs. However, although the EAAA cannot be considered to “support” the species, the Egyptian Vulture is considered a PBF due to its global status (EN) and its regional status (VU), using a precautionary approach.	Barren desert land	Yes
	Rüppel's Pipistrelle <i>(Pipistrellus rueppellii)</i> - IUCN global status: LC - National status: VU	It is recorded in a broad strip in Egypt including all of the Nile Valley and Delta and extending to the Red Sea (but not in the south) and the westernmost part of the Sinai (Monadjem et al., 2017). Although potentially occurring within the area, the EAAA is not expected to support important numbers of the species. However, the species is considered a PBF due to its national VU status, using a precautionary approach.	Barren desert land	Yes
	Fennec Fox ( <i>Vulpes zerda</i> ) - IUCN global status: LC - IUCN regional status (Mediterranean): LC - National status: EN	In Egypt, the animal is mainly recorded from the Western Desert, including Fayoum, Wadi El Rayan, Wadi El Natrun, Saqqara, El Farafra, El Dakhla, El Kharga and south-eastern Western Desert, with some isolated records from Sinai and near Suez. Although possibly present, the EAAA neither supports globally important concentrations of Fennec Fox nor nationally/regionally important concentrations of the species. However, the Fennec Fox is considered a PBF due to its national EN status, using a precautionary approach.	Barren desert land	Yes
<b>CRITERION III – SIGNIFICANT BIODIVERSITY FEATURES IDENTIFIED BY A BROAD SET OF STAKEHOLDERS OR GOVERNMENTS</b>				
NA	None present	The EAAA does not include any biodiversity features identified by a broad set of stakeholders or government and, therefore, this criterion does not apply.	Barren desert land	No

Relevant thresholds	Species / feature	Rationale	Habitat type within the EAAA	Qualifies as PBF (Yes/No)
<b>CRITERION IV – ECOLOGICAL STRUCTURE AND FUNCTIONS NEEDED TO MAINTAIN THE VIABILITY OF PRIORITY BIODIVERSITY FEATURES</b>				
NA	None present	Birds and other VU species are not dependent on any specific ecological functions or processes in the EAAA and, therefore, this criterion does not apply.	Barren desert land	No

## 4. Critical Habitat

### 4.1 Identification of Potential CH Triggering Species and/or Features

Based on their compliance with the definition of each criterion, potential CH triggering species and/or features present or potentially present within the project wider area (the EAAA) are identified as follows:

#### 4.1.1 Criterion i: Highly Threatened and/or Unique Ecosystems

The IUCN has developed a system of quantitative categories and criteria, analogous to those used for species, for assigning levels of threat to ecosystems at local, regional, and global levels (IUCN, 2015b). Ecosystems that fall within the EAAA and meet the definition of EN or CR according to IUCN are assumed to comply with this criterion.

The ecosystems of the EAAA do not meet the definition of Highly Threatened and/or Unique Ecosystems stated in IFC GN6 (IFC, 2019). Moreover, the EAAA does not include any ecosystem determined to be of high priority for conservation by national systematic conservation planning. Therefore, this criterion does not apply.

#### 4.1.2 Criterion ii: Critically Endangered and/or Endangered Species

Species threatened with global extinction and listed as CR and EN on the IUCN Red List of Threatened Species shall be considered under this criterion. Moreover, nationally<sup>1</sup> or regionally (e.g., Mediterranean) listed EN or CR species are also considered.

There is only one globally EN bird species, namely the Egyptian Vulture (*Neophron percnopterus*), with a distribution overlapping with the project area, and thus potentially qualifying the area as critical habitat under this criterion.

The Dorcas Gazelle (*Gazella dorcas*) is regionally categorized an EN species (at the Mediterranean level), globally as VU and is probably CR in Egypt (based on expert opinion). Nevertheless, it is worth nothing that the Project Site not only lacks suitable foraging habitats but is also already disturbed by human presence and activities. Accordingly, this species is highly unlikely to be encountered onsite and vicinity (i.e., the EAAA) and therefore, it is excluded from the assessment.

The Fennec Fox (*Vulpes zerda*) is categorized as LC at the global and Mediterranean levels; however, it is nationally considered as EN species.

<sup>1</sup> Although Egypt does not have an official Red List for threatened species, local literature includes the national status of some species. On the other hand, many of these references are not very recent and require updates. Therefore, the status obtained from literature is sometimes modified to reflect the actual status of animals, based on expert opinion.

#### 4.1.3 Criterion iii: Endemic and/or Restricted-range Species

Endemic and restricted range refers to a limited Extent of Occurrence (EOO)<sup>2</sup>. For terrestrial vertebrates and plants, endemic/restricted-range species are defined as those species that have an EOO less than 50,000 km<sup>2</sup>. None of the species potentially present within the EAAA comply this definition and, therefore, this criterion does not apply.

#### 4.1.4 Criterion iv: Migratory and/or Congregatory Species

Migratory species are defined as any species of which a significant proportion of its members cyclically and predictably move from one geographical area to another (including within the same ecosystem). Congregatory species are defined as species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis.

There are 17 migratory soaring bird species with a likelihood of crossing over the area. However, the Project Site is not an important location for migratory birds, as indicated by the site's Sensitivity Index being calculated to be  $\leq 0.001$ . In fact, these birds generally follow the Nile Valley during their migration as it provides sufficient availability of water, food and shelter, while the project site lies within a barren desert which does not provide any advantages to migrating avifauna during rest-stops.

In this respect, a key point relevant to inclusion of airspace utilized by avifauna is that the airspace is "anchored" to an important terrestrial area. In other words, the airspace is typically considered with respect to the ecological use of the terrestrial habitat and not "on its own" (IFC, 2023). In the present case, the project is barren desert environment which does not provide any resources to avifauna in terms of feeding, resting or nesting areas. Using this approach, Criterion 3 would not be considered with respect to the airspace where there is no associated important terrestrial area and no intersection with the project footprint.

#### 4.1.5 Criterion v: Key Evolutionary Processes

The structural attributes of a region, such as its topography, geology, soil, temperature, and vegetation, and combinations of these variables, can influence the evolutionary processes that give rise to regional configurations of species and ecological properties.

None of these features apply to the EAAA and, therefore, this criterion does not apply, and the area is not deemed of importance for key evolutionary processes.

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<sup>2</sup> Extent of Occurrence (EOO) is defined as the area contained within the shortest continuous imaginary boundary, which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy. Area of Occupancy (AOO) is defined as the area within its EOO, which is occupied by a taxon, excluding cases of vagrancy (IUCN, 2001).



## 4.2 CH Screening Exercise

Identified potential CH triggering species/features have been evaluated to verify if they qualify the EAAA (or part of it) as CH. To facilitate decision-making, numerical thresholds have been defined for the first four critical habitat criteria, while there are no numerical thresholds for Criterion V.

Results of the screening process for each of the critical habitat criteria are shown in Table 3.

## 4.3 Results of the CH Screening Exercise

The project area and surroundings do not qualify as critical habitat as none of the CH criteria/thresholds apply to the biodiversity and/or features of the area.

Table 3: Screening of CH triggering species and features potentially present within the project's EAAA

Relevant thresholds	Species / feature	Rationale	Habitat type within the EAAA	Qualifies the EAAA as CH (Yes/No)
<b>CRITERION I – HIGHLY THREATENED OR UNIQUE ECOSYSTEMS</b>				
(a) EAAA ≥5% of global extent of an ecosystem type with IUCN status of CR or EN (b) EAAA is ecosystem determined to be of high priority for conservation by national systematic conservation planning	EAAA habitats and ecosystems do not comply	<p>The ecosystems of the EAAA do not meet the definition of Highly Threatened and/or Unique Ecosystems stated in IFC GN6 (IFC, 2019), and therefore, the threshold is not applicable.</p> <p>Moreover, the EAAA does not include any ecosystem determined to be of high priority for conservation by national systematic conservation planning.</p>	Barren desert land	No
<b>CRITERION II – CRITICALLY ENDANGERED AND ENDANGERED SPECIES</b>				
(a) EAAA supports ≥ 0.5% of the global population AND ≥ 5 reproductive units of a CR or EN species (b) EAAA supports globally significant population of VU species necessary to prevent a change of IUCN Red List status to EN or CR, and satisfies threshold (a)	Egyptian Vulture ( <i>Neophron percnopterus</i> ) - IUCN global status: EN	A very preliminary estimate of the global population size is 12,400-36,000 mature individuals, roughly equating to 18,600-54,000 individuals, although further validation of this estimate is needed (BirdLife International, 2023c). The total population in Egypt was estimated at 10–100 pairs in the 1980s but recent reports suggest there are currently fewer individuals (Arkumarev et al., 2019), with recorded populations in Halayeb, Shalateen and Aswan and Gabal Elba (ElSafoury, 2020). Accordingly, the EAAA neither supports globally important concentrations of Egyptian Vulture nor nationally/regionally important concentrations of the species qualifying the area to meet the thresholds for Critical Habitat.	Airspace above the EAAA	No
(c) EAAA for important concentrations of a nationally or regionally listed EN or CR species	Fennec Fox ( <i>Vulpes zerda</i> ) - IUCN global status: LC - National status: EN	In Egypt, the animal is mainly recorded from the Western Desert, including Fayoum, Wadi El Rayan, Wadi El Natrun, Saqqara, El Farafra, El Dakhla, El Kharga and south-eastern Western Desert, with some isolated records from Sinai and near Suez. Although possibly present, the EAAA neither supports globally important concentrations of Fennec Fox nor nationally/regionally important concentrations of the species qualifying the area to meet the thresholds for Critical Habitat.	Barren desert land	No

Relevant thresholds	Species / feature	Rationale	Habitat type within the EAAA	Qualifies the EAAA as CH (Yes/No)
<b>CRITERION III – ENDEMIC/RESTRICTED RANGE SPECIES</b>				
(a) EAAA regularly holds $\geq 10\%$ of global population AND $\geq 10$ reproductive units of the species	None present	None of the species potentially present within the EAAA comply with the definition of this criterion and, therefore, the threshold is not applicable.	Barren desert land	No
<b>CRITERION IV – MIGRATORY/CONGREGATORY SPECIES</b>				
(a) EAAA sustains, on a cyclical or otherwise regular basis, $\geq 1$ percent of the global population at any point of the species' lifecycle (b) EAAA predictably supports $\geq 10$ percent of global population during periods of environmental stress	Migratory birds	A key point relevant to inclusion of airspace utilized by avifauna is that the airspace is “anchored” to an important terrestrial area. In other words, the airspace is typically considered with respect to the ecological use of the terrestrial habitat and not “on its own” (IFC, 2023). In the present case, the project is barren desert environment which does not provide any resources to avifauna in terms of feeding, resting or nesting areas. Using this approach, Criterion 3 would not apply to the airspace where there is no associated important terrestrial area and no intersection with the project footprint.	Airspace above the EAAA	No
<b>CRITERION V – KEY EVOLUTIONARY PROCESSES</b>				
NA	None present	The area has no structural attributes deemed of particular importance for key evolutionary processes.	Barren desert land	No

## **Annex 3: Glare Risk Assessment**

# **Dandara Solar Power**

## **Glare Risk Assessment for Dandara Solar Power in Nagaa Hammadi**

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## **1- Introduction**

Scatec plans to develop a 500 MWac solar photovoltaic power plant “Dandara Solar Power SAE” combined with a 100 MWh Battery Energy Storage System (BESS) in Qena Governorate, east of the Nagaa Hammadi Industrial Zone.

The project will supply renewable electricity to the Egypt Aluminum Company (EgyptAlum) under a long-term Power Purchase Agreement (PPA). Its primary objective is to support the decarbonization of aluminum production, ensure compliance with the European Union’s forthcoming Carbon Border Adjustment Mechanism (CBAM), and reduce reliance on natural gas, while contributing to Egypt’s renewable energy and climate targets. The usufruct land spans approximately 2335 ha ( $\approx 23,350,000 \text{ m}^2$ ) of which 1130 ha ( $\approx 11,300,000 \text{ m}^2$ ) are designated for the development of the 500MWac solar power project. The site is located in a desert area to the east of the Nagaa Hammadi Industrial Zone within Qena Governorate. It lies south-east of the Nagaa Hammadi Aluminum Complex (EgyptAlum).

This study includes an assessment of the potential occurrence of solar glare affecting observers surrounding the project site, as well as an evaluation of the intensity of such glare, should it occur, and the possible ocular impacts on the observers.

The analysis was conducted using mathematical modules based on mathematical and physical equations that describe the sun’s path and its position on the horizon relative to the project site, as well as the assessment of potential reflections from the photovoltaic (PV) array surfaces.

Furthermore, the study incorporated equations and graphical methods used to evaluate the intensity of solar glare and its potential effects on observers.

## 2- Background

### 2-1 Glint and Glare

The Federal Aviation Administration (FAA) has defined both terms as follows:

- Glint: A momentary flash of bright light.
- Glare: A continuous source of bright light.

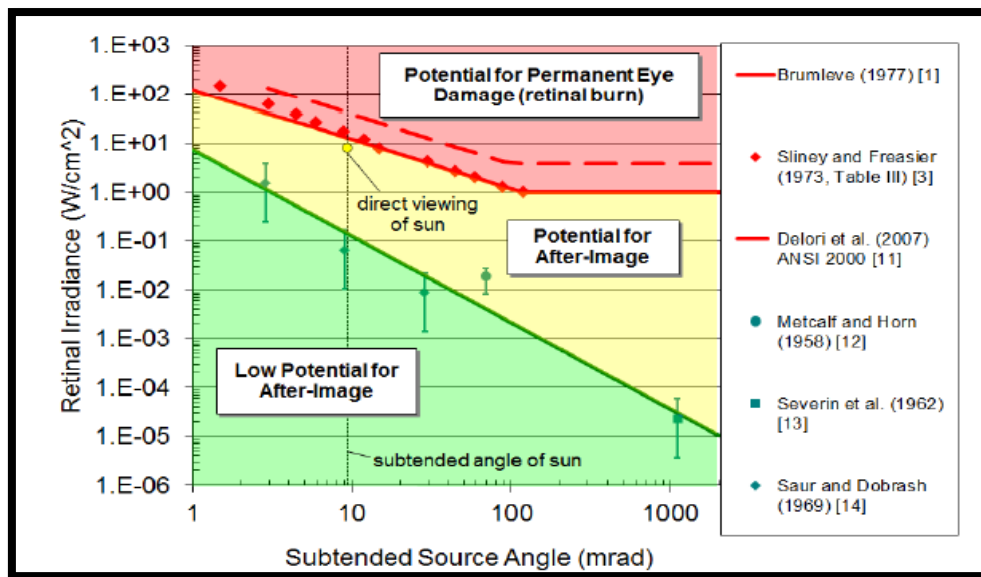
The difference between glint and glare lies in their duration, glint usually occurs due to light reflection from a moving source, while glare is generally associated with stationary objects that reflect sunlight.

The ocular impact resulting from solar glare is classified into three categories, shown in the following table:

**Table 1: Categories of glare impact and their effects**

Risk Level	Description	Meaning	Effect
Low	<i>Low potential for after-image</i>	Does not cause noticeable or lasting visual effects	Represents mild glare causing only minor discomfort
Moderate	<i>Potential for after-image</i>	May cause a temporary after-image, similar to looking at a bright light source	Lasts from a few minutes to several hours
High	<i>Potential for permanent eye damage</i>	Indicates a high risk of permanent retinal injury	May lead to partial or complete vision loss in the affected area

These classifications are based on the human blink reflex, it is worth noting that retinal burns are generally not possible in the case of glare from solar panels, as photovoltaic panels do not concentrate the reflected sunlight.

Figure 1: Glare hazard and ocular impact plot<sup>1</sup>

## 2-2 Solar Reflectance of PV Panels

Photovoltaic panels are characterized by low reflectivity, as sunlight is directly used to generate electricity within the panels, meaning their primary function is to absorb light rather than reflect it. For this reason, they are typically made from dark-colored materials, such as black or dark blue.

Studies have shown that the reflectance of photovoltaic panels is comparable to that of a water surface. However, the amount of reflected light can increase at certain times of the day -usually in the early morning or late afternoon- which may lead to glare in specific directions.

## 3- Objectives

This study aims to support the facility's management in adopting an integrated approach to risk management for the ongoing project. It focuses on analyzing and evaluating solar glare risks associated with the operation of photovoltaic (PV) arrays. The purpose of this assessment is to estimate the likelihood of such risks occurring and to determine the potential magnitude of their impact on the surrounding environment. The findings will enable management to make informed decisions regarding appropriate control measures and to identify the most effective preventive or corrective alternatives, if needed.

<sup>1</sup> [https://www.researchgate.net/figure/Glare-hazard-plot-illustrating-the-ocular-impact-30\\_fig4\\_355131286](https://www.researchgate.net/figure/Glare-hazard-plot-illustrating-the-ocular-impact-30_fig4_355131286)

## **4- Scope**

The scope of this study focuses on analyzing the potential exposure of surrounding observers to solar glare resulting from the installation of photovoltaic (PV) arrays covering an area of approximately 11,300,000 square meters, located east of the industrial zone in Nagaa Hammadi, Qena Governorate.

The analysis of potential solar glint occurrences is considered outside the scope of this study, for the following reasons:

1. Solar glint is a very brief and momentary phenomenon that does not persist over time.
2. Solar glint occurs only within a very limited range, when the angle of solar incidence exactly matches the angle of reflection, a condition that can only take place under ideal and rare circumstances.
3. PV arrays are designed to absorb sunlight rather than reflect it. Their surfaces are coated with anti-reflective layers that disperse sunlight in the event of reflection, significantly reducing glare intensity.

## **5- Limitations**

Presented below are the main limitations associated with the modules applied in this assessment:

1. The modules do not account for the backtracking effects related to panel shading and blocking.
2. Both modules do not represent the detailed system geometry, including gaps between modules and variations in PV array height.
3. The modules treat the photovoltaic arrays as a single unit rather than as separate arrays, in order to reduce the amount of output data.
4. When identifying the source of solar glare, it is determined relative to the center of the photovoltaic arrays, which represents the average glare generated by all the arrays combined.
5. It was assumed that the panel offset ( $\mu$ ) relative to the tracking axis is fixed rather than dynamic.

## 6- Methodology

This study has been prepared following a structured and scientifically grounded methodology aimed at analyzing the potential exposure of surrounding observers or sensitive receptors to solar glare originating from the photovoltaic (PV) arrays.

The study is based on the framework of risk assessment studies, from previous solar glare assessment studies, and international best practices relevant to glare hazard assessment.

The adopted methodology comprises the following main steps:

### 6-1 Glare assessment

The assessment was designed to simulate site-specific conditions accurately and to evaluate solar glare potential in accordance with recognized environmental assessment methodologies.

#### **Analytical module**

An analytical module was developed to simulate the operational principle of the Solar Glare Hazard Analysis, aiming to evaluate the potential occurrence of solar glare resulting from the reflection of sunlight on photovoltaic (PV) panel surfaces.

The module performs a geometric and temporal simulation of the solar path to determine whether observers located at specific points may experience solar glare. This is achieved by analyzing the relationship between the solar incidence angle and the tilt and azimuth of the PV panels across different times of the year.

If glare is predicted, the intensity of reflection, and its visual impact have been estimated based on the observer's location, reflection geometry, and the sun's daily trajectory. This provides a scientifically robust tool for assessing visual safety levels in solar energy projects.

The analytical equations were developed using Python programming language and ArcGIS Pro, in conjunction with the ArcPy library, which serves as an interface linking Python with Geographic Information System (GIS) functions.

This integration enables the automation of spatial analyses, thereby enhancing the efficiency, precision, and repeatability of solar glare assessments.

Combining Python3.13 with ArcGIS Pro ensures a data-driven and flexible workflow capable of processing large spatial datasets, simulating solar reflection paths, and accurately visualizing potential glare zones.

#### **Mathematical module**

This module was developed to serve as the foundational framework upon which the main module will be built. In addition, it has been designed to track every minor computational step within the analytical process, thereby facilitating error tracing and debugging.

This module is based on the mathematical solution of the physical equations governing solar glare phenomena<sup>2</sup>. The sequence of operations within the module can be summarized as follows:

- A. Sun position: The first step of the module involves determining the position of the sun relative to the project site under study. The solar position is calculated based on the specified date, time, and geographic coordinates of the site.

The following equations illustrate determination of sun zenith angle, azimuthal angle, and finally sun beam vectors.

$$t_{solar} = 4(L_{st} - L_{loc}) + EoT + t_{st}$$

$L_{st}$  = Local standard meridian

$L_{loc}$  = Given longitude

$EoT$  = Equation of time

$t_{st}$  = Standard time

$$\omega = t_{noon} \times 15$$

$\omega$  = Hour angle

$t_{noon}$  = Difference between solar time and solar noon

$$\delta = 23.45 \times \sin\left(360 \times \frac{284 + n}{365}\right)$$

$\delta$  = Declination

$n$  = Number of the day

$$\theta_z = \cos^{-1}(\cos \varphi \cos \delta \cos \omega + \sin \varphi \sin \delta)$$

$\theta_z$  = Sun zenith angle

$\varphi$  = Given latitude

$$\gamma_s = \text{sign}(\omega) \left| \cos^{-1}\left(\frac{\cos \theta_z \sin \varphi - \sin \delta}{\sin \theta_z \cos \varphi}\right) \right|$$

$\gamma_s$  = Sun azimuthal angle

$$S_L = \sin \gamma_s \cos \theta_a$$

$$S_J = \cos \gamma_s \cos \theta_a$$

$$S_K = \sin \theta_a$$

$\theta_a$  = Sun altitude angle

$S_L$  = Sun beam vector in x direction

$S_J$  = Sun beam vector in y direction

$S_K$  = Sun beam vector in z direction

- B. PV tracking system: This step is followed by the simulation of the photovoltaic (PV) array tracking system, whether the panels are fixed, single-axis tracking, or dual-axis tracking. The simulation relies on determining the tilt and orientation angles of the PV arrays, as well as the configuration and alignment of their tracking axes.

<sup>2</sup> <http://www.powerfromthesun.net/book.html>



The following equations illustrate determination of tracking axis rotation angle and the PV normal vector.

$$\rho = \tan^{-1}\left(\frac{\cos \theta_a \sin(\gamma_s - \gamma)}{\sin(\theta_a - \beta) + [1 - \cos(\gamma_s - \gamma)] \sin \beta \cos \theta_a}\right)$$

$\gamma$  = Orientation of the tracking axis, clockwise from due to south (0°)

$\rho$  = Tracking axis rotation angle

$\beta$  = Tracking axis tilt angle, 0° is parallel with flat ground

The normal vector components will be:

$$n_b = \sin \rho$$

$$n_r = \sin \mu$$

$$n_u = \cos \rho$$

$\mu$  = Panel offset angle from tracking axis

- C. Incident and reflected rays: The directions of the incident and reflected rays are calculated to estimate the potential paths of solar glare and determine whether these reflected beams are likely to reach the observer's position.

The following equations illustrate determination of reflected sun vector

$$R = v - 2(v \cdot n)n$$

$R$  = Reflected sun vector

$v$  = Incident sun vector

$n$  = Normal PV vector

- D. Glare impact assessment: If solar glare is confirmed to reach the observer, the proportion of sunlight reflected from the surface of the PV array is calculated. Subsequently, the potential visual impact on the observer is evaluated using glare intensity and ocular hazard assessment equations.

The boundary between “yellow” and “red” regions in figure1 can be quantified with the following equations:

$$E_{r,burn} = \frac{0.118}{\omega} \text{ for } \omega < 0.118 \text{ rad}$$

$$E_{r,burn} = 1 \text{ for } \omega \geq 0.118 \text{ rad}$$

The boundary between “yellow” and “green” regions in figure1 can be quantified with the following equation:

$$E_{r,flash} = \frac{3.59 \times 10^{-5}}{\omega^{1.77}}$$

## 6-2 Glare module setup

The project data (including the geographical location, observer positions, and photovoltaic (PV) array specifications) were provided to the modeling system for analysis to assess the potential occurrence of solar glare for the selected observers. In cases where solar glare is identified, the model calculates the glare intensity and evaluates the potential impacts associated with it, Taking into account the following parameters / considerations:

1. The modeling period (January–December 2025) was selected to represent a complete annual cycle, as the solar geometry and climatic conditions within a given year are generally representative of long-term patterns. Therefore, results obtained for this period are considered indicative of typical conditions for other years as well.
2. The year was divided into two main seasons -summer and winter- each lasting six months. Solar noon was assumed to occur at approximately 1:00 p.m. during summer and 12:00 p.m. during winter. This division was adopted to represent the two dominant solar conditions throughout the year, simplifying the analysis while capturing the key seasonal variations in solar altitude and azimuth. The assumed solar noon times (1:00 p.m. in summer and 12:00 p.m. in winter) reflect the typical shift in solar position due to the seasonal variation of the sun's declination and the daylight-saving time adjustment commonly applied in Egypt.
3. Due to the type of anti-reflective coating applied on the PV arrays, the dispersion angle of the reflected beam was determined to be 119 milliradians, as previously mentioned in table 4, which corresponds to approximately 6.8 degrees, this indicates that the angular range of the reflected rays is  $\pm 3.4$  degrees from the centerline of reflection.
4. The data were modeled on an hourly basis to manage the large volume of generated data efficiently. However, in cases where the angle between the observer and the reflected ray approaches the reflection cone angle (high glare probability), the modeling time step will be refined to shorter intervals (1–15 minutes) to achieve higher accuracy.

## 6-3 Result analysis

The extracted results included the angular relationship between the reflected beam and each observer, the tilt angle of the photovoltaic arrays at each selected hour, and the corresponding likelihood of glare occurrence. These parameters were analyzed to determine the temporal and geometric conditions under which potential glare events may occur. The observations were interpreted using scientific principles of solar geometry and reflection behavior to ensure that the analysis accurately represents the actual visual impact on the selected observation points.

## 7- Glare assessment activities

### 7-1 Assessment of the study area

The project site has been characterized based on both project-specific and geographical data, as outlined below:

- a. **Project Site Data:** These data help identify the project's coordinates and boundaries.
- b. **Digital Elevation Model (DEM):** These data help to determine the elevation of the project area and the surrounding lands relative to sea level.
- c. **Photovoltaic (PV) System Data:** This information supports the identification of the photovoltaic array type and layout, their elevation parameters, and the operational characteristics of the tracking system.
- d. **Observers:** The locations of observers in proximity to the project site have been identified and mapped.

### 7-2 Input data

#### A. Site data

The project site data, including coordinates, site area, and topographic information, have been provided within the module as follows:

Table 2: Project site information

Project name	Dandara Solar Power
Location	East of Nagaa Hammadi Industrial Zone, Qena governorate
Area (m <sup>2</sup> )	11,300,000
PV modules	903,960
Coordinates (center)	32.345843 E - 25.928033 N
Elevation, sea level (m)	165

#### B. Observers selection

A preliminary assessment was carried out to determine the directions potentially affected by solar glare and to identify the specific observer locations within those directions, as summarized below:

- **North:** This direction includes the Giza–Aswan Road. Due to the sun's position being predominantly toward the south throughout the year and the PV arrays being tilted southward for optimal energy capture, the northern direction will not receive reflected rays. Therefore, no observation points were selected for this direction.
- **South:** The area consists of vacant land with no human activity or visual receptors for now. As no glare impact is anticipated, no observer points were designated here.
- **East:** This area is also vacant land. During morning hours, sunlight comes from the east, but the east-facing panel surfaces reflect most rays upward rather than horizontally. Consequently, no significant glare is expected, and no observers were chosen in this direction.
- **West:** Luxor Road represents the direction with the highest potential for glare events from reflected sunlight. Accordingly, five observation points were specifically selected

along Luxor Road to capture typical viewing positions for road users and nearby receptors.

Table (3) presents the coordinates of the observation points.

**Table 3: Observers locations**

Observer	Location
Observer 1	32.316280 E - 25.917696 N
Observer 2	32.313685 E - 25.934127 N
Observer 3	32.310819 E - 25.954172 N
Observer 4	32.320466 E - 25.892937 N
Observer 5	32.305881 E - 25.957511 N

The following figure illustrates the project site boundaries and the locations of the observation points.

### C. PV data

The photovoltaic system data were provided to the modules as part of the primary input parameters, as presented in the following table.

**Table 4: PV system information**

PV tracking axis tilt	90°
Panel offset from the tracking axis	35°
Rotation angle over the tracking axis	-55°/55°
Orientation of the tracking axis	0°
PV elevation (m)	2.8
Tracking type	Single-axis tracking system
Glass cover type	Light textured glass with anti-reflection coating
Average beam spread (mrad)	119

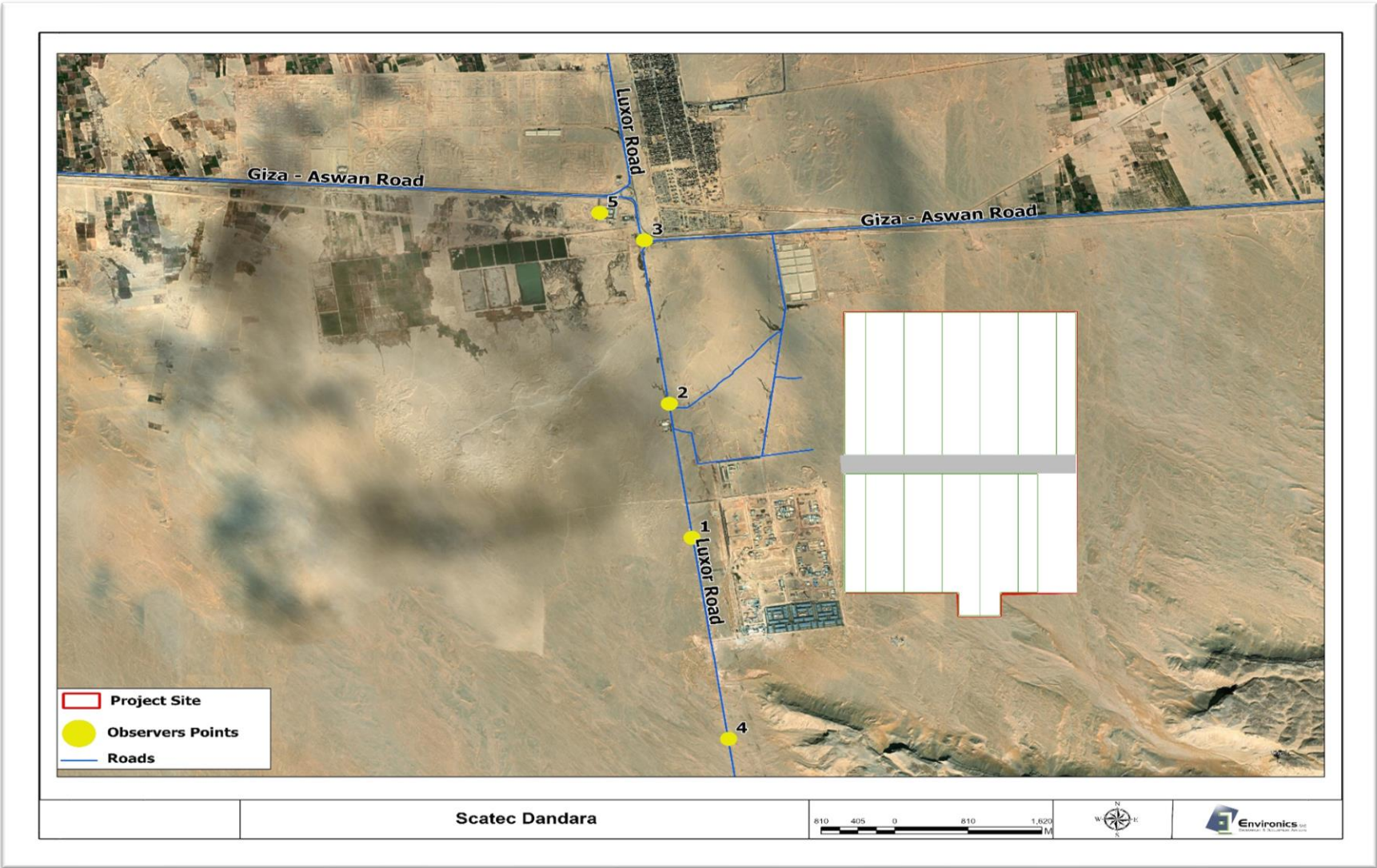


Figure 2: Project boundaries and observers' locations

## 8- Result analysis

The modeling results demonstrated that no solar glare is expected to occur throughout the analyzed year (2025) for any of the five selected observer locations. Given the extensive amount of data generated by the module, a set of representative samples was randomly selected across different periods of the year to effectively illustrate a portion of the overall results and support the interpretation of the findings.

**Table 5: Representative Sample Data of Solar Glare Modeling Results**

Day	Hour	PV rotation angle	Angle between observer and reflected ray					Glare likelihood
			Obs <sub>1</sub>	Obs <sub>2</sub>	Obs <sub>3</sub>	Obs <sub>4</sub>	Obs <sub>5</sub>	
1/1/2025	9:00 AM	46.88	139.10	134.34	144.42	82.72	144.15	No Glare
	10:00 AM	34.89	138.20	130.93	151.5	71.47	149.49	No Glare
	11:00 AM	19.78	128.43	119.81	147.94	56.71	144.06	No Glare
	12:00 PM	-2.15	108.72	99.65	130.36	36.52	125.83	No Glare
	1:00 PM	-15.79	95.79	86.80	117.47	27.05	112.91	No Glare
	2:00 PM	-31.61	81.40	72.88	102.33	25.78	97.89	No Glare
	3:00 PM	-44.31	71.85	64.36	90.98	35.28	86.86	No Glare
5/3/2025	4:00 PM	-54.218	67.92	62.02	83.98	47.65	80.41	No Glare
	9:50 AM	54.07	156.69	150.23	159.54	88.30	160.91	No Glare
	10:50 AM	37.98	148.57	139.30	168.77	72.40	165.13	No Glare
	11:50 AM	15.17	126.88	117.21	149.99	49.44	145.14	No Glare
	12:50 PM	-11.89	99.86	90.18	123.01	22.47	118.15	No Glare
	13:50 PM	-35.52	76.47	66.94	99.41	8.53	94.58	No Glare
	2:50 PM	-52.37	61.24	52.37	83.17	25.25	78.508	No Glare
13/5/2025	3:00 PM	-54.62	59.53	50.87	81.16	28.04	76.54	No Glare
	9:00 AM	53.91	96.58	105.84	74.82	159.87	79.32	No Glare
	10:00 AM	40.51	88.48	97.61	67.18	154.06	71.55	No Glare
	11:00 AM	26.73	81.31	90.39	60.33	148.69	64.61	No Glare
	12:00 PM	12.58	75.14	84.19	54.40	143.83	58.60	No Glare
	1:00 PM	-1.76	69.59	78.60	49.14	139.10	53.23	No Glare
	2:00 PM	-16.07	64.01	72.95	43.99	133.98	47.94	No Glare
	3:00 PM	-30.14	57.72	66.58	38.32	128.06	42.06	No Glare
	4:00 PM	-43.83	50.25	59.04	31.66	121.24	35.08	No Glare
7/10/2025	4:50 PM	-54.95	43.03	51.82	25.19	115.02	28.26	No Glare
	10:00 AM	54.41	156.89	150.49	159.4	88.62	160.84	No Glare
	11:00 AM	38.37	148.96	139.69	169.06	72.78	165.48	No Glare
	12:00 PM	15.55	127.27	117.59	150.38	49.81	145.53	No Glare
	1:00 PM	-11.65	100.10	90.42	123.25	22.68	118.39	No Glare
	2:00 PM	-35.45	76.53	66.99	99.48	8.26	94.65	No Glare
	3:00 PM	-52.40	61.17	52.28	83.13	25.09	78.46	No Glare



1. The selected number of operating hours throughout the day depends on the array's solar tracking angle, which ranges between  $-55^{\circ}$  and  $+55^{\circ}$ . Although the sun remains above the horizon before and after these times, the tracking angle limits of the array cause the reflected rays to be directed upward, which does not affect the observers.
2. The results indicate that the angles between the reflected rays and the observers are significantly larger than the reflected solar cone angle ( $3.4^{\circ}$ ). This wide margin excludes the possibility that solar glare occurs.
3. The observer's elevation relative to the array surface -whether higher or lower- played a significant role in the absence of solar glare. Additionally, the considerable distance of the observers from the arrays (exceeding 2 km) further contributed to eliminating glare visibility.

## **9- Conclusion**

Based on the comprehensive glare analysis performed for the "Dandara Solar Power SAE" Project, it can be conclusively stated that the project poses no risk of solar glare to surrounding areas, receptors, or observers under the proposed design and operational configuration.

The simulation results across all analyzed time periods and observation points consistently demonstrated that no reflected sunlight reaches the observers' line of sight at any time of the year. This outcome is primarily attributed to several key design and technical considerations, including the low reflectivity of the photovoltaic (PV) module surfaces, the incorporation of anti-reflective (AR) coated glass, and the optimized tilt and orientation of the single-axis tracking system. Furthermore, the relative elevation, distance, and positioning of the potential observation points with respect to the PV array surface significantly reduce the likelihood of glare occurrence.

Considering these results, the assessment concludes that the project is not expected to cause any ocular discomfort or visual hazards to the observers that had been selected. Therefore, no additional mitigation measures are deemed necessary to manage potential solar glare impacts.