Obelisk

ESIA for Obelisk PV Power Plant and BESS in Nagaa Hammadi

Prepared by:

Environics, SAE
Environment & Development Advisors

December 2024

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Executive Summary

Introduction

Obelisk, a global leader in renewable energy is planning to develop an Environmental and Social Impact Assessment (ESIA) for the establishment of a photovoltaic (PV) power plant with a capacity a 1GWac, including a 100mW/200MWh Battery Energy Storage System (BESS). The project is located in the Nagaa Hammadi area of Qena Governorate. The generated electricity is to be connected to the national grid through a transmission line.

The Egyptian Electricity Transmission Company (EETC) will be responsible for constructing the necessary transmission line to accommodate the generated electricity.

The proposed project site will occupy an area of about 3888 feddans in desert area within Marakz Nagaa Hammadi, Qena governorate. The project area is devoid of residential or other human activities.

Environics has been assigned by Obelisk to develop the project's ESIA according to the national laws as well as the environmental requirements of international financing institutions, including the Performance Standards (PS) of the International Finance Corporation (IFC), the Performance Requirements (PR) of the European Bank for Reconstruction and Development (EBRD), and the regulations of multilateral development banks such as the African Development Bank (AFDB).

Goals and Specific Objectives

The project aims to contribute to Egypt's renewable energy goals by generating clean electricity and enhancing grid stability through the integration of BESS.

The broad goal of the Environmental and Social Impact Assessment (ESIA) is to provide decision-makers and project proponents with information on potentially significant environmental and social impacts and risks associated with the proposed PV Power Plant and BESS project in Nagaa Hammadi.

The specific objectives are:

- To identify potential positive and negative impacts of the proposed project.
- To suggest mitigation and enhancement measures for the identified significant adverse and beneficial impacts.
- To provide management and monitoring plans.
- To ensure that the proposed project complies with the national environmental regulations and international funding institutions' requirements.

Institutional and Legal frameworks

This framework includes both national legislation and international standards and guidelines.

National Legislation

The project must comply with Egyptian environmental and social laws and regulations, including:

Environmental Impact Assessment (EIA): The national Environmental Law 4/1994 (as amended by Laws 9/2009 and 105/2015) and its Executive Regulations require an EIA study for new projects. The EIA is to be submitted to the environmental authority for review and approval. According to the national regulations, this project is categorised under Category Scoped B projects.

Air Quality: Law 4/1994 and its associated regulations set maximum limits for ambient air pollutants and exhaust gases. The project will need to comply with these limits during both construction and operation.

Noise: Law 4/1994 and its regulations define permissible ambient and work noise levels.

Waste Management: The Waste Management Law 202/2020 and its Executive Regulations set requirements for managing non-hazardous and hazardous waste generated from the different activities.

Biodiversity Protection: Article 28 of Environmental Law 4/1994 prohibits activities that harm specific wild animals and plants and their habitats. Annex 4 of this law lists protected species. The project site does not exhibit significant ecological diversity, and these regulations are not expected to apply.

Cultural Heritage: Law 117 of 1983, as amended by Law 3 of 2010, protects archaeological and historical sites. The project will need to coordinate with the Ministry of Tourism and Antiquities (MOTA) to ensure compliance.

Labor Law: Labor Law 12/2003 and associated decrees address working conditions, occupational health and safety, child labor, and other labor-related issues.

Community Investment: The Egyptian Investment Law 72/2017 encourages investors to contribute to social development initiatives, including environmental protection, healthcare, education, and research.

International Standards and Guidelines

In addition to national legislation, the project will align with international standards and guidelines, particularly those of international financing institutions:

EBRD Performance Requirements: The project must adhere to the European Bank for Reconstruction and Development's (EBRD) Performance Requirements (PRs), including those related to environmental and social impact assessment, labor and working conditions, biodiversity conservation, and community health and safety.

African Development Bank Group's Operational Safeguards (AFDB OS): The project must also comply with the African Development Bank's (AfDB) Operational Safeguards, which cover similar areas as the EBRD PRs.

World Bank EHS Guidelines: The World Bank Group's Environmental Health and Safety (EHS) Guidelines provide technical guidance on Good International Industry Practice (GIIP) for various sectors. The project will utilize these guidelines as a reference 29.

DFC'S Environmental and Social Policy and Procedures (ESPP):
DFC'S ESPP outlines its commitments to sustainability through environmental and social screening, review, risk mitigation, and monitoring. The ESPP adopts the International Finance Corporation's (IFC) Performance Standards and the World Bank Group's Environmental, Health, and Safety (EHS) Guidelines. These measures ensure that DFC-supported projects adhere to rigorous environmental and social standards.

International Labour Organization (ILO) Conventions: The project will adhere to relevant ILO conventions, ensuring fair and safe working conditions, freedom of association, and the prevention of child and forced labor.

Project Description

Project components and main activities
The proposed project comprises three broad components as follows:

Solar Field (PV Modules): The solar energy conversion to electricity takes place in a semiconductor device that is called a solar cell. The project includes the Installation of 1,620,750 high-efficiency bifacial polycrystalline silicon solar panels (710 Wp each) on single-axis tracking systems to maximize solar exposure. The system includes 3,975 inverters to convert DC to AC, with switchgear managing medium voltage circuits before stepping up to 220kV.

Battery Energy Storage System (BESS): Lithium-ion batteries with 205 MWh capacity, housed in insulated containers, with a Battery Management System (BMS) for performance monitoring. Cooling systems prevent overheating, and control systems provide real-time data. Auxiliary systems support safe operation.

Connection to the grid: A 33kV/220kV substation with four 250 MVA transformers will step up voltage for long-distance transmission. The Overhead Transmission Line (OHTL) will connect the project to the existing Nagaa Hammadi substation. EETC will be responsible for the OHTL construction and maintenance. A separate ESIA for the OHTL will be prepared by EETC and submit it to EEAA.

Project location
The project site is located at about 0.5 km west of the Hiw light industrial zone in Nagaa Hammadi. The nearest residential area is approximately 5.6 km away north of the site as well as a number of reclaimed agricultural lands. The Giza-Luxor Road is 3 km to the north. The site can be accessed via a paved road approximately 0.5 km to the east of the site.

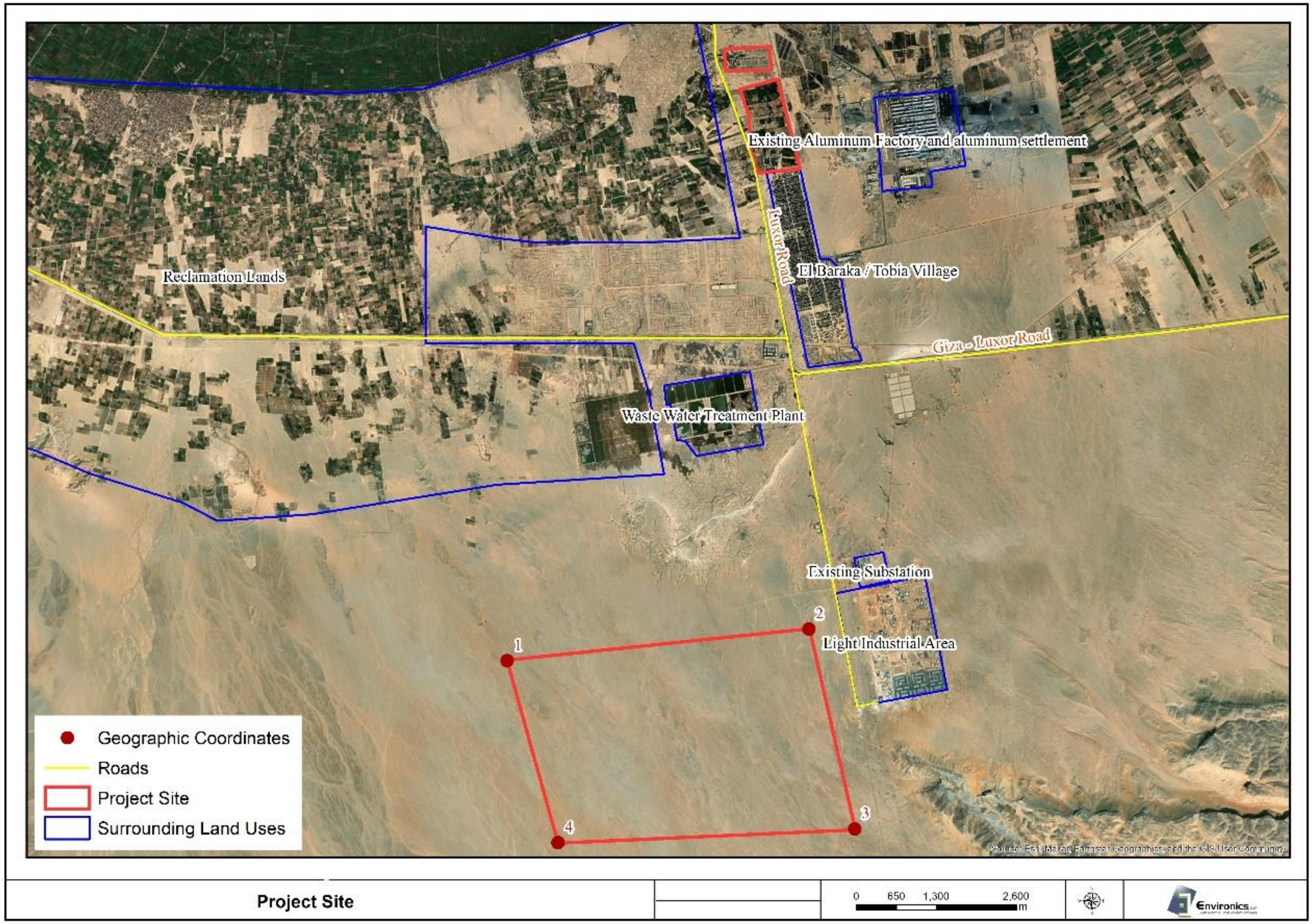


Figure (1): Proposed Project Location

Associated Facilities: Overhead Transmission line (OHTL)

The facilities associated with the project include the electrical transmission line that runs parallel to the Nag Hammadi industrial area east of the proposed project site. It extends northward crossing the Giza-Luxor Road, passing adjacent to the village of Al-Barka. Its last segments where no new towers will be built, passes through reclaimed agricultural lands to reach the Nag Hammadi substation. No new towers will be constructed between points 1 and 5, while towers will be built from point 5 southward to the project substation (extending over a distance of about 6km within publicly owned desert land) as shown in the figure below. Typically, a distance of about 400-600m is maintained between each tower. The Egyptian Electricity Transmission Company (EETC) will be responsible for the construction, operation, and maintenance of the transmission lines and will prepare a separate Environmental and Social Impact Assessment (ESIA) study to obtain approval from the Environmental Affairs Agency.

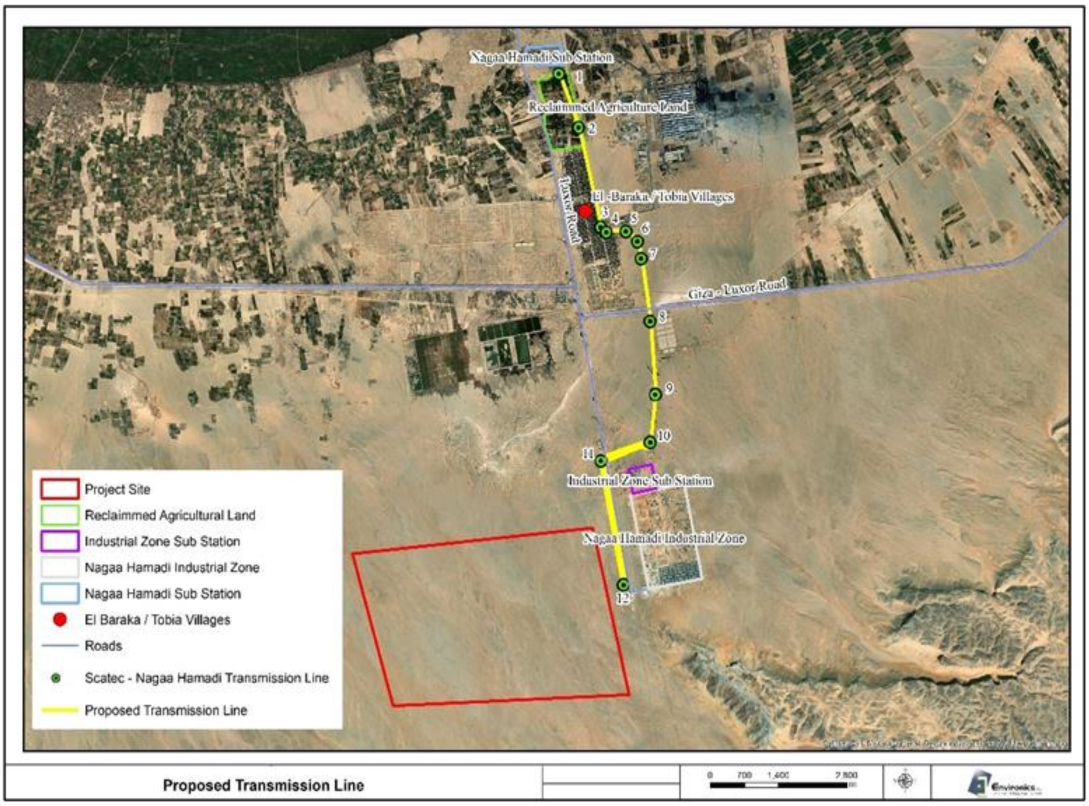


Figure (2): Proposed OHTL Route

Baseline conditions
Physical Environment:

- ***Climate and Meteorology:***
  The project site is located within a hot, arid desert climate with high temperatures, low precipitation with an annual average of less than 50 mm, abundant solar radiation, moderate wind speeds, occasional strong winds, sandstorms, and low humidity levels.
- ***Air Quality:***
  Air quality is generally good due to the sparse population, but dust and particulate matter can be elevated from wind and sandstorms.

- ***Geology and Geomorphology:***
  - ✓ Geological Formations: The project site is underlain by stable limestone and sandstone formations, providing a solid foundation for the PV power plant and BESS.
  - ✓ Topography: The generally flat topography with gentle slopes facilitates solar panel installation and minimizes the need for extensive earthworks.
  - ✓ Geomorphological Features: The landscape includes typical desert features such as sand dunes, rocky outcrops, and dry wadis (seasonal watercourses).
  - ✓ Hydrology and Hydrogeology**:** Surface water resources are scarce, with no perennial rivers or streams nearby. Groundwater is present at varying depths, requiring quality and availability assessment. Flash floods, though infrequent, necessitate appropriate drainage and flood protection measures.

Biological Environment:

The project site entirely consists of bare ground. This was indicated by remote sensing and confirmed by site visits. 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, there are none extending 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. No critical habitats or protected areas are present within the project's area of influence.

- ✓ Habitats: The project site is located in a desert environment, characterized by sparse vegetation, sandy plains, rocky outcrops, and limited water availability. No significant water bodies or wetlands are present within the project area.
- ✓ Flora: the site is completely devoid of vegetation, and only a few desert shrubs were observed outside of the Project Site, restricted to the flood paths west of the Project Site (the ones on which dams were recently erected). .
- ✓ Fauna: Based on species distribution maps, the following reptiles may visit the Project Site: Sahara Sand Viper, Horned Viper, Saharan Sand Snake, and Diadem Snake. Although no reptile traces were found during several surveys, the possibility of their presence cannot be ruled out. Additionally, species like the Egyptian Catsnake, Striped Sand Snake, Egyptian Cobra, and Nubian Spitting Cobra are unlikely to be onsite unless suitable conditions are provided. Likely lizards include the Desert Monitor, Bosc's Fringe-toed Lizard, Elegant Gecko, and Anderson's Short-fingered Gecko. Again, no traces were detected, but their occurrence is possible. Mammals potentially occurring within the site and vicinity include Rüppell's Fox (*Vulpes rueppellii*), which is the most widespread desert fox in Egypt, as well as three rodents; namely the Lesser Egyptian Gerbil (*Gerbillus gerbillus*), Greater Egyptian Gerbil (*Gerbillus pyramidum*) and the Lesser Egyptian Jerboa (*Jaculus jaculus*). The Fennec Fox (*Vulpes zerda*), which is nationally EN, could be also present within or around the Project Site.
- ✓ Avifauna: There are 17 migratory soaring bird species with a likelihood of crossing over the Project Site, of these, the Egyptian Vulture (*Neophron percnopterus*) and the Pallid Harrier (*Circus macrourus*) are of conservation concern. 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 birds passing over the Project Site as the area does not provide any resources to avifauna in terms of food and resting

areas. Moreover, the Project Site is not suitable for resident breeding birds due to its lack of shelter, cover, water, and food resources.

Socio-Economic Environment:
The surrounding area is sparsely populated, with the nearest residential community located a significant distance away.

- ✓ Population Density and Distribution: The project area, situated in the Nagaa Hammadi Markaz of the Qena Governorate, is characterized by a predominantly rural population. The socio-economic baseline highlights the demographic characteristics of the region, including population size, age distribution, and gender ratios.
- ✓ Labor Force and Economic Activities: The assessment encompasses the labor force participation rates, employment distribution across various economic sectors (agriculture, industry, services), and occupational categories. This analysis provides insights into the economic dynamics and employment opportunities in the area.
- ✓ Land Use: The study examines the existing land use types in the the project site, including agricultural lands, residential areas, industrial zones, and infrastructure.
- ✓ Infrastructure and Services: The availability and accessibility of essential infrastructure and services, such as healthcare facilities, educational institutions, water supply, sanitation, and transportation networks, are assessed.

Based on the review of the socio-economic baseline of the project area and the stakeholders' meetings, the utilities and infrastructure within the project area is suitable and sufficient to support the project. In addition, there is available local labour force and local businesses that can support maximising the local hiring. In addition, no current land uses or ownership claims exist. The nearest land use is agriculture land reclamation activities located at about 5km north of the project site.

Tangible Cultural Heritage
According to the Egyptian Archeological Map (2022) and UNESCO's World Heritage List, no registered antiquities or cultural heritage sites exist within the Project Site. However, five archaeological sites and monuments are in close proximity (at distance of more than 9 km from the site), with one UNESCO World Heritage site nearby. These include Abu Amuri, Hur, Hiw, Gebel El-Arqi, El-Halfaya Qibli, and the ancient city of Thebes with its necropolises.

Intangible Cultural Heritage
No intangible cultural heritage elements are practiced within the Project Site itself, although local communities nearby may engage in traditional crafts and practices such as handmade weaving, the Tahteeb stick game, the Al-Sirah Al-Hilaliyyah epic, and date palm cultivation.

Analyses of Project Alternatives
The "no-development" 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 on 3888 feddan[2] of 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 systems.
BESS Alternatives: Different BESS technologies, such as lithium-ion and flow batteries, were considered. Lithium-ion batteries 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, were investigated. Ultimately, the project will utilize water trucking and pipeline supply for its water needs will also be considered.

Wastewater Management: Options for wastewater treatment and disposal were assessed. The project will consider wastewater trucking to the nearest authorized wastewater treatment plant.

Assessment of Environmental and social Risks and Impacts

This chapter evaluates the potential environmental and social risks and impacts of the project. It includes a detailed analysis of the project's risks and impacts and emphasizing the mitigation hierarchy: avoiding, minimizing, mitigating for impacts.

Positive impacts include the production of 1GW of clean, renewable solar energy, reducing CO_2 emissions by 2.68 million metric tons annually compared to a fossil fuel (diesel) power plant, and avoiding air pollutants. Additionally, the project helps conserve water resources in this desert area compared to traditional thermal power plants, integrates renewable energy via a Battery Energy Storage System (BESS), and provides around 5,000 direct construction jobs, 100 permanent operational jobs, and 500 indirect jobs, boosting local businesses and services in Nagaa Hammadi.

Summary of the potential negative impacts on the environment and society during the construction and operation phases of the project illustrated in table below.

Environmental Aspect	Expected risks and Impacts	Mitigation Measures Summary	Residual Impacts
Construction Phase			
Air Quality			
• Air Quality	MINOR	Implement policies to reduce idling, maintain machinery, impose site speed restrictions, ensure worker awareness of safe practices, and conduct periodic generator compliance measurements.	INSIGNIFICANT
Ambient Noise			
Equipment and machinery Vehicles Movement Power Generators	MINOR	Ensure regular maintenance, use low-noise machinery where possible, avoid simultaneous high-noise activities, and provide hearing protection for workers exposed to high noise levels.	INSIGNIFICANT
Impacts on Soil			
Domestic wastewater tanks, material and wastes storage, and accidental spills	MINOR	Conduct off-site maintenance, dispose of hazardous waste properly, and maintain good housekeeping. Ensure proper wastewater disposal and protect local wildlife. Use licensed contractors for waste management.	INSIGNIFICANT
Risks and Impacts on the Biological Environment			
Habitat disruption, flora, fauna, and avifauna	INSIGNIFICANT	Develop, implement, and update a solid waste management plan to ensure environmentally sustainable waste management, preventing vermin and avifauna attraction.	No residual impact
Risks and Impacts on the Social Environment			
Water Resources	INSIGNIFICANT	A comprehensive water management plan will be developed	No residual impact
Worker Influx	Minor	Prioritize hiring local workers, implement and maintain a community grievance mechanism, and select labor accommodation away from existing communities, considering establishing a labor camp on-site.	INSIGNIFICANT
Infrastructure			
• Land use	INSIGNIFICANT	Obelisk has developed Transportation Management Procedures for project, operations, contractors, and subcontractors, defining minimum safety requirements that supplement national regulations and project specifications. Also, implementation of a traffic management plan for the construction phase is required.	No residual impact

Environmental Aspect	Expected risks and Impacts	Mitigation Measures Summary	Residual Impacts
• Traffic	MODERATE	Obelisk has developed Transportation Management Procedures for projects, operations, contractors, and subcontractors. These procedures define the minimum safety requirements for transportation activities, supplementing national regulations and project specifications.	MINOR
Occupational Health and Safety			
• Impacts on workforce health and safety	MODERATE	Surround excavation sites with warning signs and ensure continuous supervision of workers. Provide proper training, regular maintenance, hydration, shaded breaks, and enforce speed limits. Use PPE, inspect equipment, control noise, offer lifting training, and implement fire prevention measures.	MINOR
Operation Phase			
Air Quality			
• Emissions from emergency generator	MINOR	Optimize the operation of backup generators to reduce usage and emissions.	INSIGNIFICANT
Ambient Noise & Vibration			
Operation of Transformers, BESS Use of backup generators during power outages	MINOR	Noise-generating machines and equipment will comply with statutory regulations, and workers will be provided with appropriate PPE. A grievance mechanism will be established to handle complaints.	INSIGNIFICANT
Risk and Impact on the Social Environment			
• Water Resources	INSIGNIFICANT	Wastewater generated during the operation phase is minimal and will be collected by an approved contractor and discharged to designated treatment plants.	No residual impact
Risks and Impacts on Occupational Health and Safety			
• Impacts on workplace	INSIGNIFICANT	A health and safety policy will be implemented, ensuring the provision of appropriate personal protective equipment (PPE) and an adequate supply of drinking water.	No residual impact

These potential negative impacts and risks can be effectively mitigated through the implementation of appropriate measures outlined in the Environmental and Social Management Plan.

Cumulative Impacts

PV projects typically do not pose significant environmental risks and impacts during operation, and construction-related impacts are localized and short-term. Cumulative impacts depend on the timing of nearby construction activities and may include interactions with existing and future projects.

In this respect, the potential cumulative impacts include:

Impact on Water Resources and Wastewater Treatment Capacity: Cumulative effects from parallel construction activities may impact local water resources and wastewater treatment, but these impacts are short-term and localized.

Traffic and Logistics Management: Transportation of construction materials and PV components may increase traffic (about 75 equipment/construction material vehicles/day are expected at peak construction and buses for workers transportation from Nagaa Hammadi and the surrounding communities), but these impacts are short-term and insignificant.

Air Quality: Construction impacts on air quality are localized and limited to the site, making cumulative impacts on the airshed insignificant.

Influx of Workers and Worker Accommodation, Catering, and Transport: EPC contractors typically hire local workers for unskilled jobs, and the number of non-local workers will be low, minimizing community impact.

Environmental and Social Management Plan

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.

It includes mitigation and monitoring measures to ensure environmental and social performance.

The ESMP encompasses the following key components:
The Summary of Impacts and Mitigation Measures,
Environmental and Social Management Plans include the following:

- 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
- Housekeeping and Cleanliness
- Social Management Plan includes Obelisk'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.

Environmental and Social Monitoring Plan~~:~~

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

Stakeholder Engagement Activities and Consultation

Stakeholder consultations were conducted as part of the ESIA study to engage local communities and gather feedback. It took place with different entities, local communities and stakeholders throughout the project lifecycle, including regular communication, consultation, and grievance redressal to address concerns and ensure transparency. Multiple meetings that took place during both the scoping and disclosure phases of an Environmental and Social Impact Assessment (ESIA) for the proposed project.

Scoping Stage Meetings with various entities in Qena Governorate, including authority entities, Hiw Industrial Area, local farmers north of the site, Egypt Alum, the water pumping station, a farmland owner in the vicinity of the Naga Hammadi substation, and the new sewage treatment facility.

Disclosure Meetings: On October 23rd and 24th, 2024, a series of meetings were conducted to disclose and discuss the Environmental and Social Impact Assessment (ESIA) results. These meetings represented a continuation of stakeholder engagement initiated during the scoping stage. Participants included the industrial area management, investors, and employees; farmers closest to the project; local women; the El-Baraka village health unit; and ongoing discussions with the Qena Governorate and relevant authorities.

The Key issues raised during the consultations included potential impacts on the environment (dust, glare) and employment opportunities. The project team provided clarifications and committed to implementing mitigation measures and prioritizing local employment. Overall, the consultations fostered a positive dialogue and helped build trust between the project team and local communities.

Conclusion

The development of large-scale renewable energy supply schemes is strategically important to Egypt to diversify energy supply and avoid energy imports. Therefore, the No-Project option is not considered as a suitable option on this Project. By adhering to the ESIA commitments and mitigating the potential impacts, the Project aims to balance energy development with environmental and social sustainability.

Therefore, with the implementation of the proposed management plans, the identified risks and impacts can be monitored and managed to acceptable levels.

1. Introduction

1.1 Project Overview

Obelisk is a global leader in renewable energy, specializing in solar and hydropower projects. With a strong presence in Africa, Asia, and Latin America, Obelisk has been instrumental in driving the transition to cleaner energy sources. Obelisk's commitment to sustainability and long-term operations has contributed to its success.

The company plans to establish a photovoltaic (PV) power plant with a capacity of 1Gega Watt (GW) coupled with a Battery Energy Storage System (BESS). The project is located in Nagaa Hammadi area of Qena Governorate.

The Egyptian Electricity Transmission Company (EETC) is responsible for constructing the transmission lines in Egypt including the one associated with this project as shown in figure 2 below, to accommodate the generated electricity from the PV power plant and connect it to the national electricity grid.

The project site is located in a desert area, devoid of residential or other human activities. The nearest residential community is located approximately 5.6 kilometers north of the site. The project will occupy an area of about 3888 feddan.

The following Figure (1) is showing the proposed project location. Figure (2) shows the project and the proposed route of the grid connecting overhead transmission line (OHTL).

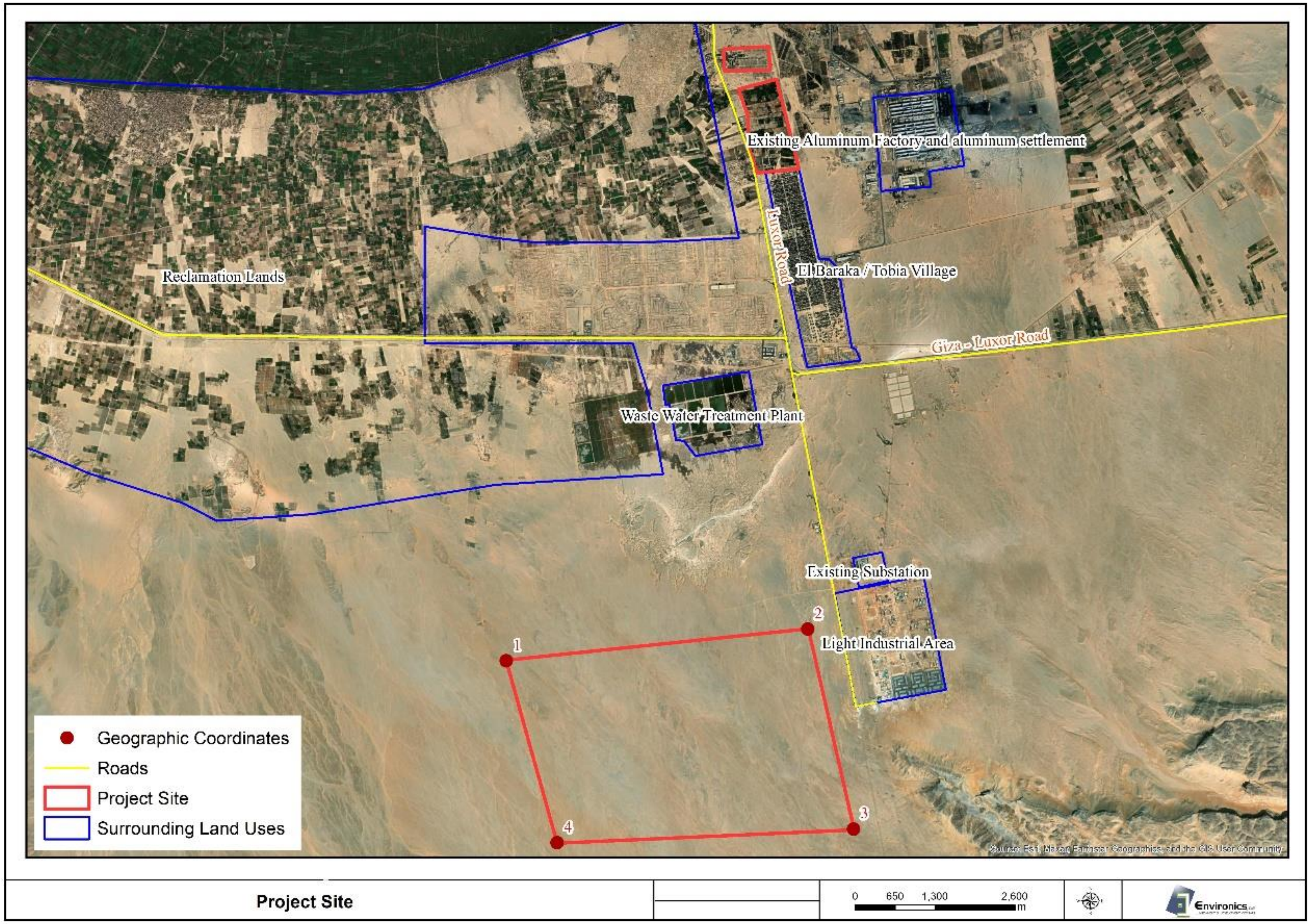


Figure 1: Proposed Project Location

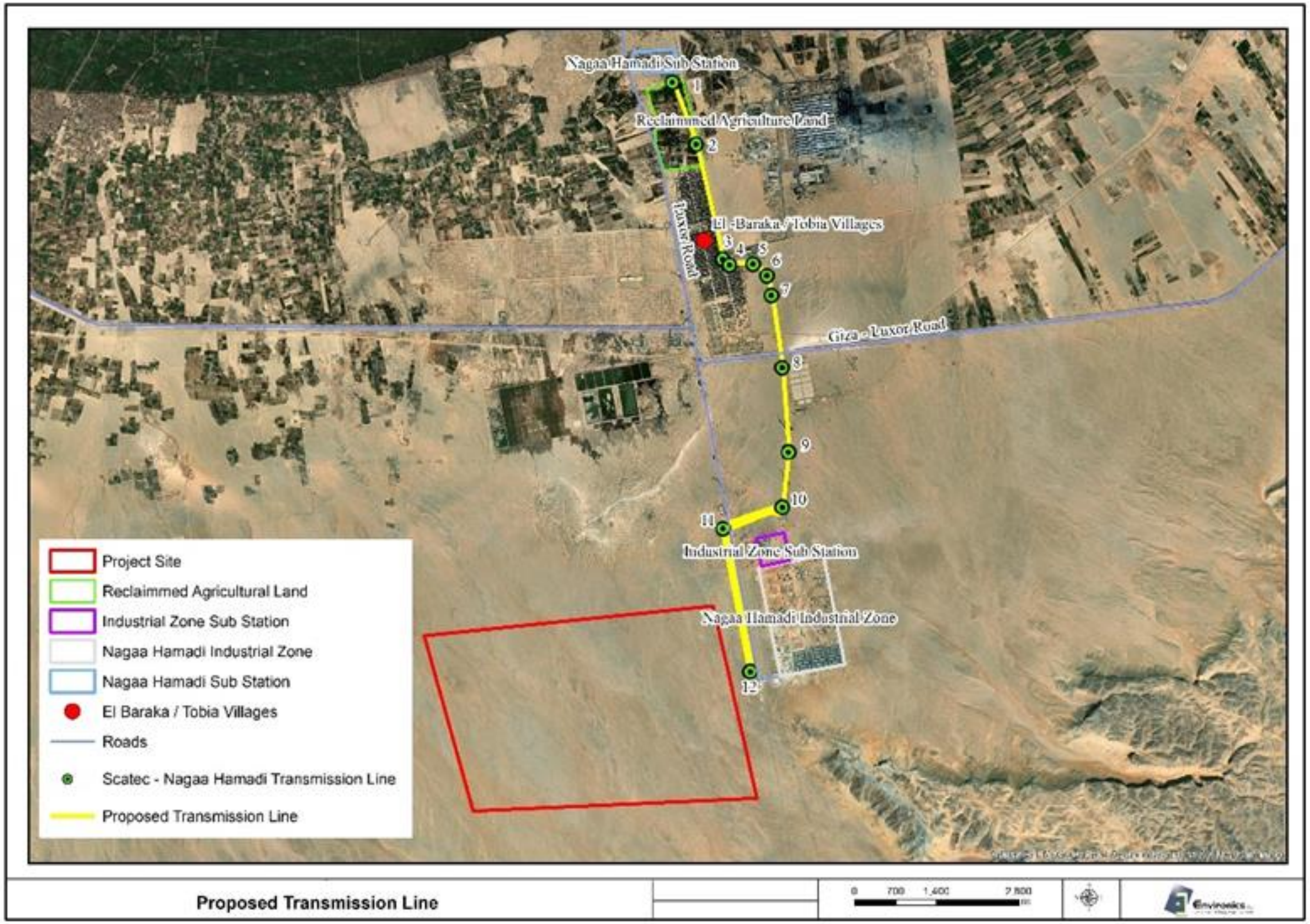


Figure 2: Project location and associated OHTL

In accordance with Environment Law 4/1994 (as amended by Laws 9/2009 and 105/2015) and its revised Executive Regulations, an Environmental Impact Assessment (EIA) study is to be prepared for the PV plant and Battery Energy Storage System (BESS) project.

As per the project categorization lists issued by the Egyptian Environmental Affairs Agency (EEAA) in June 2023, the Obelisk PV Plant (1GW, AC) and the BESS have been classified as Category Scoped-B projects. The ESIA was approved by EEAA on 8th December 2024. Annex 1 includes the EEAA approval from the project.

However, according to the Lenders categorization, the project is a Category A project, requiring a full scale ESIA including preparation of a scoping report and undertake public disclosure activities.

1.2 Objective of the ESIA

The objective of the ESIA is to ensure that the project is environmentally sound and 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 proposed project, to be within the limits of legal environmental 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 Performance Standards (PS) of International Finance Cooperation (IFC) and the Performance Requirements (PR) of the EBRD, the E&S operational safeguards requirements of AfDB, as well as the multilateral development banks.

1.3 Scope of Work

The ESIA of the proposed project would evaluate the project potential environmental and social risks and impacts in its area of influence; identify ways of improving project environmental performance during its different stages by preventing, minimizing or mitigating potential adverse environmental and social risks and impacts and enhancing positive impacts. The ESIA will cover the different components of the plant at the different phases of site preparation, construction, startup, operation and decommissioning.

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 Outline of ESIA study

This ESIA report includes:

- ***Chapter 1:*** 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 aspects
- ***Chapter 3:*** E&S Aspects of PV projects
- ***Chapter 4***: Project's Area of influence
- ***Chapter 5***: Description of the local institutional and regulatory framework as well as the IFC Performance Standards applicable to the project activities
- ***Chapter 6:*** Description of the baseline environment in the project area
- ***Chapter 7:*** Discussion of alternatives for different project components.
- ***Chapter 8:*** Assessment of the potential environmental and social risks and impacts and their mitigation measures.
- ***Chapter 9:*** The environmental and social management and monitoring plan for the PV plant
- ***Chapter 10:*** Stakeholders Consultation

2. Project Description

Obelisk is planning to establish a 1GWac solar power generation project, including a 100mW/200MWh Battery Energy Storage System (BESS), in the Nagaa Hammadi area. This project aims to deliver 1 GWac of solar power into the grid.

2.1 Project Location

The project site spans approximately 3888 feddans in an undeveloped desert area, located about 0.5 kilometers west of the Hiw light industrial zone in Nagaa Hammadi. The nearest residential area is approximately 5.6 km away north of the site as well as a number of reclaimed agricultural lands. The Giza-Luxor Road is 3 km to the north. The site can be accessed *via* a paved road approximately 0.5 km to the east of the site.

Figure 3 below shows the activities/land uses surrounding the proposed site.

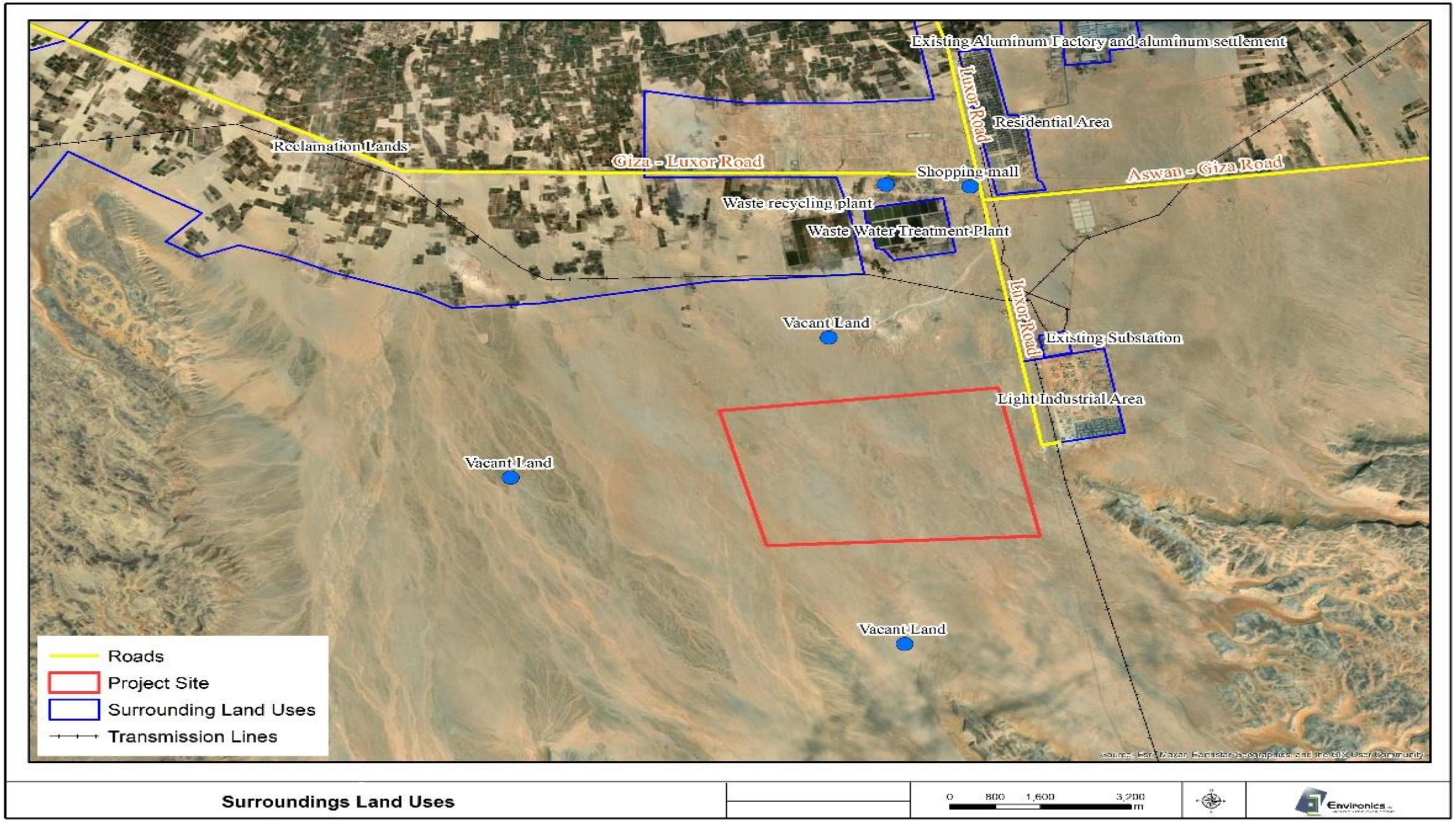


Figure 3: Location and surrounding activities of the project site

2.2 Process Description

2.2.1 General Outline

The Photovoltaic (PV) Power Plant will utilize high-efficiency mono-crystalline silicon solar panels along with single-axis tracking systems (horizontal single axis tracker -1P Dual Row) to maximize energy capture. Additionally, a Battery Energy Storage System (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 EETC and to connect to existing substations.

The project consists of the following Components and Associated Facilities.

2.2.2 Project Components:

2.2.3 Component 1: Solar field Photovoltaic modules: High-efficiency mono-crystalline silicon solar panels

- **Solar Panels**

  PV Plant using 1,620,750 photovoltaic modules, each with a peak power output of 710 watts. 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 and tilt angle, and shading from surrounding obstructions.

- **Mounting structures**

  For optimal performance, PV systems aim to maximize the time they face the sun. In static mounted systems modules are often set to latitude tilt, an angle equal to the latitude. To continuously orient the panels towards the sun, the project will adopt a single-axis horizontal tracking system.
  PV modules will be installed at a single-axis horizontal tracking system that has a maximum height of approx. 1.5 m at -60°/+60° turning angle range. The following table describes the PV module.

Table 1: Module Description (1000MWac/ 1150MWp)

No	Item Description	Unit	Total Qty for 1000MWac
	PV Modules (710Wp)	Nos	1 620 750
	Substructure –Tracker	Tables	18007 (3/2 strings per table)
	No. of PV Module per table	Module	90/60
	Inverter	Nos	3975
	No. of blocks/ MV transformer station	Nos	133
	Technology	----	Bifacial
	BESS Container	Nos	48
	220/33kV Pooling Substation (4 X 250 MVA Power transformers)		

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 (PV) 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 3,975 inverters to convert the direct current (DC) generated by the photovoltaic modules into alternating current (AC) for use in the power grid. These inverters will handle the conversion process, ensuring efficient energy transmission. The project will employ inverters with a total capacity of 1,131 MVA, and approximately 80 MVar of reactive power will be supplied by the Battery Energy Storage System (BESS).

  - ***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.

2.2.4 Component 2: Battery Energy Storage System (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 Battery Energy Storage Systems (BESS) primarily use lithium nickel manganese cobalt oxide (NMC) or lithium iron phosphate (LFP) for their cathodes.

The Battery Energy Storage System (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 4 illustrates the Battery Energy Storage System (BESS)

Key Components of the BESS

1. Battery Modules
   - The core of the BESS, typically lithium-ion batteries with a designed capacity of 205 MWh and a dispatchable capacity of 100MWac/200MWh 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 will accommodate Ancillary Services and load shifting. 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 of 7 pm to 9 pm, 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.

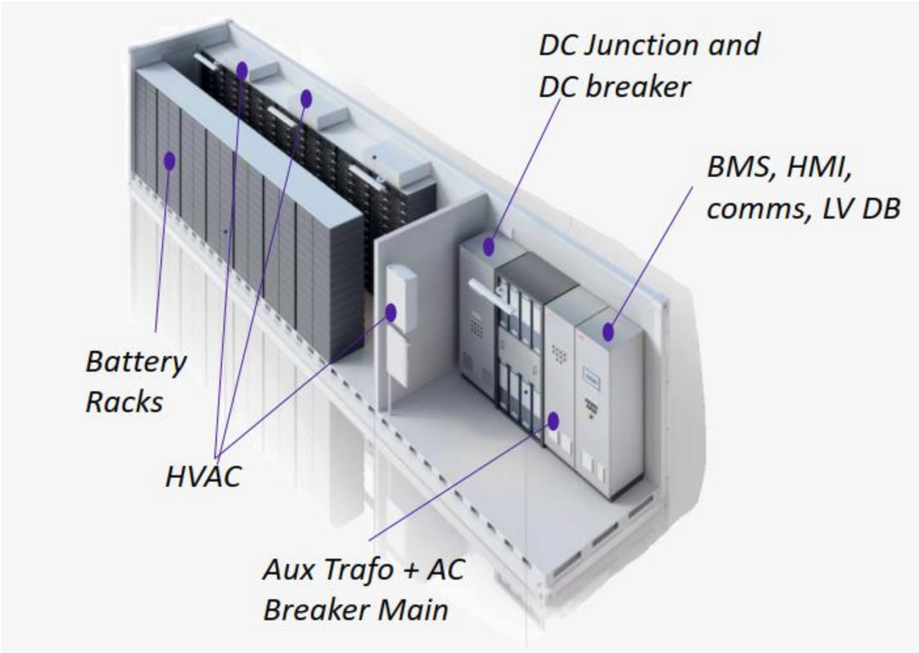
2. Battery Management System (BMS)
   The Battery Management System (BMS) is an essential component of the battery-based energy storage system. This system aims to monitor and manage the performance of batteries to ensure they operate efficiently and safely. Some of the main tasks performed by the BMS 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 liquid-cooled temperature control system to optimize the auxiliary power consumption for fans required to circulate air, 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.



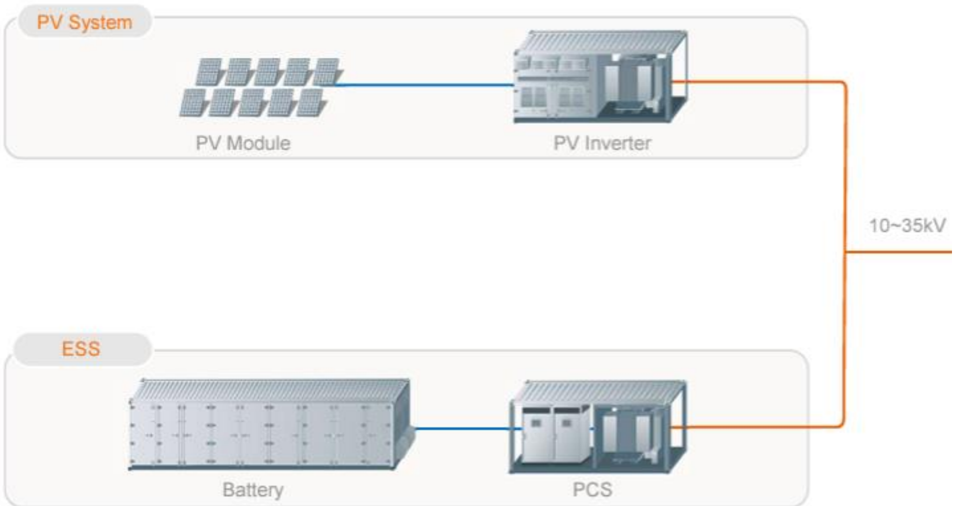


Figure 4: Battery Energy Storage System (BESS)

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 detailed in Chapters 5 and 6 of study.

2.2.5 Component 3: Connection to the grid

33kV/220kV Pooling Substation

A 33/220kV pooling substation has 4 transformers, each with a capacity of 250 megavolt-amperes (MVA) to step up the voltage from 33kV to 220kV for efficient long-distance transmission. It integrates renewable energy into the grid, ensuring reliability and reducing energy losses. Key components include switchgear, circuit breakers, and Power System Stabilizer (PSS). For electrical insulation, current interruption and arc quenching in the transmission and distribution systems, SF6 gas and Air insulations are typically used in electric power systems, where SF6 the mostly used insulation material as illustrated in Figure (5) for Project's Electrical Block Diagram and project layout in Figure (6).

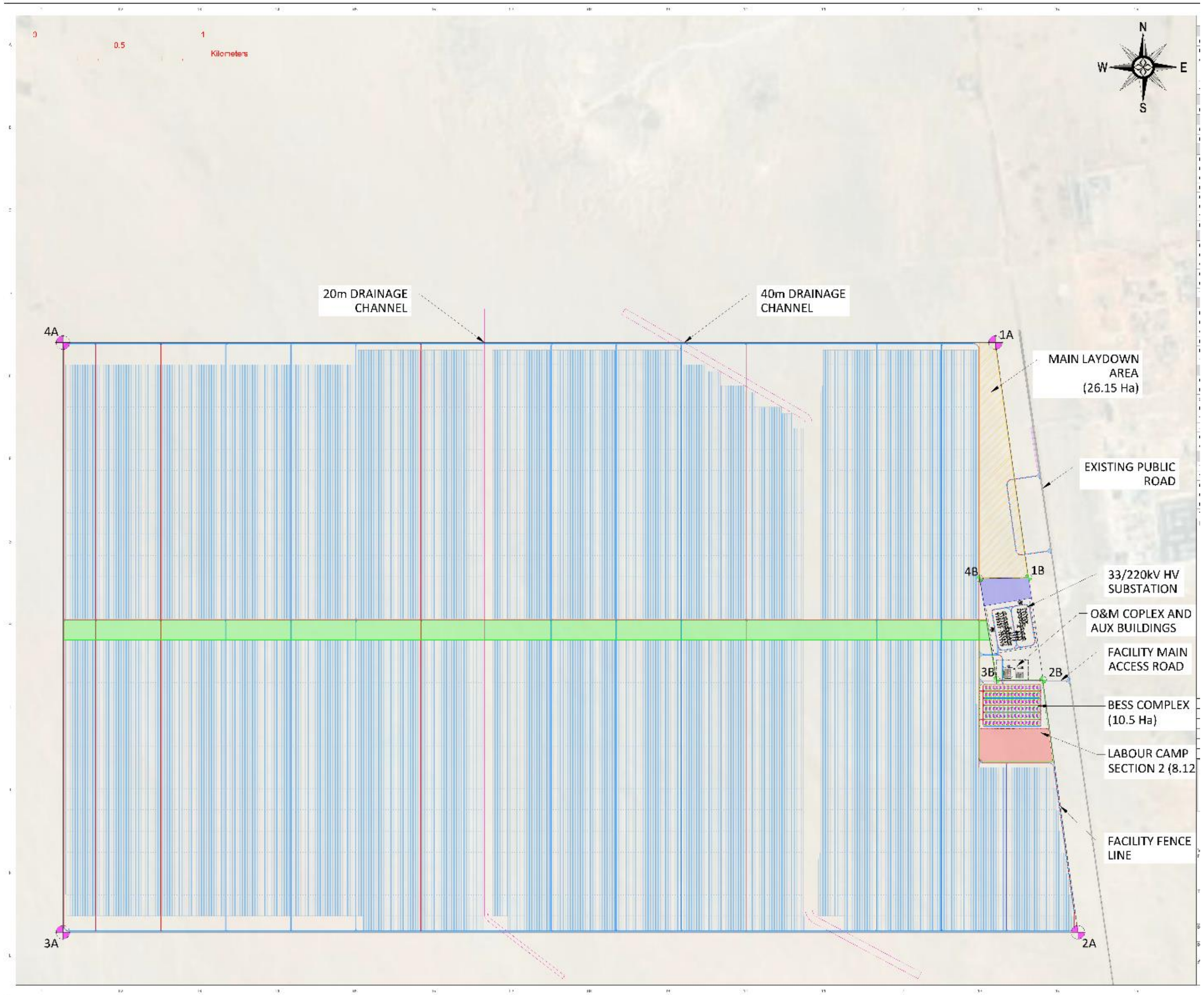
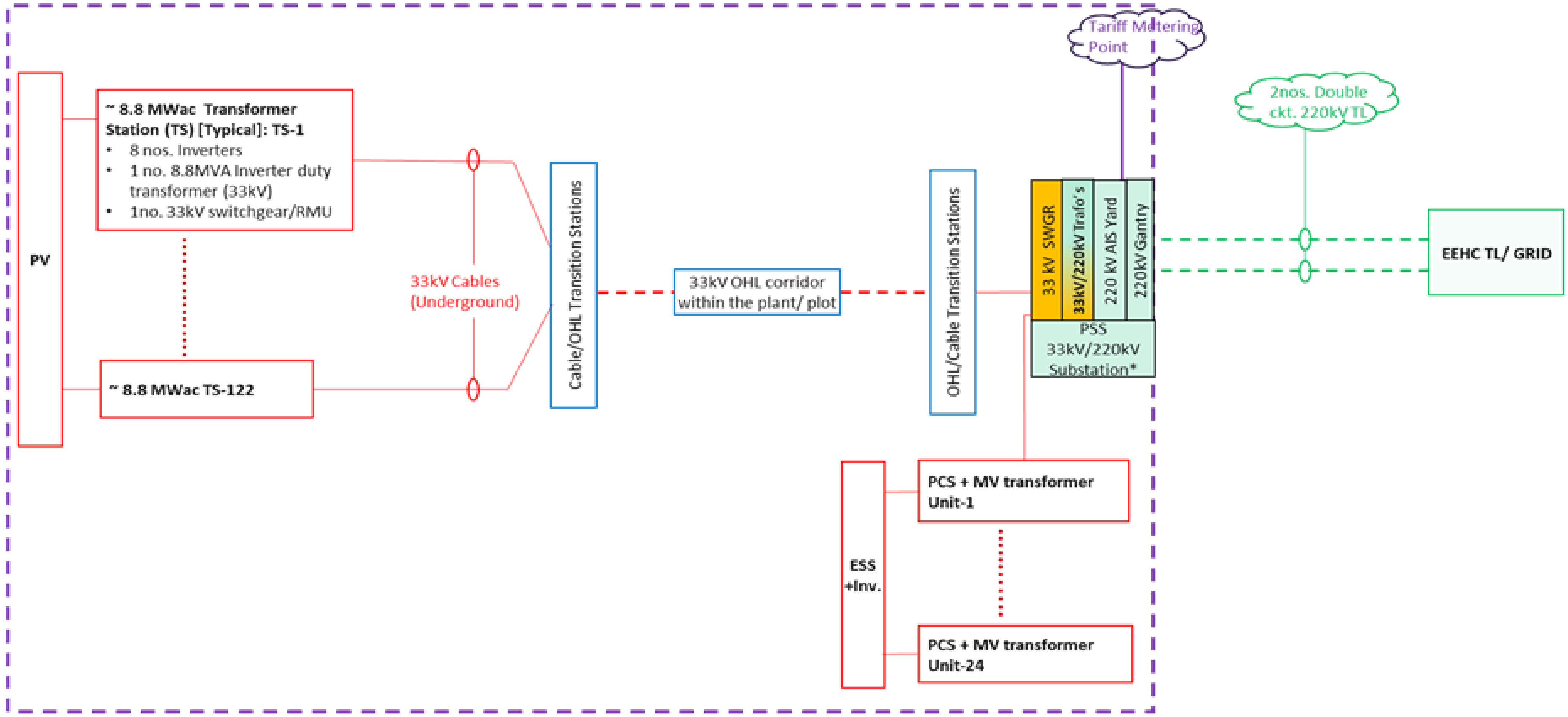


Figure 5: Layout of the project



** Substation will include 80 MVAr CapBank*

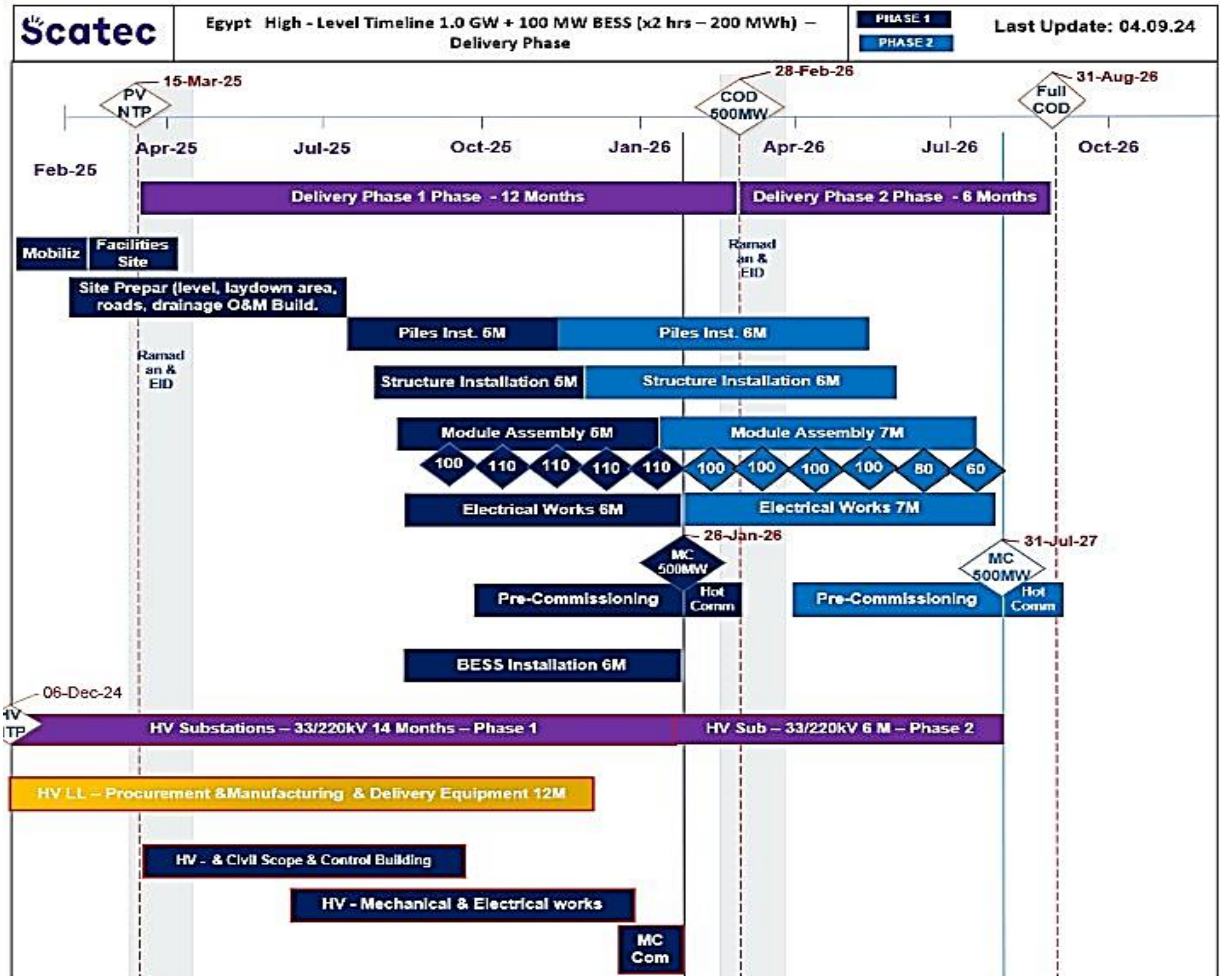
Figure 6: Project's Electrical Block Diagram

2.3 Construction Phase

2.3.1 Project Schedule

According to the proposed timeframe, the project will be delivering in August 2026 upon obtaining all the necessary permits and approvals, starting March 2025 the works including site facilities, civil, electrical, and mechanical works are expected to take about 17 months. Table (5) illustrates the Construction Schedule.

Table 2: Construction Schedule



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 roads
  - 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 east of the PV plant area. Length: Approximately 500 m
  - Internal roads for handling construction equipment (construction material: tar or 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
  - Several ephemeral drainage lines (wadis) crossing the site. Concept design includes diversion of most severe streams crossing the site with constructed channels. The inlet and outlet for these channels require to be established outside of the PV project area. Design will ensure that the downstream discharge, velocity and energy shall not impact the natural drainage of the area.

- Fencing and gates
  Perimeter fencing with main gates and emergency gates enclosing 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)**
  Worker Accommodation
  During the construction phase, workers will be housed in a camp located within the project site, with subcontractors responsible for providing a range of on-site amenities.

  The camp structures will be made of prefabricated modular units constructed off-site and then assembled on-site. The use of prefabricated modular units allows for faster installation and ease of dismantling once the construction phase is completed. The key materials used for the camp structures include:
  - Walls: Galvanized steel frames with insulated panels, such as mineral wool or polystyrene-based insulation
  - Roofs: Lightweight metal sheets or tiles
  - Floors: Raised concrete or timber platforms
  - Windows: Aluminum or uPVC frames
  - Doors: Solid wood or metal doors with appropriate locking mechanisms

  All camp structures will be designed to provide adequate ventilation, lighting, and thermal comfort for the occupants.

  The workers accommodation facilities will be designed and managed in alignment with the GIIP standards for human health and safety, including adequate kitchens, toilets, sinks and showers, appropriate cleaning and maintenance, light, electricity and ventilation and other key elements of adequate housing, including those pertaining to privacy and security as well as the International Labor Organization's (ILO) "Workers' Housing Recommendation, 1961 (No. 115)" and the European Bank for Reconstruction and Development's (EBRD) "Workers' Accommodation: Processes and Standards" guidance.

  The facilities to be provided include:
  - Separate, well-maintained bath facilities (toilets and restrooms) and changing rooms for male and female workers. Toilets will be equipped with sufficient water, soap, and toilet paper, and signage will clearly indicate separate facilities for "Male" and "Female."
  - Dining facilities supplied with clean water and maintained in favorable sanitary conditions.
  - Septic tank-soak pit systems for domestic sewage.
  - A fully stocked first aid kit available at the contractor's office.
  - Offices buildings for the employers (air-conditioned).
  - stores and warehouses.
  - Mess / dining facilities.
  - Sanitary facilities

Labor and Working Conditions
The project will strictly adhere to the Egyptian Labor Law 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 labor and forced labor.

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 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 construction phase will be used in 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.
- Daily consumption is expected to be 80-120 m³/day during peak construction. The maximum water capacity is planned to be 6 tanks, each of 50 m³.

Operation & maintenance Phase:

- O&M consumption is expected to be 150-200 m³/month only for office sanitary purposes and will be trucked to the site through water tankers, as required, water could be also 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 constcruted 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.
- Fire Protection: Water storage tanks of appropriate capacity will be available near the pooling substation for firefighting purposes.Fire extinguishers wil also be distributed

B. *Wastewater:*

Construction Phase:

- Wastewater volumes are estimated at 40-60 m³/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 fordischarge at an authorized wastewater treatment facility.

Operation Phase:

- Wastewater volumes are expected to be 8-12 m³/day.
- Wastewater is planned to be pumped out of the septic tanks and trucked for, and discharge by authorized contractors at the appropriate wastewater treatment facility nearby the site.
- There will be no discharge from the PV cleaning process

2.5.2 Fuel supply

- Diesel will be used for power generators for construction works as well as equipment operation. It will be provided through a contractor.
- During Operation, fuel required for emergency generator during operation will be sourced from the existing fuel stations in the area.
- Moreover, a portion of the generated energy will be allocated to the lighting system, buildings, and the tracking system.

2.5.3 Labour

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

During the construction period, the construction subcontractors will provide the, food & transportation as per the IFC Standard. Current plan to build the labour camp at site with complete facility management services.
Permanent employees during operation are expected to be about 100 workers. According to the company's employment policy, preference will be given to workers from neighboring areas, depending on 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. Battery Energy Storage System (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 decommisioning 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 gases 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 workforce

B. Operation Phase

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

C. Decommissioning phase

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.

2.8 Associated Facilities: Overhead Transmission line (OHTL)

An overhead transmission line (OHTL) will be stablished by EETC to connect the project to the national grid through the existing Nagaa Hammadi substation. The proposed OHTL route runs parallel to the Nagaa Hammadi industrial zone, east of the project site, heading north, crossing the Giza–Luxor Road. It connects to an existing OHTL traversing the buffer area between El Baraka village residential area and the Aluminium Complex, located to the north of the site. The existing OHTL also traverses reclaimed agricultural lands to ultimately reach the Nagaa Hammadi substation north of the farmlands. As illustrated in Figure 7 and Figure 8 below showing the proposed OHTL route and the features of its surrounding respectively.

For the points from 1 to 5 crossing the farmlands and bordering El Baraka village from the east, no new towers will be built, only cables and/or conductors may be installed on the existing towers at this segment. Transmission towers will be built from point 5 southwards to the Project’s substation.

This segment, south of point 5, representing the majority of the proposed OHTL route, is located within empty publicly owned desert land.

According to the national laws, the construction, operation and maintenance of OHTLs are within the scope of responsibility of the Egyptian Electricity Transmission Company (EETC).

The number and distribution of the towers to be constructed within the southern part of the proposed route are to be determined by the construction contractor(s) that will be assigned by EETC and will be confirmed during the detailed design phase. Typically, an average distance of 400-600m is maintained between each tower for a distance of about 6km within a publicly owned desert land. The size and type of towers foundation will depend on the soil bearing capacity (actual sub-soil conditions) and where the OHTL changes direction, more extensive foundations may be required for support than in-line suspension structures.

For cable stringing, a guide wire is used to string the conductors between towers. This can be undertaken mechanically or manually.

Although no new towers will be constructed within the northern section of the OHTL, yet, potential impacts on existing private land use might take place as result of the cable laydown area and the selected technique for cable stringing. In this respect, a separate ESIA is to be developed by EETC for the proposed OHTL. It is expected that the typical towers construction within the desert area will require site preparation prior to constructing the foundation. The expected impacts of towers construction are expected mainly during project construction phase, where civil works take place including the use of different construction vehicles, heavy equipment, however, these will be limited to the construction area. Adverse impacts during operation on the physical and socioeconomic aspects are not significant and may be addressed through management plans and procedures.

The construction, operation and maintenance of the OHTL is within the scope of the Egyptian Electricity Transmission Company. In this respect, a separate ESIA for the OHTL is to be prepared by EETC and submitted to the EEAA for approval.

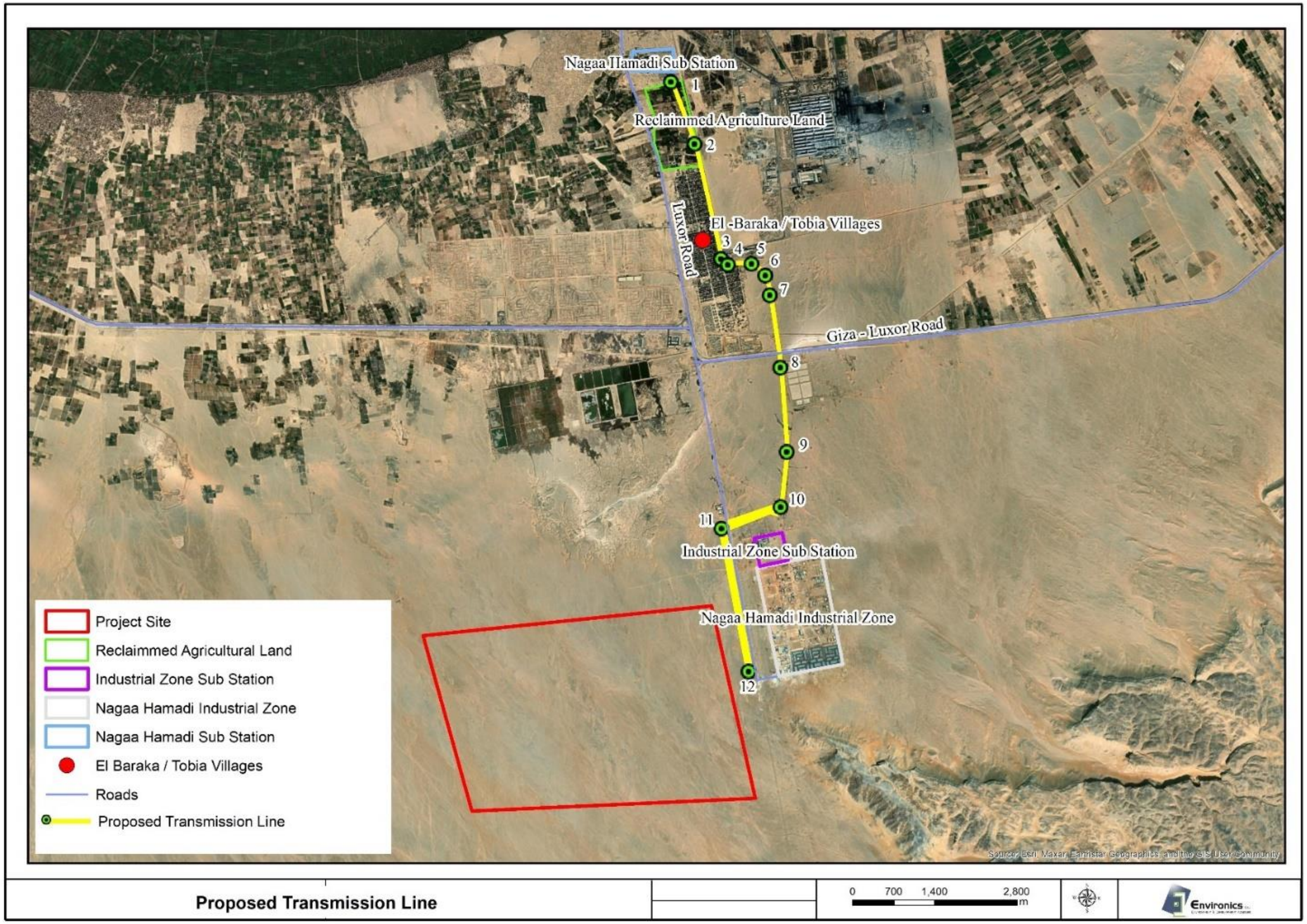


Figure 7: Proposed OHTL route

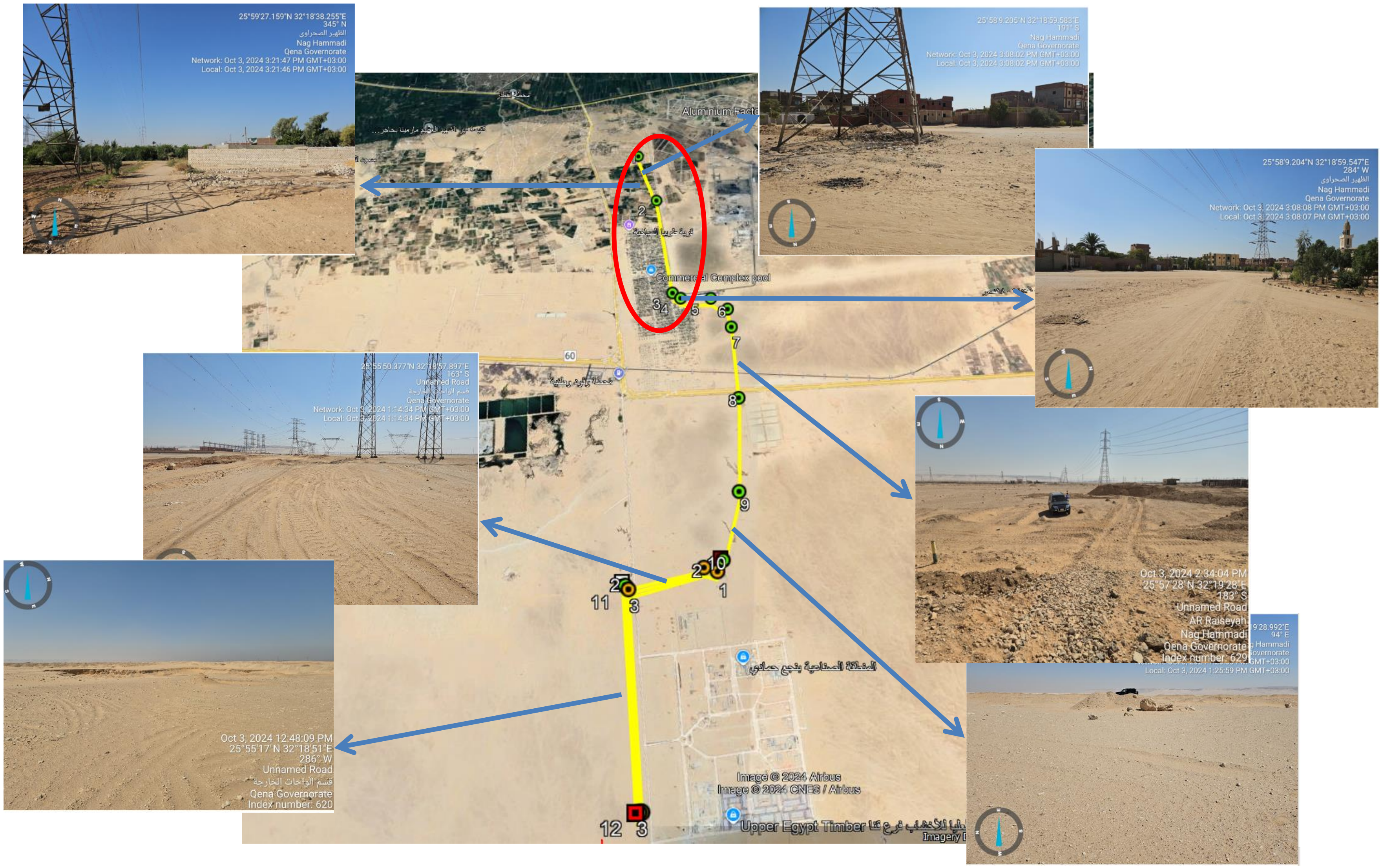


Figure 8: Characteristics of the OHTL surrounding area

3. E&S Aspects of the PV Project

The construction and operation of PV systems have specific environmental and social aspects resulting from specific activities that may lead to potential impacts, which need to be managed effectively to minimize their adverse effects.

Based on the project components described above, the following table outlines the environmental and social aspects of PV systems during the construction and operation phases, along with their potential sources/causes:

Table 3: Project E&S aspects

Environmental & Social Aspects		Source(s)	
		Construction phase	**Operation phase**
Land Uptake	**Land Access Restriction**	- Project infrastructure and assets (e.g., equipment) security	- Project infrastructure and asset (e.g., equipment) 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)	Project footprint will totally be stripped of its natural state.
	Land Acquisition	- Potential private ownership or land use along the northern part of the OHTL (associated facility) - The proposed project site is state-owned	- N/A
Transportation Demand		- Transportation of project components - Transportation of machinery & equipment - Transportation of water, fuel and other material for construction activities - Transportation of workers to and from project sites and accommodation camps	- Limited transportation requirements of workforce and potentially for maintenance.
Workers Influx		- Skilled and non-skilled construction workers (site preparation activities, turbine assembly, technical installations, etc...)	- Limited work force
Worker welfare		- In the work environment - In the workers camp,	- In the work environment - In the workers camp, if any
Water Demand		- Construction activities (preparation of concrete,) - Potable (drinking) water - workers (workforce accommodation, catering, & other facilities - Dust suppression.	- Limited O&M workforce sanitation and other facilities. - Panels cleaning.
Noise & Vibration		- Site preparation (grading, leveling, clearing) - moving machines (mixers, tippers, communicating workers) - Incoming vehicles to deliver construction materials, components, and workers to site - Installation of the components (especially ramming machines)	- Limited activities from O&M (inverters, transformers, cooling fans, and trackers) - Limited Worker's transportation and maintenance equipment's
Dust/Particulate Matter/Gaseous Emissions		- Site preparation (site clearance, excavation and spreading of the topsoil) - Movement of vehicles across dirt/unpaved roads, topsoil, and excavated soil handling - Increased traffic flows (vehicles emissions) - Emissions from onsite diesel power generators	- During operation and maintenance there is no emissions -

Environmental & Social Aspects	Source(s)	
	Construction phase	**Operation phase**
Wastewater Generation	- Domestic waste from a large number of workers	- Limited generation from sanitation facilities
Waste Generation (Hazardous and non-hazardous)	***Non-hazardous*** - Construction material packaging and waste - Non-hazardous off-cuts - Domestic waste from workforce (e.g., food waste, plastic bottles & cans, Paper, Glass ***Hazardous*** - Empty containers of hazardous substances - waste paints, coatings, adhesives, cleaning solvents - Spent lubricating oils and hydraulic fluid	***Non-hazardous:*** Limited quantities of - O&M material packaging (e.g., spare parts) - Domestic waste from workforce (e.g., food waste, plastic bottles & cans glass and mud) - Paper & other office supplies - Cardboard. ***Hazardous*** - Absorbent material, waste oil from machinery lubricants - Empty containers of hazardous substances - Waste cleaning solvents - End of life lithium batteries
Visual Aspects	- Equipment and machinery to include excavators, trucks, front end loaders	- PV panels are alien to the landscape
Glare	N/A	- Sunlight reflected off the modules and the metal mounting structure
Electromagnetic waves	N/A	- Substation and Transformer - Switch gears - Transmission Lines (associated facility)
Lake effect	N/A	- 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 are said to attract birds - For PV panels with tracking system, this will happen only during a short portion of the day

4. Area of Influence

The area of influence 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 and their anticipated Areas of influence are described in the table below. Figure 9 below shows the project AoI (the figure does not include the roads AoI)

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 most of the transmission line are on state-owned desert land Private ownership or land use for line stringing lay down areas potentially between point 1 and point 5 in the Figure above.
Transportation Demand		- Roads from import ports to the project area and the right of way including: ○ The Red Sea roads from the ports of Sokhna or Adabeya ○ Safaga-Qena Road to Qena Bridge, or to ○ The east desert road to Luxor bridge ○ Both leading to the Giza – Luxor Road ○ The site access road from Giza-Luxor road to the industrial area east of the project
Workers Influx		The nearest communities at El Baraka village.
Water Demand		Water would be trucked from the closest water plant
Noise & Vibration		The immediate project vicinity
Dust/Particulate Matter/Gaseous Emissions		The immediate vicinity of the project area

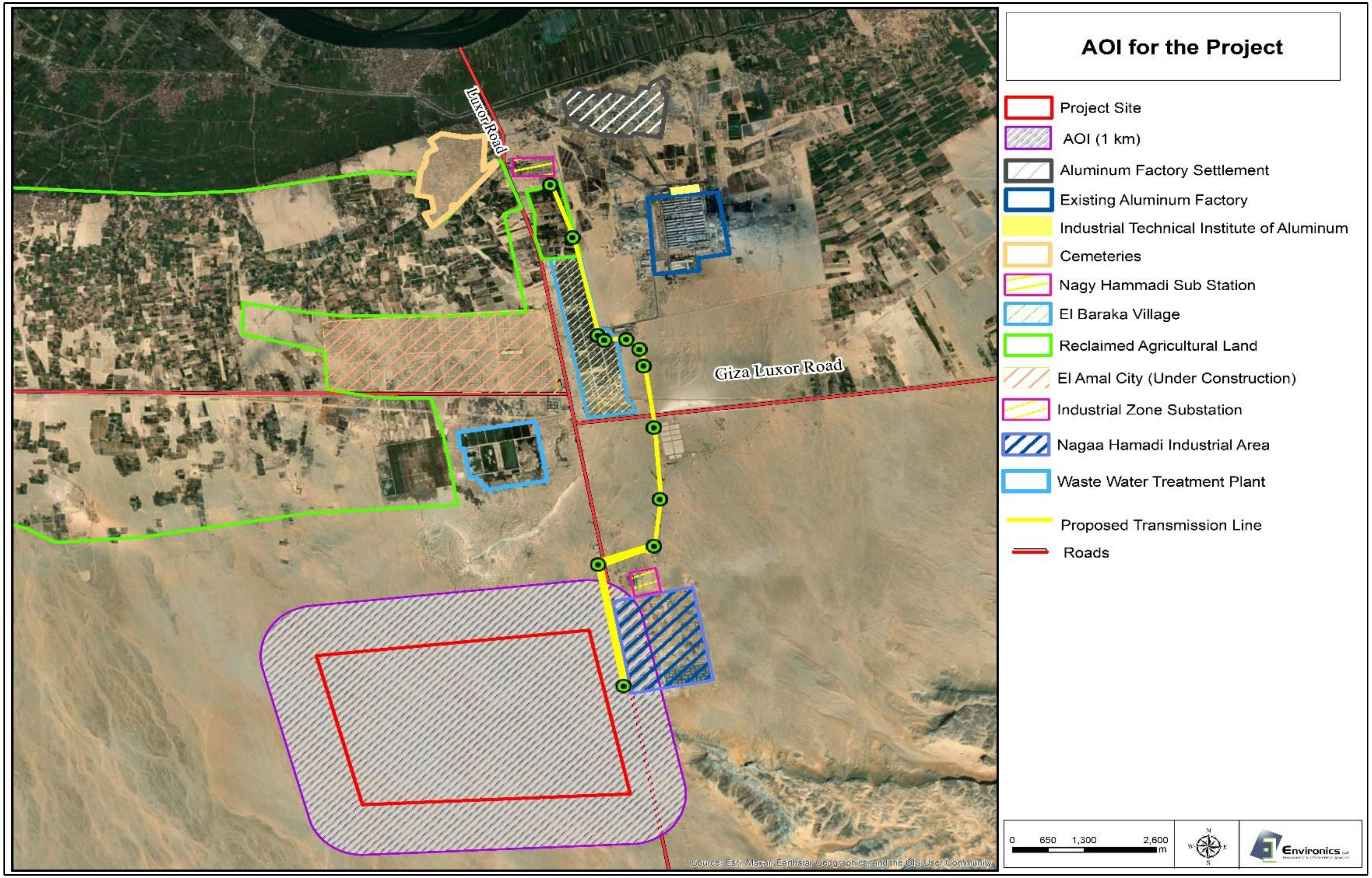


Figure 9: Project AoI

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
Transportation Demand		limited needs for the same roads as for construction for transportation during O&M
Workers Influx		N/A
Water Demand		Limited water needs during O&M and may be trucked or supplied r through water connections
Noise & Vibration		Limited to the workplace
Dust/Particulate Matter/Gaseous Emissions		N/A
Visual Aspects		The project site boundaries
Glare		Not relevant since the panels' orientation will be to the south where there are no communities. The closest airport Luxor is at a distance of 50 km and its runway runs NNE to SSW
Electromagnetic waves		- Project footprint - Right of way of the transmission line 25m at each side of the line (associated facility)

5. 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 3), its geographic location and the expected impacts. Consideration is first given to the national legislations 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.

5.1 National Legislations 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 Environmental Impact Assessment (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 Environmental Impact Assessment (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 Obelisk PV Plant (1GW, AC) and Battery Energy Storage System (BESS) have been classified as Category Scope B project. Consequently, public stakeholder consultation meeting is not required for these projects. The project categorization has been confirmed during the meeting with the head of the EEAA EIA department on October 7, 2024.

However, according to the lenders categorization, the project is a Category A project, requiring a full scale ESIA report including preparation of a scoping report and a public disclosure

5.2 Applicable Egyptian and International Environmental Regulations pertaining to the project

5.2.1 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 ($\mu g/m^3$)	Urban Areas	300	-	125	50
EU[1]		*350*	-	*125*	*20*
Carbon Monoxide (mg/m^3)	Urban Areas	30	10	-	-
EU		-	*10*	-	-
Nitrogen Dioxide ($\mu g/m^3$)	Urban Areas	300	-	150	60
EU		*200*	-	-	*40*
Total Suspended Particles ($\mu g/m^3$)	Urban Areas	-	-	230	125
EU		-	-	-	-
PM_{10} ($\mu g/m^3$)	Urban Areas	-	-	150	70
EU		-	-	*50*	*40*

** 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.*

5.2.2 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 (2-2) below provides the maximum permissible limits for noise intensity in different areas according to Annex 7 of the ER replaced by Decree 710/2012.

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

<table>
<tr><th rowspan="2">Type of zone</th><th colspan="3">The permissible limit for noise level, dB (A)</th></tr>
<tr><th>Day time
7 am – 10 pm</th><th colspan="2">Night
10 pm – 7 am</th></tr>
<tr><td>Areas on roads whose width is 12 m or more, or industrial areas which comprise light industries and other activities</td><td>70</td><td colspan="2">60</td></tr>
<tr><td rowspan="3">EU (Mixed commercial and industrial areas)</td><td>Day-time</td><td>Evening-time</td><td>Night-time</td></tr>
<tr><td>68</td><td>63</td><td>58</td></tr>
<tr><td colspan="3">During Construction Activities: Up to 70 dBA during the day.</td></tr>
</table>

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

[1] https://www.europarl.europa.eu/factsheets/en/section/193/environment-policy

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

5.2.3 Groundwater

Nationally, New Water Resources and Irrigation Law (Law 147/2021) imposes strict regulations on groundwater utilization. Article 70 prohibits the drilling of groundwater wells without obtaining a permit from the Ministry of Water Resources and Irrigation.

Article 78 mandates that development projects using groundwater, especially for non-agricultural projects in coastal areas and those involving desalination of brackish water, must establish a monitoring well. Additionally, Article 79 necessitates well owners to install a system to control the actual rate of groundwater usage.

Article 81 grants the Ministry of Water Resources and Irrigation the authority to close any groundwater well if inspection reports confirm water pollution or a decline in quality, as per the conditions to be specified in its executive regulations No. 81/2023.

Article 80 prohibits the drilling of injection wells for the disposal of wastewater from desalination units without a permit from the Ministry of Water Resources and Irrigation. The executive regulations outline the specific conditions, controls, and procedures for obtaining such a permit.

The above regulations would likely not apply as the project is not expected to use groundwater

5.2.4 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 solid waste management framework.

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

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

5.2.5 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.

5.2.6 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 Regulations No. 1741 of 2005, 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 aforementioned Executive Regulations.

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 with the provisions of Article 211 of Law No. 12/2003 and 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.

5.2.7 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 CITES Convention, 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 No. 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.

These requirements do not apply to the proposed project. As described in Chapter 4, the proposed project area indicates the absence of significant ecological diversity.

5.2.8 Cultural Heritage

Law No. 117 of 1983, as amended by Law No. 3 of 2010, 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 Ministry of Tourism and Antiquities (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.

5.2.9 Work Environment

A. Workplace emissions

The Labor Law 12/2003 organizes working conditions and management of worker relationship. Part 3 of Book 5 of the Labor Law 12/2003, articles 208 through 215, address the responsibility of companies to protect workers against risks resulting from exposure to biological hazards and handling of gaseous, liquid and solid chemical substances.

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 - Work rooms for computers, typewriters and similar equipment	--	65
Work rooms for activities requiring routine mental concentration - control rooms	--	60

C. Occupational health and safety

Based on the Ministerial Decree 153/2003 for the labor law 12/2003, 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 12/2003 organizes working conditions and management of worker relationship. 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. The occupational health and safety requirements are addressed in Book five.

E. Noise in 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 decree 964 /2015).

If 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 ear plugs.

F. ***Employment organization***

The Egyptian Labour Law 12/2003 organizes employment terms, working conditions, and management in chapters one to four of Book 5 of the Labour Law. The national labour law in its different articles addresses the following aspects:

- Individual labour contracts;
- Terms of employment;
- Wages and leaves;
- Collective negotiations and collective labour agreements and litigations; and
- Vocational training.

G. ***Child labour***

Article 64 of the "Child Law" 12/1996 states that: "children shall not be employed for work before reaching the age of fifteen (15) calendar years".

Articles 98 to 103 of the Labour Law 12/2003 (amended by law 90/2005) address the children working conditions, as well as the obligations of the owner who employs children. The Minister of Labour decree 118/2003 concerning child labour describes the terms and conditions for recruiting including providing periodical medical examinations, first aid, good working environment, PPEs and a list includes names, age date of recruitment for each child and post it clearly at the site as well as providing healthy meals.

The articles below of the ministerial labour decree 118/ 2003 concerning child labour indicate the following:

- Article 1 indicates a list of jobs where it is prohibited to employ a child under 18 years old.
- Article 2 indicates a list of jobs where it is prohibited to employ a child under 16 years old. It includes jobs which require a lot of physical and mental work. It also includes jobs that put them at physical chemical or biological risks.
- Articles 3 to 8 describe the terms and conditions for recruiting a child such as providing periodical medical examinations, first aid, a good working environment, PPEs, and a list including names, age dates of recruitment for each child and post it in a visible place at the site as well as providing healthy meals.

H. ***Persons with Disabilities***

Egyptian Law No. 10 of 2018 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 the 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 include 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.

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 12/2003 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*

Article 89 of Labor Law 12/2003 stipulates that the Minister of Manpower shall issue a decree outlining the specific circumstances, types of work, and occasions during which the employment of women is prohibited between the hours of 7 PM and 7 AM. This decree aims to ensure the safety and well-being of women in the workplace by identifying jobs and conditions that may pose potential risks during these hours.

K. *Protection from Harassment*

Article 90 of Labor Law No. 12/2003: it pertains to the issuance of decisions by the Ministry of Manpower related to identifying work that is harmful to health and morals.

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.

5.3 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 Photovoltaic (PV) and Battery Energy Storage System (BESS) projects to the Egypt's National Climate Change Strategy (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 operationsThese would include measures to withstand extreme weather conditions, such as high temperatures and flash floods, which are common in regions like Qena governorate.
- Reducing Greenhouse Gas Emissions: By transitioning to renewable energy sources, PV and BESS projects contribute to reducing greenhouse gas emissions associated with fossil fuel consumption if the same amount of egergy was 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's 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 Nationally Determined Contribution (NDC) to the (UNFCCC). It outlines Egypt's commitments to reducing greenhouse gas (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 greenhouse gas emissions in the oil and gas sector by 2030 from 2,575 GgCO2-eq under a business-as-usual (BAU) scenario to 0,89 GgCO2-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.

5.4 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:

5.4.1 Biodiversity

- **Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA), 1995**
  The convention emphasizes on 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 re-creational, ecological, economic, educational services etc. and its importance in maintaining life. The convention emphasizes that countries and States are responsible to preserve their biological diversity and that specific human activities negatively affects 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 recognizes 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.

5.4.2 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 (UNFCCC), 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 greenhouse gases. 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 greenhouse gases 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 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 industrial years. It provides flexibility on how the countries reach their target (eg: increase in forests to compensate 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 UNFCC convention.

5.4.3 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 United Nations Educational, Scientific and Cultural Organization (UNESCO) meeting was held in Paris from 17 October to 21 November 1972, at its seventeenth session.
  - Egypt ratified the convention on the 7th 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 in order to improve the protection of those sites.

5.4.4 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.

5.5 International Standards and Guidelines

In addition to complying with Law 4/1994, the Environmental and Social Impact Assessment (ESIA) study has been prepared in accordance with the requirements of international financial institutions, particularly the European bank for Reconstruction (EBRD) and the African Development Bank AfDB for projects seeking funding.

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

5.5.1 EBRD Performance Requirements

PR1: Assessment and Management of Environmental and Social Risks and Impacts

This performance requirement establishes the importance for:

1. Integrated assessment to identify the social and environmental impacts, risks, and opportunities of projects;
2. Effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them.
3. The client's management of social and environmental performance throughout the life of the project.

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

PR2: Labour and Working Conditions

This performance requirement 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 PR 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[2]. 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)

PR3: Resource Efficiency and Pollution Prevention and Control
This performance requirement recognizes that industrial activities often generate increased levels of pollution in air, water, and land, which can have potential adverse impact on the surrounding environment.

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

PR4: Health, Safety and Security
This performance requirement 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.

Regarding the proposed project is a PV Power Plant (1GW, AC) and Battery Energy Storage System (BESS) and is located at a distance of about 5 km from the nearest community and about 3 Km from the Giza - Luxor Road. North of the propose 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 Environmental and Social Impact Assessment (ESIA) study will address these potential impacts.

[2] 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

PR5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement

This performance requirement recognizes that the project design minimizes economic and physical displacement, balancing social environmental and financial costs and benefits.

Provisions of this performance requirement do not apply to the proposed project since the activities will not involve any involuntary resettlement or change in the land use.

PR6: Biodiversity Conservation and Sustainable Management 35 of Living Natural Resources

This performance requirements addresses how projects[3] 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.

PR7: 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 PR do not apply to the proposed project since there are no indigenous communities in the area.

PR8: 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.

No cultural heritage components are expected. Moreover, there are no registered archeological sites within or in close proximity to the proposed project location. However, cases of chance find will be addressed in the ESIA.

PR 10: Information Disclosure and Stakeholder Engagement

This PR recognises the importance of an open and transparent engagement between the client, its workers, worker representatives, local communities and persons affected by the project. The PR aims to ensure that appropriate environmental and social information is disclosed and meaningful consultation

[3] 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.21

is held with the project's stakeholders and where appropriate, feedback provided through the consultation is taken into consideration; and ensure that grievances from stakeholders are responded to and managed appropriately.

Provisions of this PR apply to the proposed project

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

The Bank has defined the E&S Operational Safeguards (OSs), 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 the 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 Good International Industry Practice (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 the 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 area, and there are no registered archaeological sites in or near the proposed project location, any instances of chance finds will be addressed in the Environmental and Social Impact Assessment (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.

5.5.3 DFC Environmental and Social Policy and Procedures (ESPP)

The U.S. International Development Finance Corporation (DFC) Environmental and Social Policy and Procedures (ESPP) outlines DFC’s commitments to environmental and social screening, review, risk mitigation, and monitoring. These measures ensure the sustainability of DFC-supported projects.

The ESPP adopts the Performance Standards on Social and Environmental Sustainability of the International Finance Corporation (IFC) and the Environmental, Health, and Safety (EHS) Guidelines of the World Bank Group. These standards guide the assessment and mitigation of environmental and social impacts of the projects supported by DFC.

The ESPP underscores DFC's commitment to reducing greenhouse gas emissions associated with its projects. DFC evaluates projects for climate-related risks and vulnerabilities, promotes energy efficiency and conservation, encourages the use of low-carbon fuels and technologies, and supports climate adaptation and resilience measures. The ESPP also details the responsibilities of clients regarding climate change mitigation and adaptation.

5.5.4 World Bank EHS Guidelines

The World Bank Group members are committed to abide by the general Environmental Health and Safety (EHS) Guidelines for different projects where they are involved. These are complemented with industry specific guidelines for complex projects.

The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (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.

6. Environmental and Social Baseline

6.1 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 15 km southeast of the town of Nagaa Hammadi. The nearest settlements to the Project Site is located approximately 5.6 km north of the Project Site. Other notable areas surrounding the Project Site include the Nile Valley, located 12 km north of the Project Site, and the capital of the Qena governorate, Qena City, situated 50 km northeast of the Project Site. The coordinates for the corner points of the Project Site and the locations of the nearest roads and land use are provided below (Figure 10)

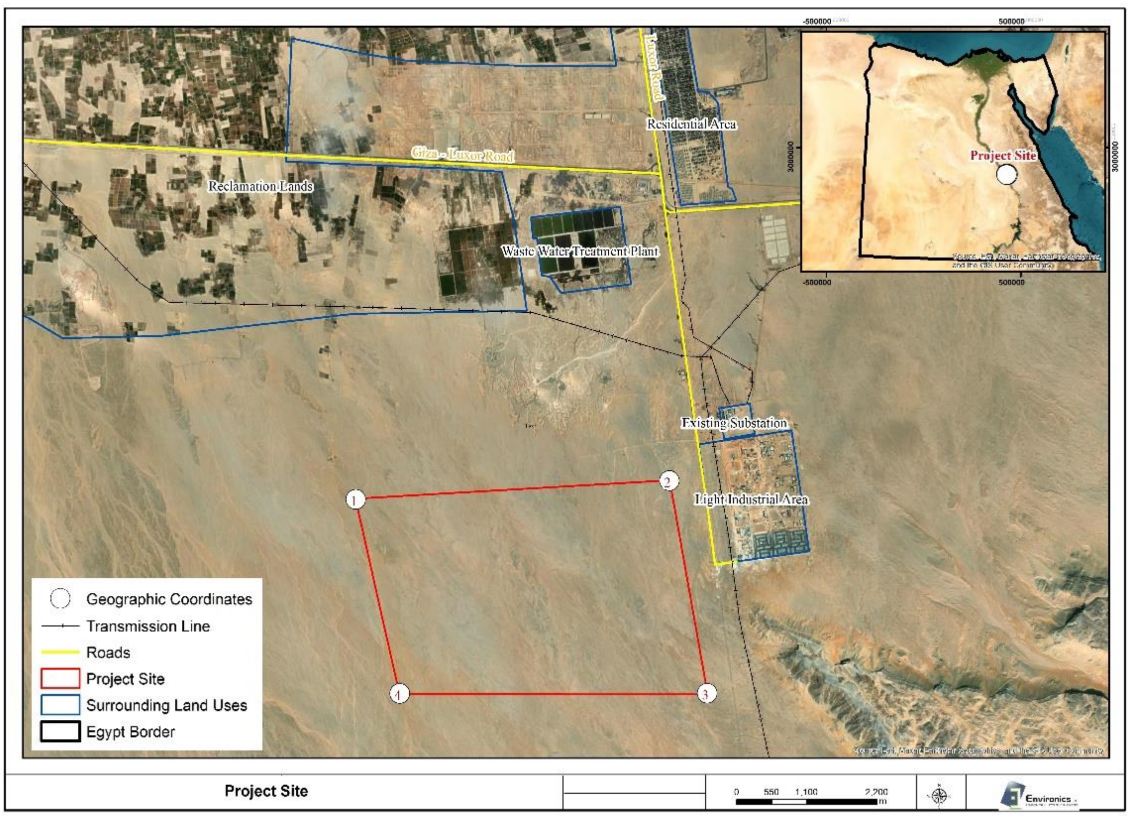


Figure 10: Location of the Project Site, and the locations of the nearest roads and land use

Table 9: Location coordinates for the four corners of the Project Site

Corner No.	Latitude	Longitude
1	32.262144	25.91387
2	32.311175	25.91671
3	32.317281	25.887197
4	32.269188	25.886933

6.2 Physical Environment

6.2.1 Climate and Meteorology

The Qena governorate is characterised 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 characterised 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, 2024).

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 metre squared per day ($MJ/m^2/day$) received in the Qena governorate between 2012 and 2016 reveal 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 $MJ/m^2/day$) in July of 2012. On the other hand, the lowest SR values were recorded in December, where the minimum SR level (12 $MJ/m^2/day$) 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 $MJ/m^2/day$ between 2012 and 2016 in the Qena governorate

Year	Monthly Average SR ($MJ/m^2/day$)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Max**	**Mi n**
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^2/ year and 2,264 kWh/m^2/ year and 6.0 kWh/m^2/ day to 6.2 kWh/m^2/ day (Figure 11) (Solargis, 2024).

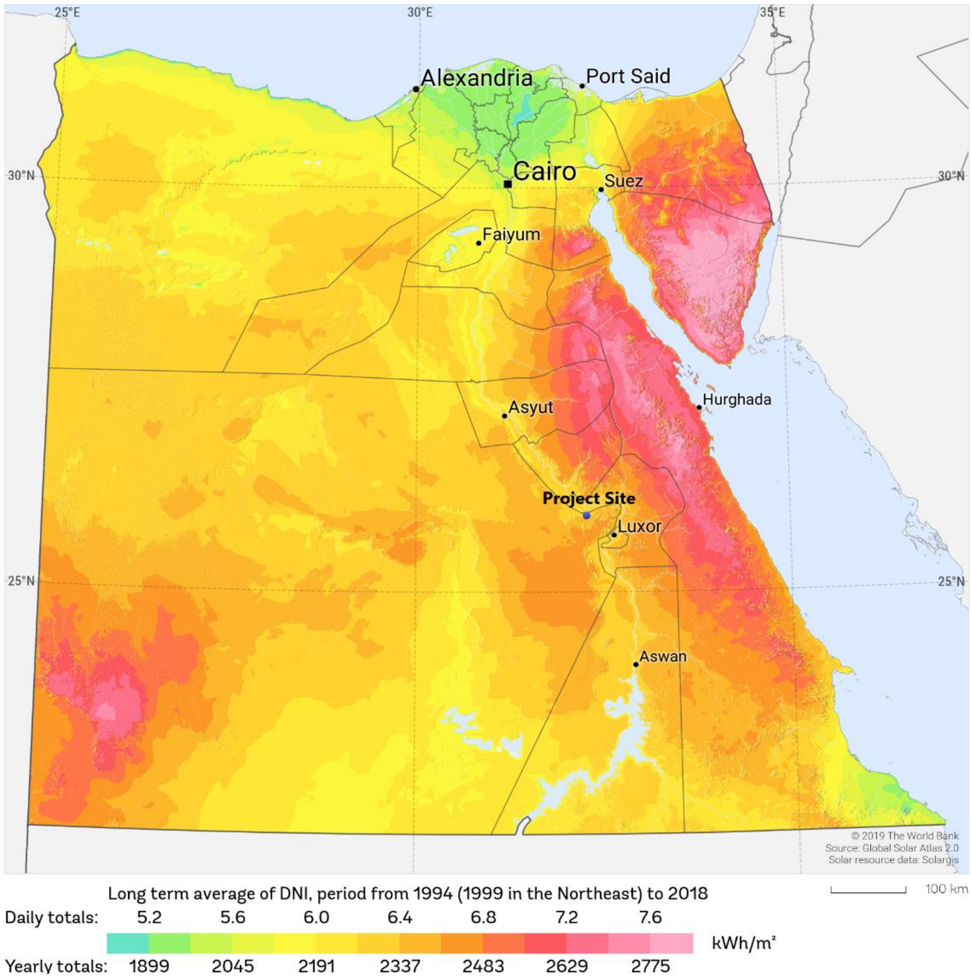


Figure 11: Solar map of Egypt

- **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 summarised below (Table 12) (Weatherbase, 2024).

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 12) (Meteoblue, 2024).

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

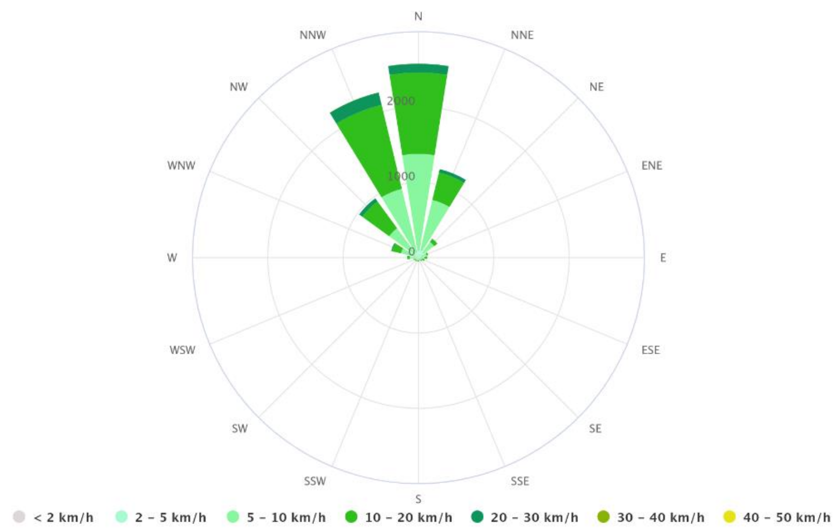


Figure 12: Wind Rose for the Qena governorate showing the dominant windspeeds and directions

- **Precipitation**

  The Qena governorate is located in a dry climatic region characterised 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, 2024).

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, 2024).

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 this year, over the last 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 3.5 m/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 characterised 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 characterised 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, characterised 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.

6.2.2 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_{10} (particulate matter where particles have a diameter of 10 micrometres or less) of 166 µg/m³. This is higher than the regulatory threshold of 70 µg/m³, 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/m³)

Air Pollutant	PM_{10}	SO_2	NO_2	NH_3
Monthly Average Concentration (µg/m³)	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_{10} (149 µg/m³), which is again, higher than the regulatory threshold of 70 µg/m³. The annual average concentrations Sulphur dioxide and nitrogen dioxide are also provided below (Table 17) (EEAA, 2022).

Table 17: Annual average concentration of air pollutants in Qena and Luxor monitoring stations during the year 2022 (µg/m³)

Air Pollutant	PM_{10}	SO_2	NO_2
Annual Average Concentration (µg/m³)	149	15	22

6.2.3 Geomorphology and Topography

- **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).

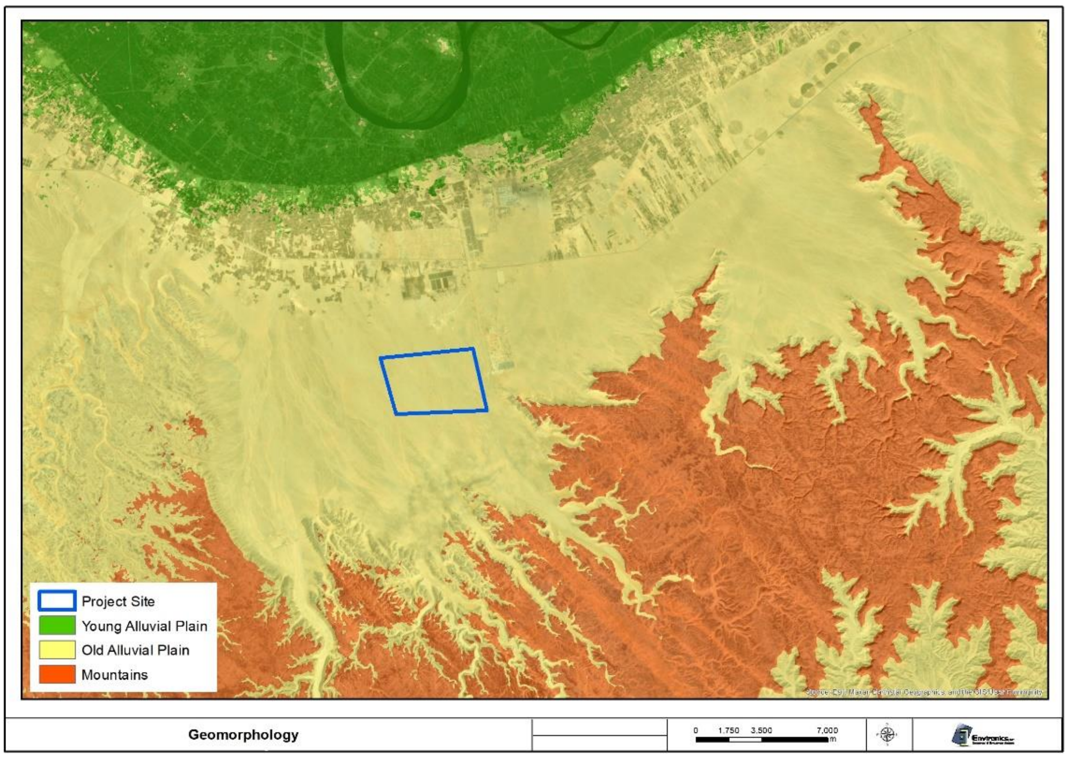


Figure 13: Geomorphological features of the Project Site

According to the soil map of Egypt, the soils of the entire Project Site are soils developed mainly from limestone. More specifically, the Project Site's soil type is classified as sandy loam soil that is particularly shallow or stoney (El-Ramady et al., 2019).

- **Topography**

  Elevations outside of the Project Site increase towards the south, peaking at a range of 450 - 500 m above Mean Sea Level (MSL). Within the Project Site, elevations peak at 213 m above MSL in the northern parts of the Project Site, and 250 m MSL in its southern parts (Figure 14).

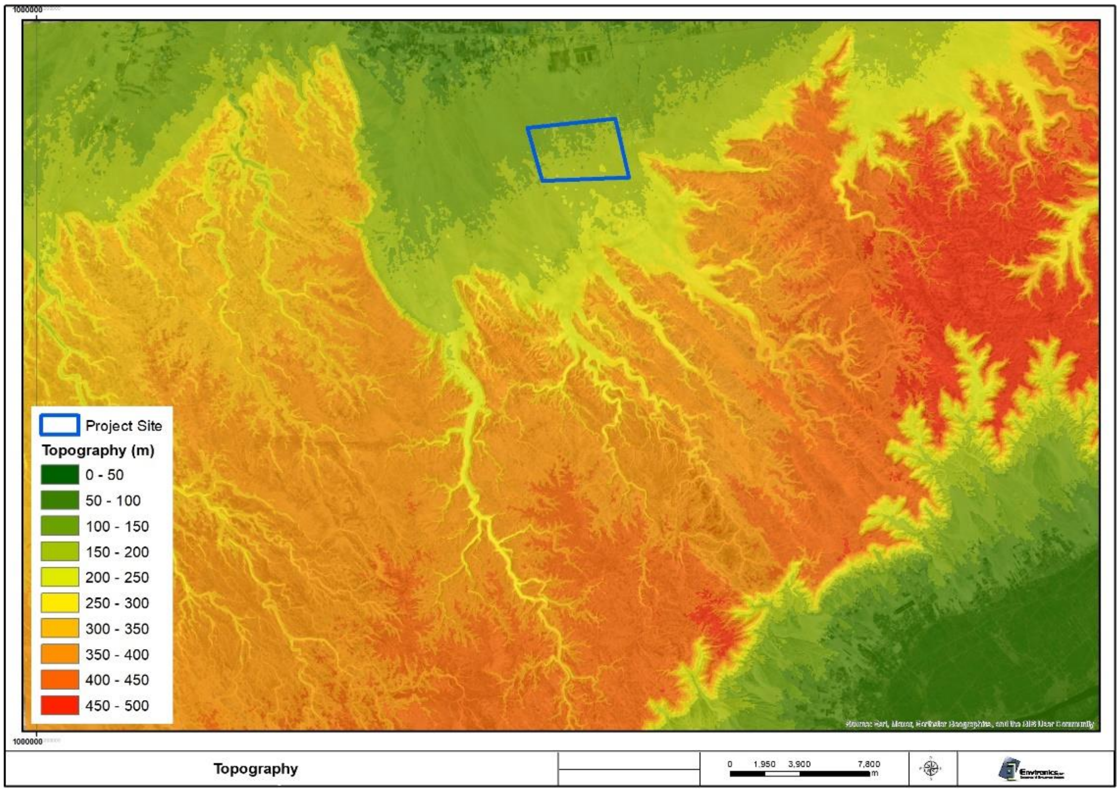


Figure 14: Topography of the Project Site (indicated in blue)

6.2.4 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 neare 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 10.5 km north of it. The Almarashda Canal follows closely, with the canal being situated only 11 km away from the Project Site. Lastly, the river Nile, the only naturally occurring surface body relatively close to the Project Site, is located 12 km north of it (Figure 15).

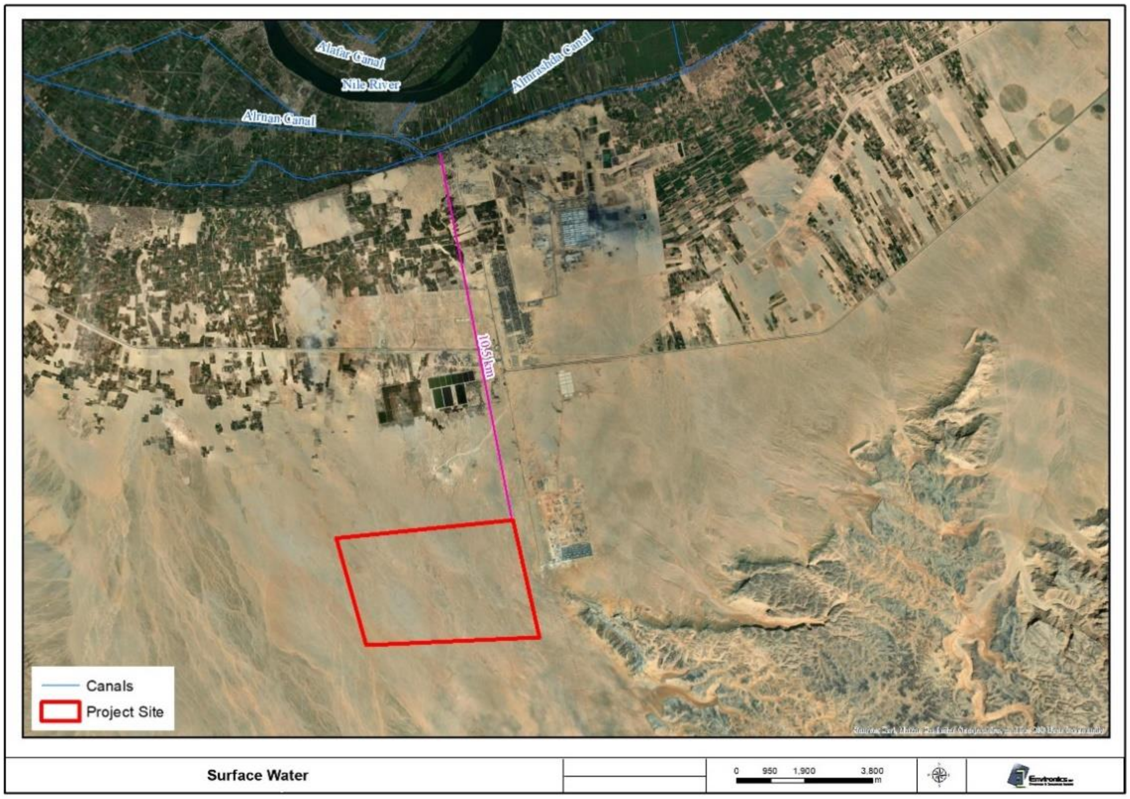


Figure 15: Surface water bodies and canals in close proximity to the Project Site

- **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 characterised by moderate to very high recharge potentialities. The Project Site is located in an area of high recharge groundwater potentiality (Figure 16) (Gaber et al., 2020).

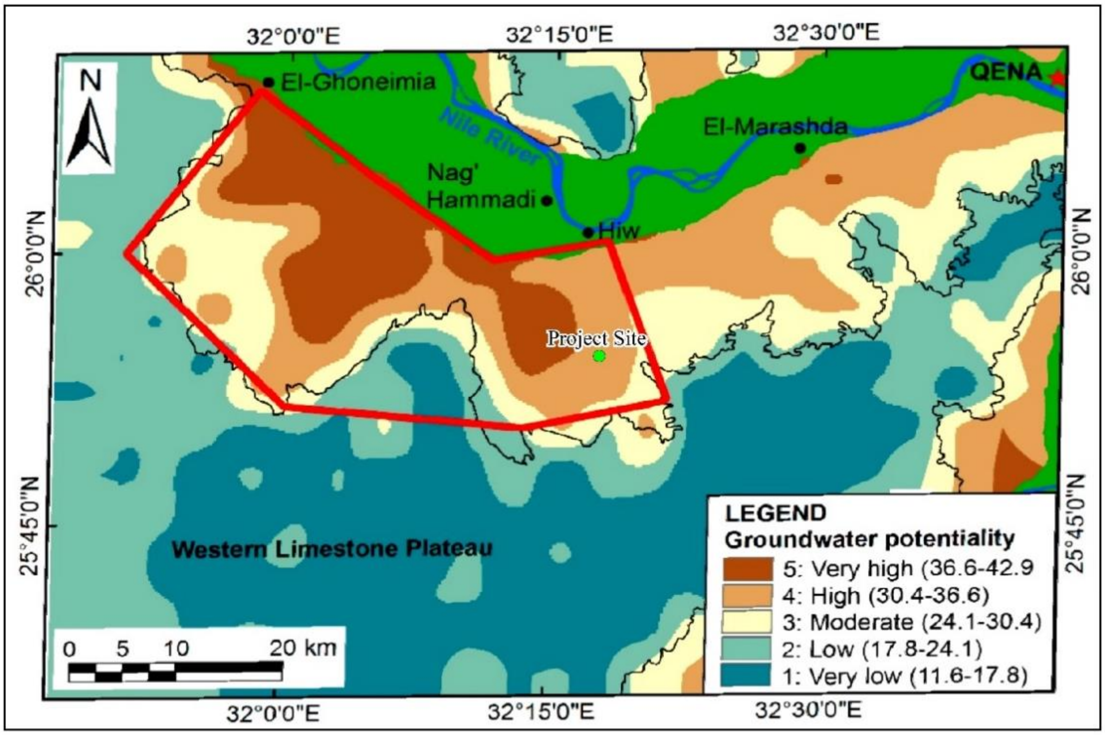


Figure 16: Groundwater recharge potentiality map including the Project Site, indicated by a green circle

The groundwater in the Project Site occurs at shallow depth that ranges between 30 meters to 36 meters close to the cultivated lands and the depth increases toward the plateau, reaching depths exceeding 70 m (Figure 17) (Gaber et al., 2020).

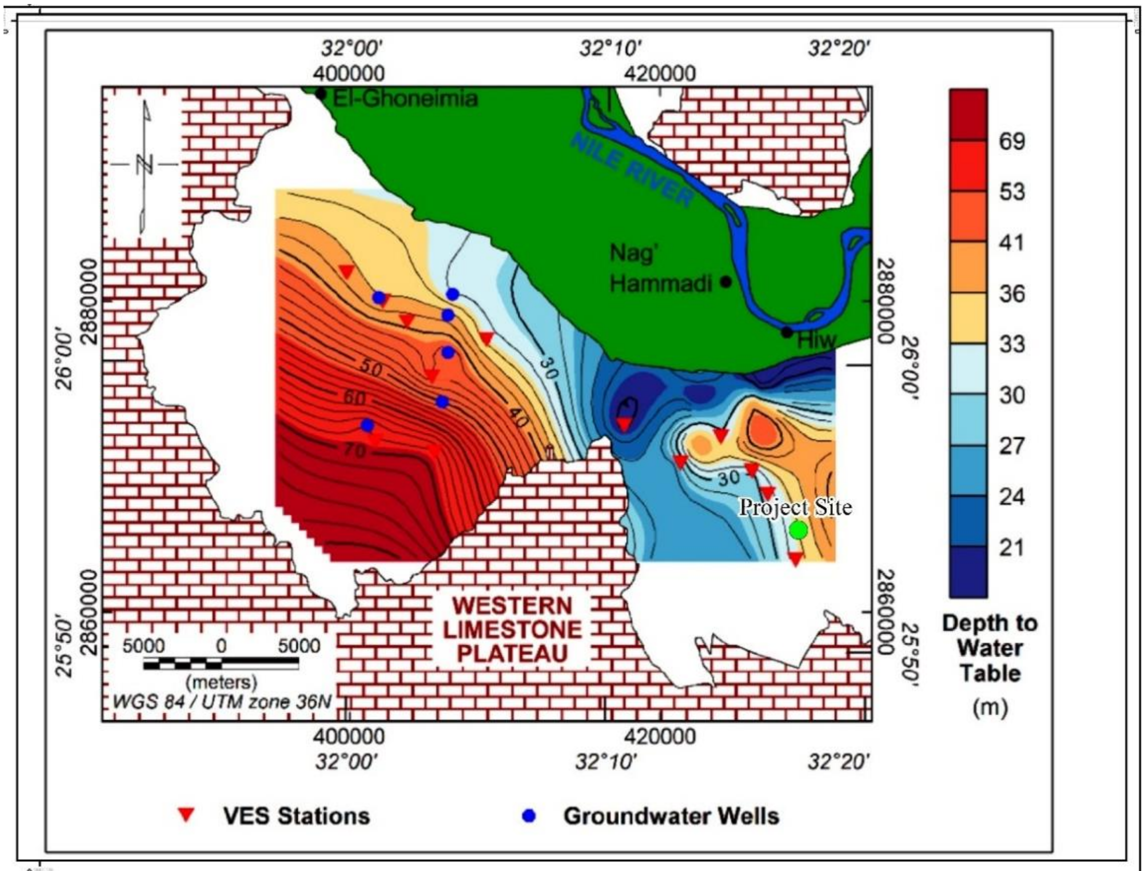


Figure 17: Depth to water contour map in relation to the Project Site

- **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 Digital Elevation Models (DEM) for the whole study area were obtained from the ALOS satellite for imaging and Earth observation, of 30 meters resolution, widely used in the identification of drainage basins for hydrological analysis. Morphological studies and identification of streams and drainage basins affecting the boundaries of the study area were performed using Digital Elevation Models (DEM) within ArcGIS using ArcHydro Tools.

  The 1: 50,000 topographic map of the study area was obtained from the Egypt Geological Survey and used to confirm the DEM 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.

Based on the above, the natural wadis were defined in Figure 18 below until the end of the mountains. Beyond this point, the wadi becomes very wide, acting like a sheet flow with no defined streams.

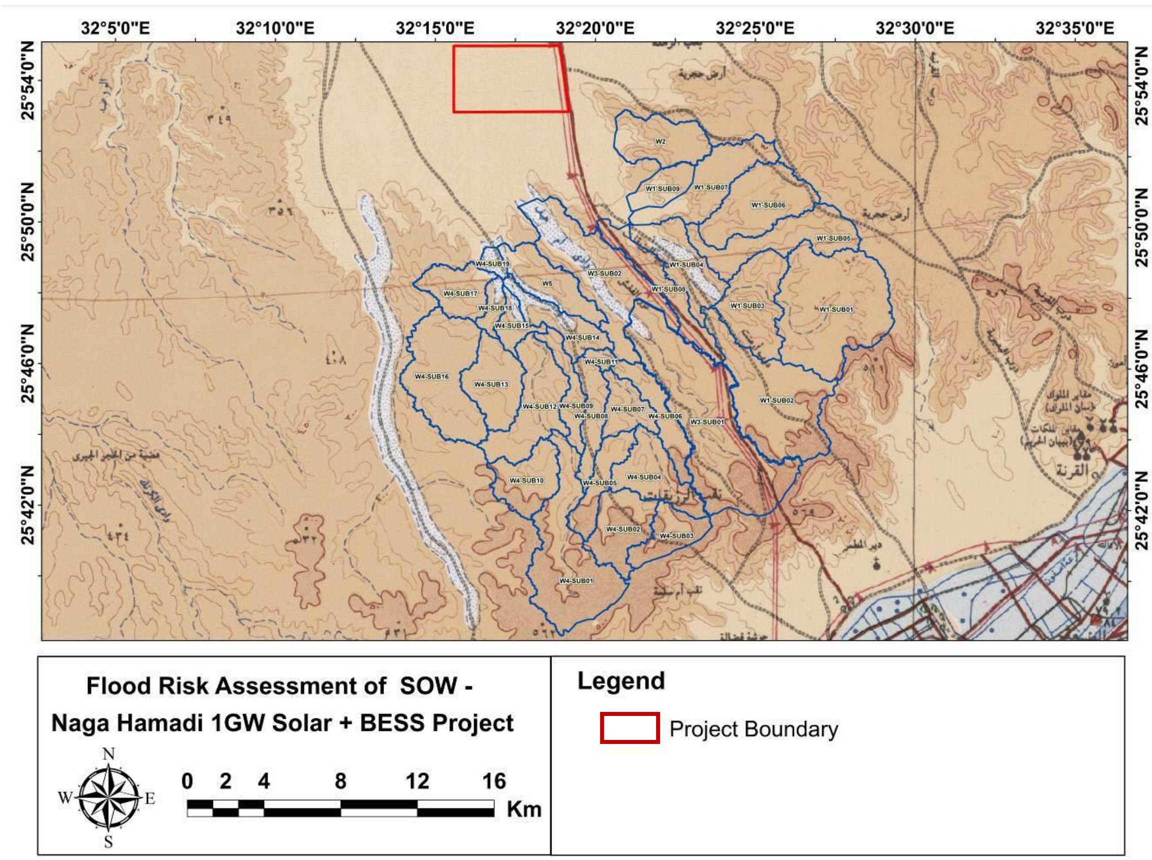


Figure 18: Natural Wadis in the project area

A number of flood paths are located westwards of the project site where a number of dams were recently erected. These dams measure approximately 3 meters in height, are composed of earthworks and protected by rubble from the flood side. In cases of extreme water flow rates, the dam allows water to flow through a weir of slightly lower height at a certain segment of the dam. At the downstream end of the dam, piles of boulders are placed to resist and filter water flow. Moreover, A number of culverts are located at the Luxor – Giza Road north of the Project Site to control anticipated flooding events.

The aforementioned streams and the dams that were constructed to mitigate floods, do not affect the project site.

- **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.

  The African Development Bank (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 under the African Development Bank's Climate Safeguard System, acknowledging its potential vulnerability to these climatic factors and the need for targeted adaptation measures to enhance its resilience.

6.3 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 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) extending 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 Bahr Youssef irrigation canal; the other oases depend on groundwater resources from the Nubia Sandstone aquifers. <u>The Project Site is located within the southeastern part of the MLP.</u>
- The Nubian Sandstone Plateau sloping gradually toward the north from Gebel Uweinat and the Gilf Plateau to the fringe of the oases' depressions (EEAA, 1993).

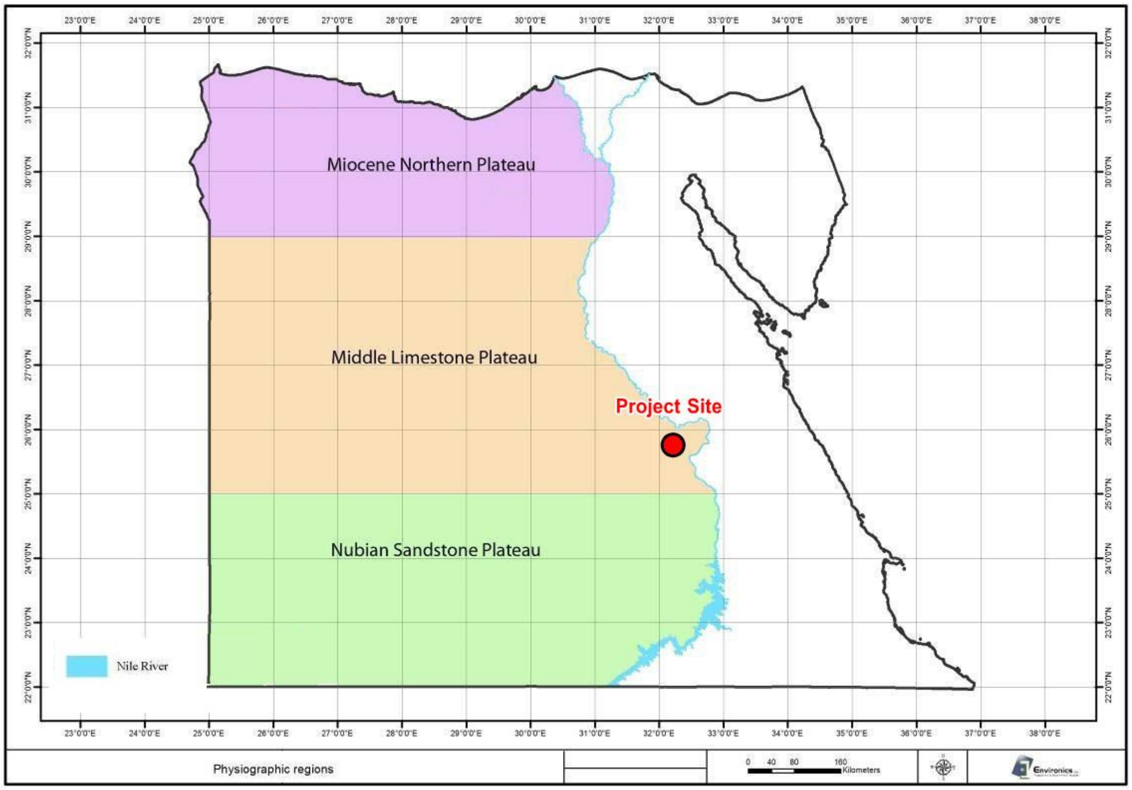


Figure 19: Physiographic regions of the Western Desert and location of the Project Site

6.3.1 Habitats

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

The Nile Valley is located at a distance of 12 km, and as mentioned above, there are numerous farmlands north of the Project Site. These are essentially nearly completely modified habitats, nevertheless, these farmlands provide habitat for a variety of weeds and ruderal plants in the fields, canal and drain banks.

Reclaimed Agricultural Lands

Similarly, as mentioned earlier, there are several desert lands reclaimed for agriculture near the Project Site, the closest of which is located 5 km north 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 of the Project Site.

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).

Middle Limestone Plateau

The Qena governorate encompasses a large area of the Middle Limestone Plateau of the Western Desert. As previously mentioned, this plateau is where the Project Site is located. 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, 2003). 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 tend to be species adapted to such harsh desert environs. The Project Site is located within the southeastern part of this plateau.

- **The Project Site**

  The project site is entirely consists of bare ground. This was indicated by remote sensing (Figure 20) (Copernicus, 2024) and confirmed by site visits.

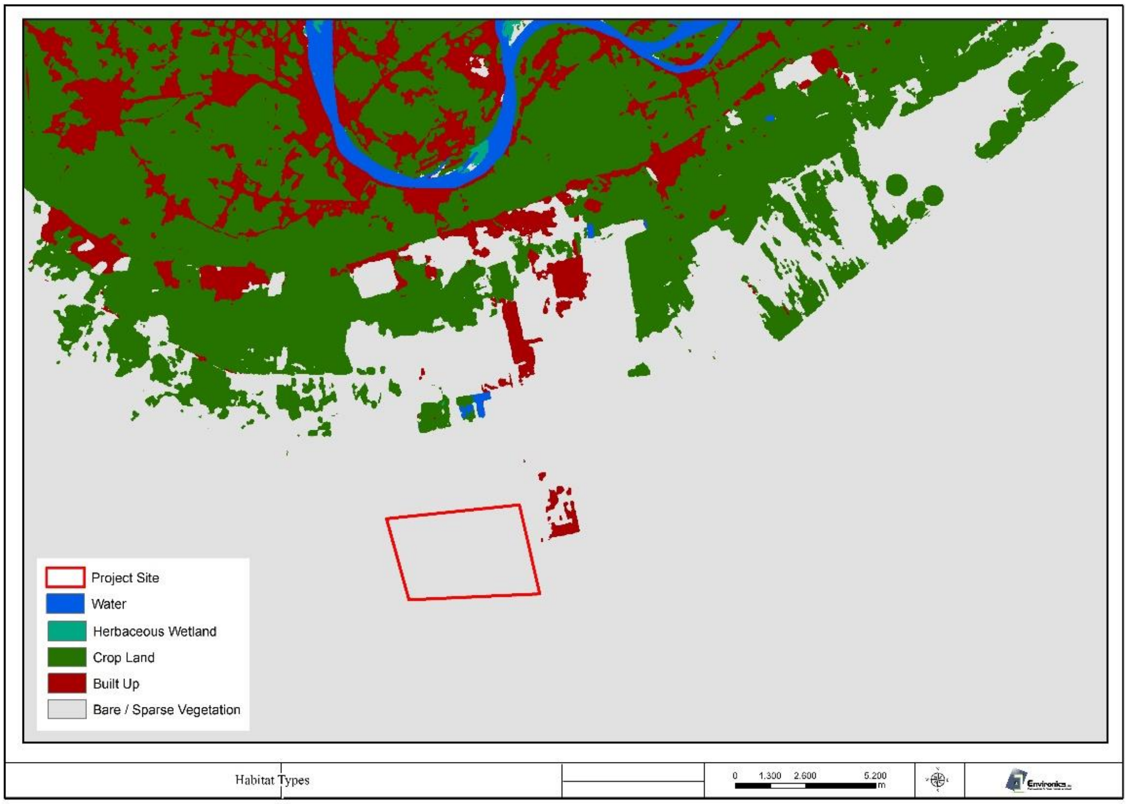


Figure 20: Habitat types of the Project Site and the localities within its vicinity

- **Natural and modified habitats**
  In accordance with IFC's Performance Standard 6 (IFC PS6), habitat types are categorisedinto natural and modified habitats. The entire Project Site is categorised as a "natural habitat".

6.3.2 Flora

Due to the extreme aridity of the southern WD and southeastern Middle Limestone Plateau, 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, there are none extending 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, there are some floral species adapted to life outside of the WDs oases and depressions, and have been recorded from the sandy desert habitats of the Middle Limestone Plateau. 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 a survey of the Project Site conducted in October of 2024 indicated that the site is completely devoid of vegetation, and only afew desert shrubs were observed outside of the Project Site, restricted to the flood paths west of the Project Site (the ones on which dams were recently erected). Although the survey was carried out following an exceptionally hot summer, the absence of dry/defoliated plants indicates that the Project Site does not support annual floral species.

6.3.3 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, 2024).

  Although no traces of reptiles were detected during several walkovers of the Project Site, the likelihood of the abovementioned species occurrence in the site cannot be totally excluded.

  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, 2024).

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, but 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 characterise 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 deserts 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, 2024).

Again, although no traces of reptiles were detected during several walkovers of the Project Site, the likelihood of the abovementioned species occurrence in the site cannot be totally excluded.

- **Avifauna**

Based on data extracted utilisng 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

There are no resident breeding birds expected to occur within the Project Site, due to its lack of shelter, cover, water, and food sources, making the Project Site inhospitable for breeding birds. However, 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*[4]), 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*[5]) and the House Sparrow (*Passer domesticus*) (Saleh, 1993). Some of these Nile Valley species can be expected to be 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.

Some other species characteristic of the WD's sandy desert habitats include the Spotted Sandgrouse (*Pterocles senegallus*), Cream-coloured Courser (Cursorius *cursor*), Bar-tailed Lark (*Ammomanes cincturus*), Greater Hoopoe-lark (*Alaemon alaudipes*), Temminck's Lark (*Eremophila bilopha*), Desert Wheatear (*Oenanthe deserti*), and the Brown-necked Raven (*Corvus ruficolllis*) (EEAA, 1995).

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 17 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

[4] Previously placed in the genus *Streptopelia*
[5] Considered until recent times a subspecies of *Corvus corone*

(*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*), White Stork (*Ciconia ciconia*), and the Egyptian Vulture (*Neophron percnopterus*).

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 ≤ 0.001 (Figure 21). 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 categorised 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 categorised 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, 2024; MSBT, 2024). Moreover, the Lanner Falcon, Hen Harrier, and Osprey are all globally categorised 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 21) (MSBT, 2024).

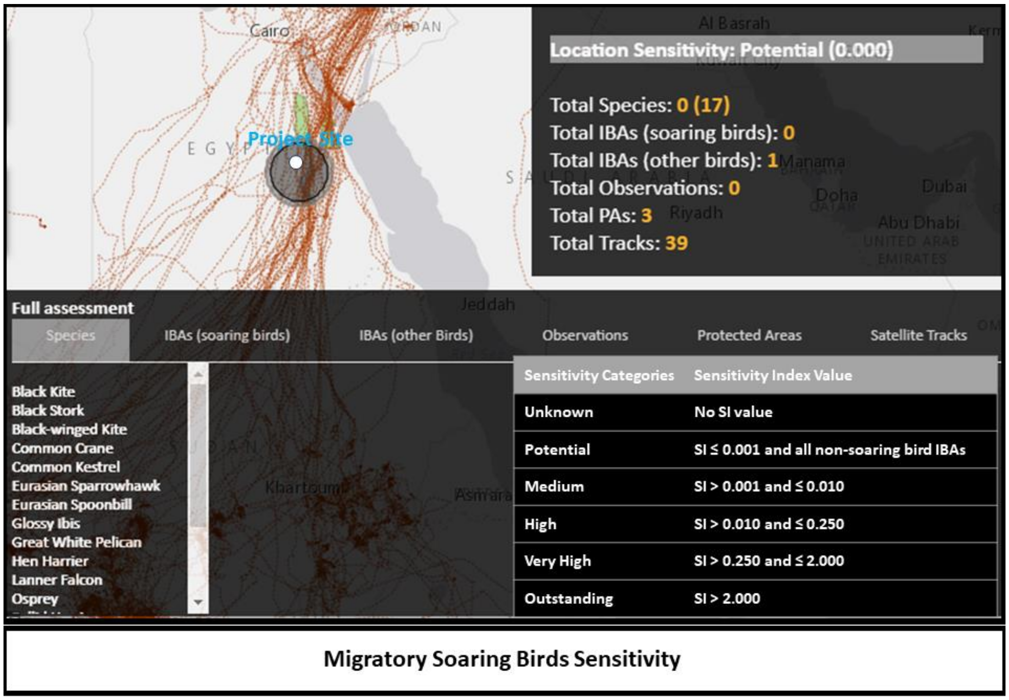


Figure 21: Location sensitivity of the Project Site to migratory soaring birds

The associated OHTL extends from the project site to the Nagaa Hammadi substation. It could be divided into two distinct segments:

- A southern section starting from the project site to the fringes of the developed area (the Aluminum complex and El-Baraka village). This is about 7.8 km segment where new towers will be erected. This segment extends in a area highly similar to that of the project site, mostly baren land with no or sparse vegetation. It, however, moves closer to the Nile Valley and the probability of occurrence of the birds mentioned above is accordingly, even if marginally, higher. However, as there are no resources to attract these birds in this segment, it is expected that these will not be approaching the land surface. However, the specific flight altitude cannot be speculated.
- A northern section where no new towers will be erected but new lines will be added to the existing towers. This is about 3.8 km segment, which is even closer to the Nile valley and which most northern portion of 1.5 km passes through agricultural lands.

In this segment, in which food and water are more available, it is expected that birds could potentially be flying at a lower altitude.

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 asits range in Egypt has been drastically reduced due to habitat loss and hunting activities (Hoath, 2009; Basuony et al., 2010; IUCN, 2024). 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, 2024).

There are four species of bats that may cross over or visit the Project Site and the environs in its vicinity. These are the Cape Long-eared Bat (*Nycteris thebaica*), Greater Mouse-tailed Bat (*Rhinopoma microphyllum*) and Rüppell's Pipistrelle (*Pipistrellus rueppellii*) and the Egyptian Fruit Bat (*Rousettus aegyptiacus*). The Cape Long-eared Bat has a wide habitat~~,~~ also ranging into desert. The Greater Mouse-tailed Bat is a true desert species that occurs in arid areas with sparse vegetation. It is known to have a high tolerance for low relative humidity.

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, 2024).

6.3.4 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 characterised by any ecological features that renders 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 that could have been potentially missed during the site visit or that may occur in close proximity to the Project Site are all common species widespread in the Western Desert.

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 categorised as a NT species (currently possibly VU as the previous NT status mentioned 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 categorised 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, 2024).

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 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*) are threatened, but both are listed under Appendix II of CMS (IUCN, 2024).

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 utilised 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"[6]. 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.

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, 2024). 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).

[6] 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 categorised 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 categorised as VU at the national level (Hoath, 2009; Basuony et al., 2010; IUCN, 2024).

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. However, it is herein considered as its potential presence (at least as vagrant individuals) cannot be totally excluded.

- **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 40 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 50 km southeast of the Project Site and is separated from it by the Nile Valley (Figure 22).

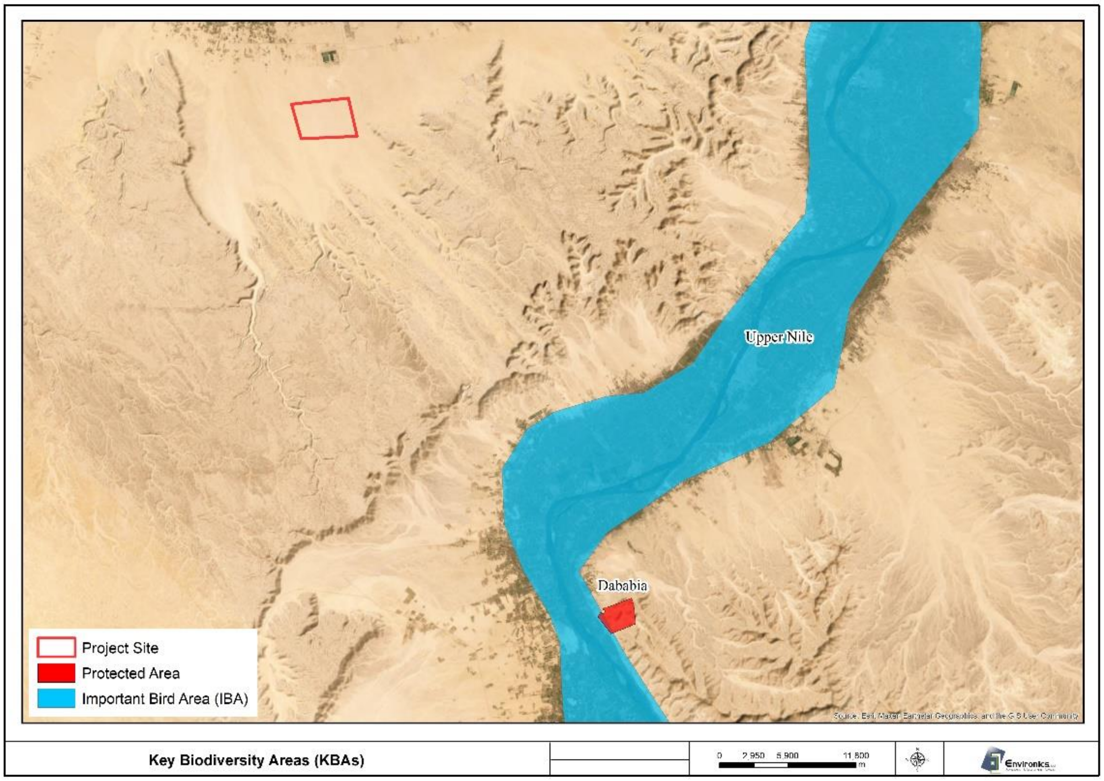


Figure 22: Nearest Key Biodiversity Areas (KBAs) to the Project Site

There is also one proposed PA, the Wadi Qena proposed PA, located at a distance of about 80 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 23).

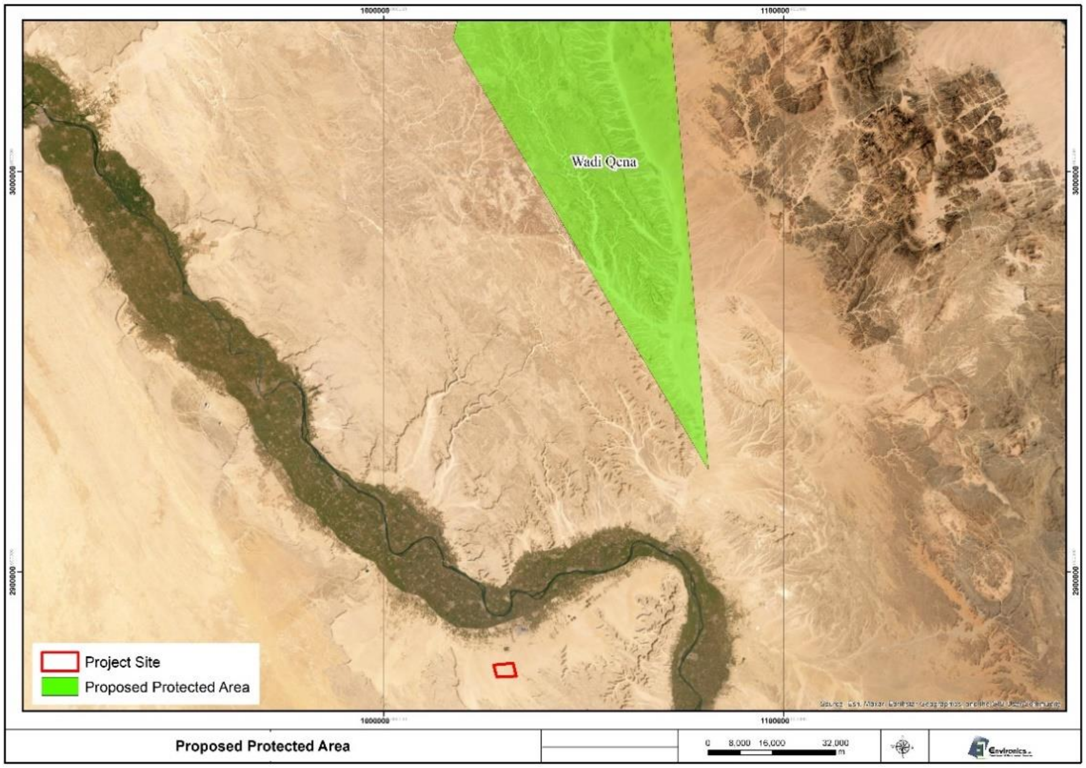


Figure 23: **Location of Wadi Qena proposed PA in relation to the location of the Project Site**

6.3.5 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[7].

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 ranges between low and moderate importance (Figure 24) (IBAT, 2024).

[7] https://www.iucnredlist.org/resources/other-spatial-downloads#:~:text=Rarity%2DWeighted%20Richness%20is%20the,range%20contained%20within%20that%20cell.

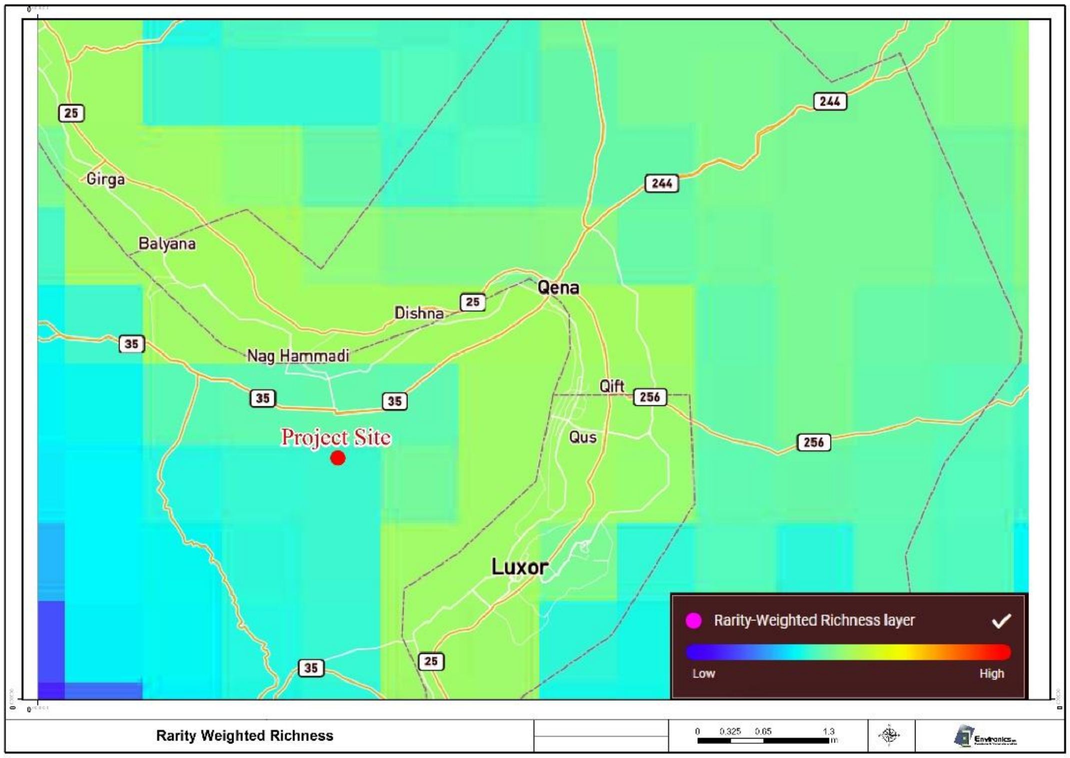


Figure 24: Rarity-weighted richness map of the Project Site

6.3.6 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 organised 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.

6.3.7 Critical Habitats

Paragraph 16 of IFC PS6 defines critical habitat as an area with high biodiversity value, which meets the following criteria:

- Criterion 1: Critically Endangered (CR) and/or Endangered (EN) species
- Criterion 2: Endemic and/or restricted-range species
- Criterion 3: Migratory and/or congregatory species
- Criterion 4: Highly threatened and/or unique ecosystems
- Criterion 5: Key evolutionary processes

The Project Site and the localities in its proximity are barren desert lands with no or sparse vegetation, providing little opportunities to biodiversity to thrive. Such habitats are common and recurring throughout the Western Desert. Moreover, even if one or more of the reported species of conservation concern was found to be present in the area, their extremely limited numbers would not trigger the thresholds for the above-mentioned criteria. Therefore, no Critical Habitat (CH) is expected to exist within the Project Site.

6.4 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'[8] 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.

6.4.1 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^2, 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^2, this 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^2, accounting for 16.11% of the governorate's total area (SIS, 2016; QG, 2024).

- **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 25) (SIS, 2016; QG, 2024).

[8] A Markaz within a governorate may also be classified as both a Markaz and a city, as in the case of Markaz Nagaaa Hammadi

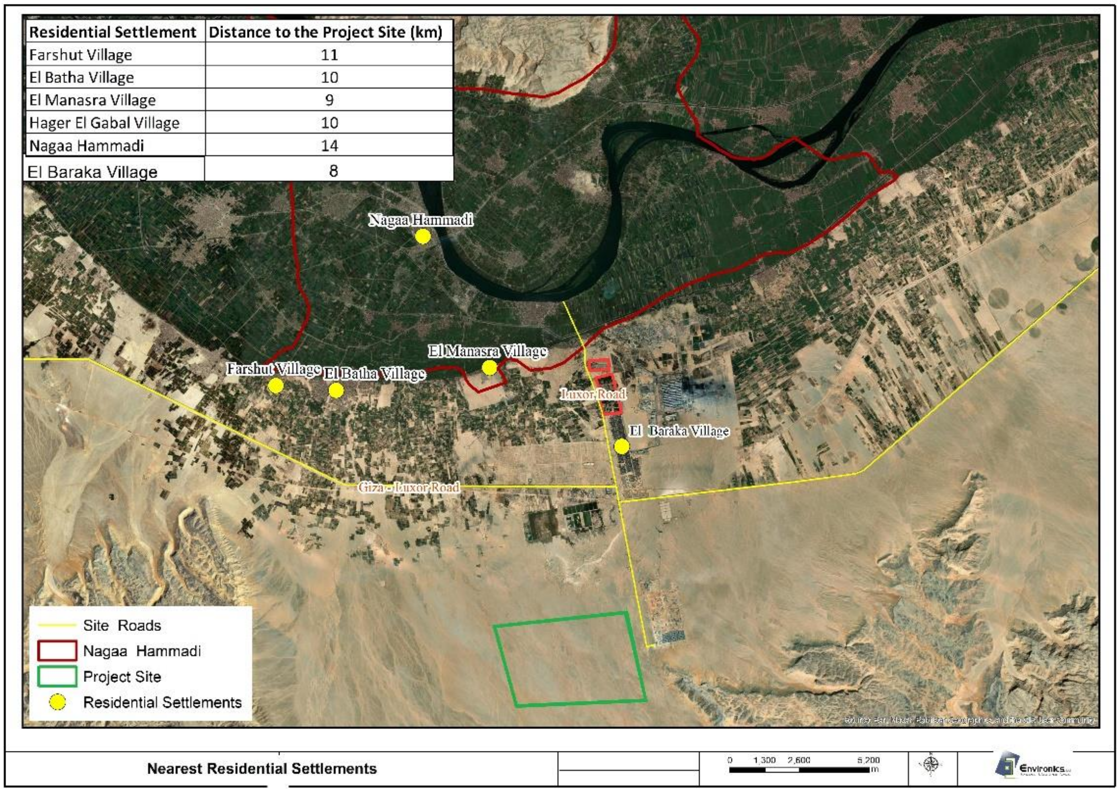


Figure 25: Location of residential settlements in close proximity to the Project Site

- **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^2. 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 18) (CAPMAS, 2017).

Table 18: 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

6.4.2 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 19) (CAPMAS, 2017).

Table 19: 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 20) (CAPMAS, 2017).

Table 20: 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 21) (CAPMAS, 2017).

Table 21: 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 Associate Professional	52,786	11,269	64,055	11,791	2,618	14,409
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 22) (CAPMAS, 2017).

Table 22: 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
Illiterate	168,971	102,044	271,015	30,688	21,113	51,801
Literate (Unqualified)	16,318	5,564	21,882	3,087	11,83	4,270
Literate (Qualified)	4,131	945	5,076	720	235	955
Special Education	223	29	252	38	10	48
Primary Education	23,843	8,571	32,414	4,431	1,758	6,189
Preparatory	31,978	17,309	49,287	5,096	2,401	7,497
General / Al-Azhar Secondary	81,724	15,390	97,114	14,517	2,922	17,439
Technical Intermediate	246,818	44,975	291,793	49,348	12,359	61,707
Above Intermediate	28,625	6,913	35,538	5,809	1,371	7,180
University Degree	91,014	28,390	119,404	17,435	7,402	24,837
Higher Diploma	953	485	1,438	161	105	266
Master's Degree	843	243	1,086	107	0	107
Ph.D.	585	224	809	106	48	154

6.4.3 Land Use Types

The Project Site is not currently utilised 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 with never more than 10% vegetated cover during any time of the year). However, land use types in close proximity to the Project Site (Figure 26) are as follows:

- The Nagaa Hammadi industrial zone (0.5 km east of the Project Site)
- Reclaimed agricultural lands (5.5 km north of the Project Site)
- Wastewater treatment plant (3 km north of the Project Site)
- The Giza – Luxor Road (5 km north of the Project Site)
- A residential area (5.6 km northeast of the Project Site)
- Other local communities located between 9 km and 10 km north of the Project Site

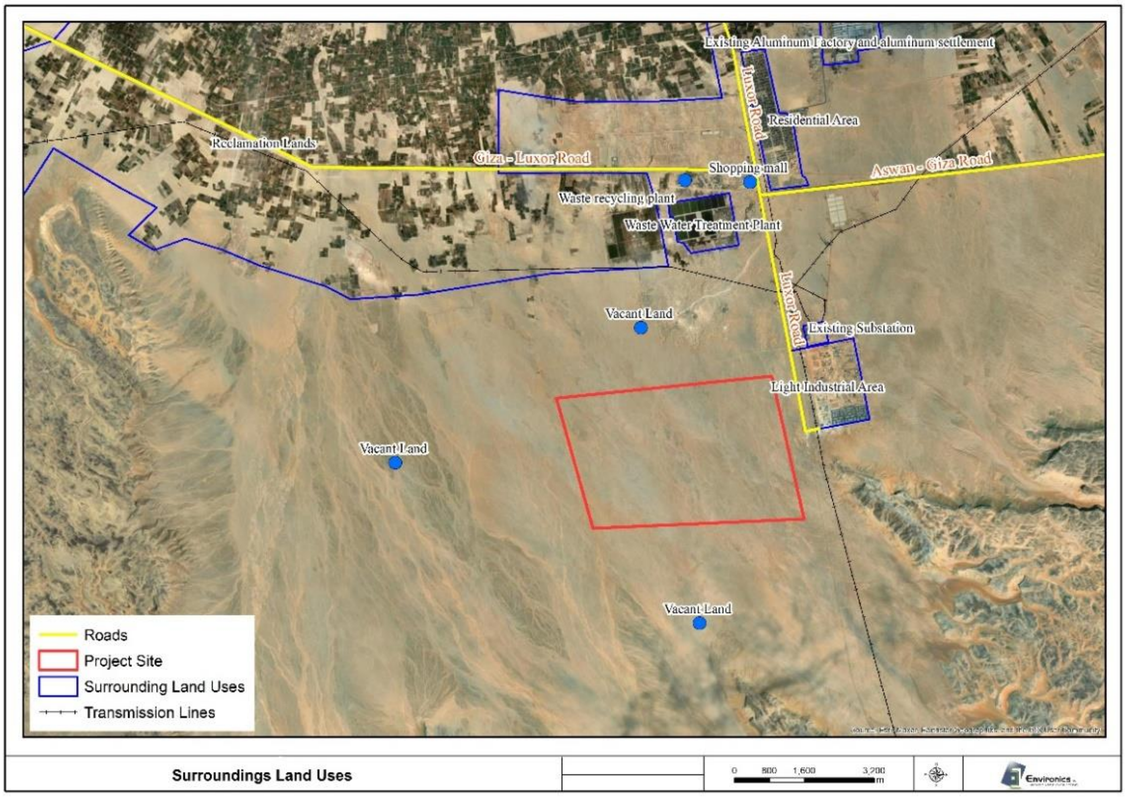


Figure 26: Land use types in close proximity to the Project Site

6.4.4 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 23) (QG, 2024).

Table 23: 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 (6.4 km north of the Project Site). The Alumninum City Hospital (located 11 km northeast of the Project Site), and the How Village Health Unit (12 km north of the Project Site) (Figure 27).

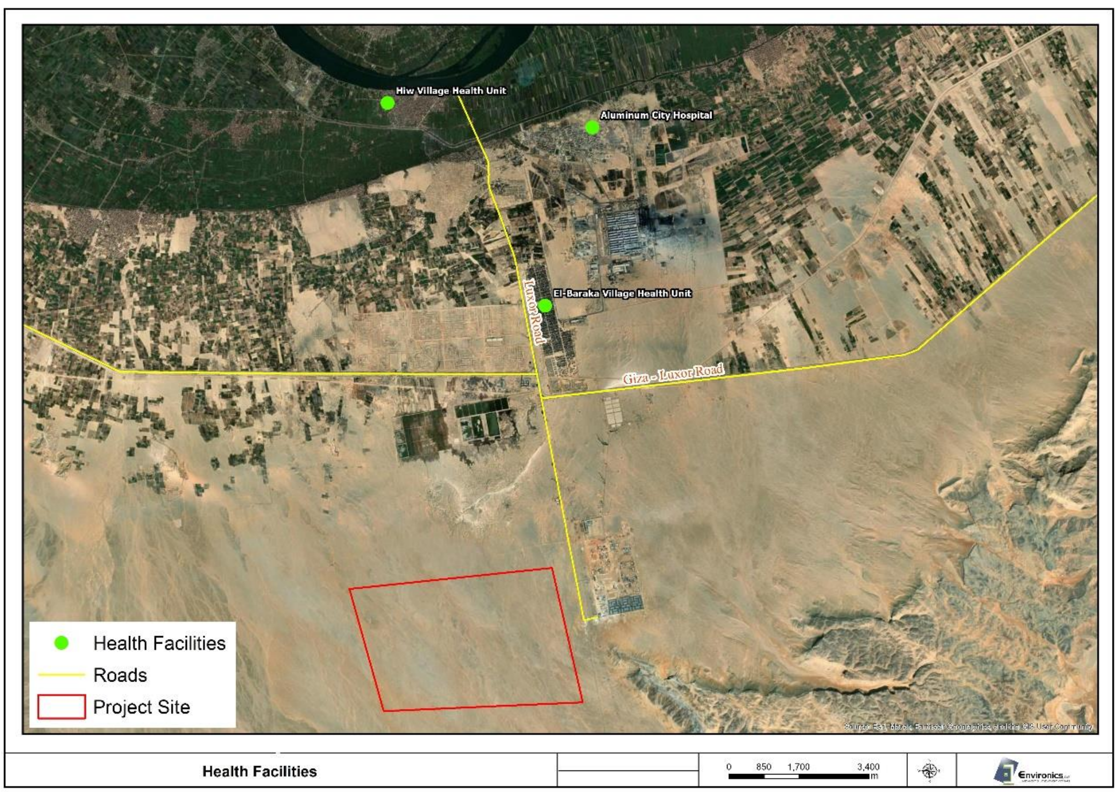


Figure 27: Healthcare facilities in close proximity to the Project Site

Furthermore, an ambulance point is available in the village of El-Baraka for immediate medical emergencies (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%) rely 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 stations within the Qena governorate, with a combined total design capacity of 207,000 m^3/day. This roughly equates to 48.1 million m^3 of sewage being treated per year (Table 24) (CAPMAS, 2021).

Table 24: 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^3/day)	207,000
Sewage Treatment Quantity (Mill.m^3/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.

6.4.5 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 28). All six sites are described below (EAM, 2022; CULTNAT, 2022; UNESCO, 2024).

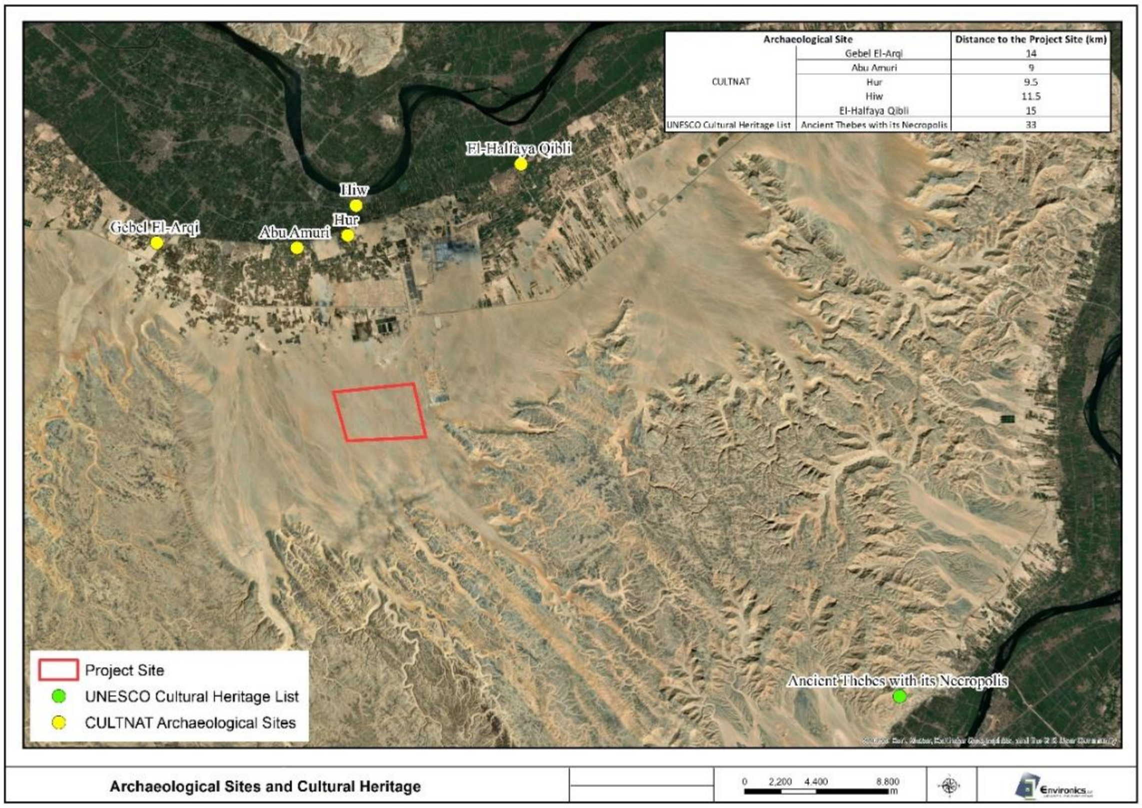


Figure 28: Archaeological sites, monuments, and cultural heritage sites in the vicinity of the Project Site

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 9 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 9.5 km north 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 20th 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 11.5 km north 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 seen been re-located to the French Louvre Museum (CULTANT, 2023). 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 (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 33 km north 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, 2024a).

- **Intangible Cultural Heritage**

  Based on UNESCOs 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;

  - **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, 2024).

- **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).

7. 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.

7.1 No Project Alternative

The ‘no project’ alternative means that the 1GW solar plant project 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 greenhouse gas emissions, particularly CO_2, 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.

7.2 Alternative Site Location

The proposed project is located south of Nagaa Hammadi, in the vacant desert land, covering approximately 21 km^2. The site has been allocated by the Egyptian government 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.

7.3 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 module is shown in Figure 28 Materials marked with red dotted lines means that these are new emerging technologies modules are under research and development stage.

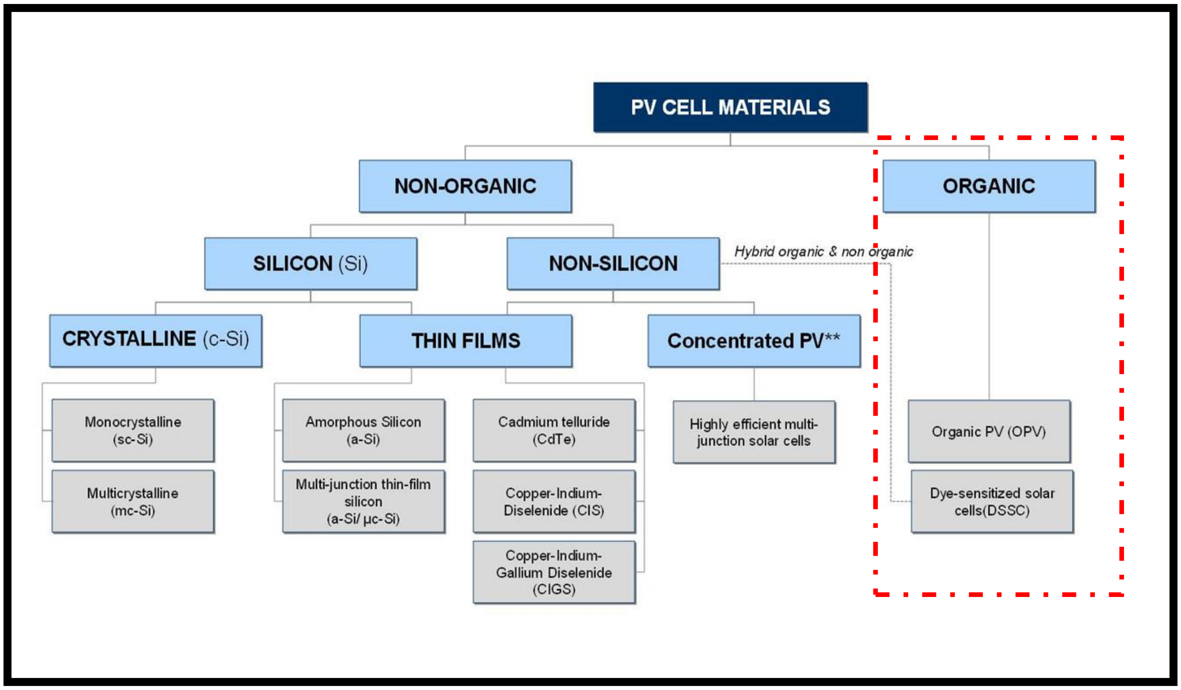


Figure 29: Types of PV modules[9]

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 25 below shows the comparison between various PV panel options.

[9] Source: http://sovoxglobal.com/cell_classification.html

Table 25: Evaluation Result for each Photovoltaic Module[10]

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
Environmental consideration	Safe	Safe	Safe	Safe	Includes hazardous substance Cd	Can include small amount of Cd
Land/per MW	4-5 acres (16187 – 20234 m^2/MW)		7.5-9 acres (30351 - 36421 m^2/MW)			

7.4 Alternative Tracking Systems

Photovoltaic power systems are also classified according to their configurations: (1) Fixed PV systems, normally oriented to the south at northern latitudes and vice versa at southern latitudes; (2) PV tracking systems, which follow the sun's path in the sky (Figure 30).

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.

[10] 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.pdt.

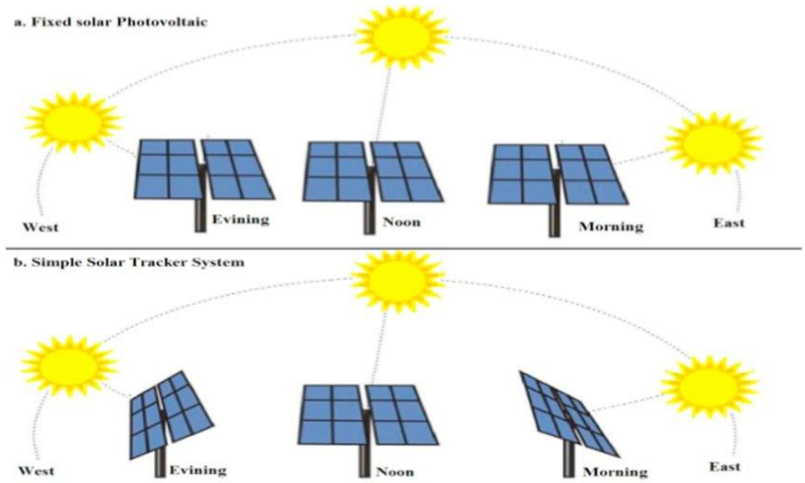


Figure 30: Fixed angle solar panel (a) and solar panels with a tracking system (b)
Source: Nadia et al., (2018) [11]

Compared to a fixed mount, a single axis tracker increases annual output by approximately 15% to 25%[12] as shown in Figure (31).

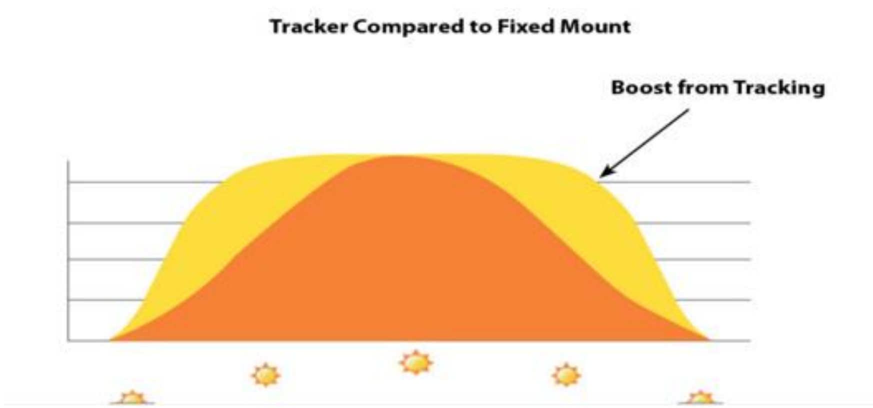


Figure 31: Daily power production, fixed tilt versus tracking
Source: First Solar

Solar tracking systems can be mainly divided into two main groups based on the techniques that control the photovoltaic module. These two main groups are active and passive tracking system. Active tracking systems use electric motors (DC or AC) or hydraulic systems. to direct the panel toward the sun. Passive tracking systems use a low boiling point compressed gas fluid that originates from solar heat as shown in Figure (32) and (33).

[11] 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.

[12] Design of a Solar Tracker System for PV Power Plants, Tudorache. T, Kreindler, L. Acta Polytechnica Hungarica, Vol. 7, No. 1, 2010

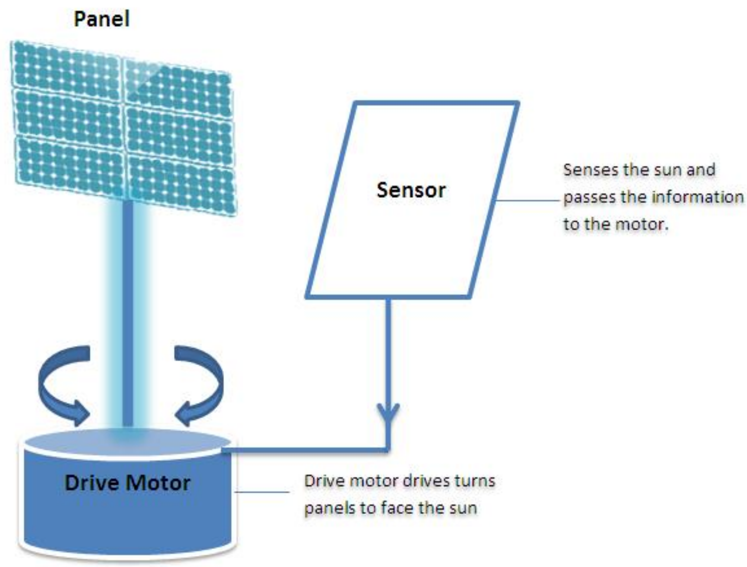


Figure 32: Active solar tracking system.

Source: Solarmango[13]

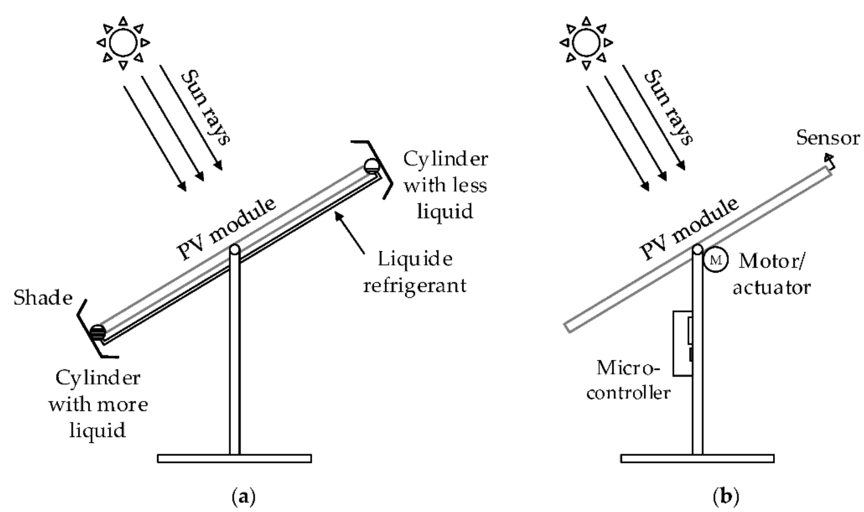


Figure 33: (i) passive tracking system and (ii) active tracking system.

Source: Seme, et al., (2020)[14]

The main Advantage of passive solar tracking systems is their ability to track the sun from side to side without using motors, gears, or controllers. They offer a relatively easy installation process, effective results, no external power requirements, and low maintenance costs.

[13] https://www.solarmango.com/scp/solar-tracker-tracking-the-sun-for-maximum-power/

[14] Seme, S., Štumberger, B., Hadžiselimović, M., & Sredenšek, K. (2020). Solar photovoltaic tracking systems for electricity generation: A review. Energies, 13(16), 4224.

However, passive solar tracking systems face several performance issues. The primary drawback is their strong dependency on weather conditions. While they can maximize heating from the sun, adverse weather conditions can render these trackers inefficient. Harsh winters can overwhelm passive solar tracking systems, necessitating additional assistance devices and increasing costs. Another challenge is selecting the appropriate types of glass and gas to build more efficient passive solar tracking systems. The orientation of these systems is imprecise, making them unsuitable for certain types of concentrated photovoltaic modules.

Active trackers, contain two types: Single-axis trackers and dual axis trackers. Single-axis trackers operate with only a single motor and one axis of movement (this movement could be horizontal or vertical). They are generally less expensive and require less maintenance as they have fewer moving parts. The most common driving mechanism is an electric motor because it allows a simpler and precise control of the movement.

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 active single-axis solar tracking system has been selected for the project.

7.5 Alternative module cleaning

At present, there are multiple cleaning options available to clean PV modules.

(1) Non-Automated 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 34.

(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 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.

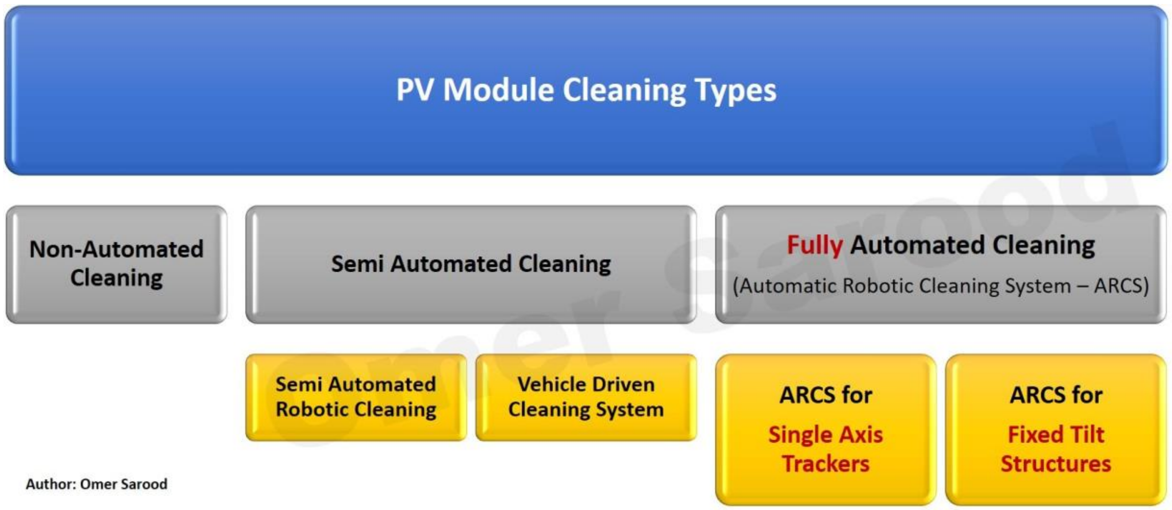


Figure 34: PV Modules cleaning options

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

Table 26 below presents a comparison between the different types of cleaning methods. It is expected that the cleaning method adopted by Scatec Solar is wiping with dry cloth. For module cleaning Scatec Solar intends to deploy fully automated systems based on rotating brush/cloth carried by a tractor equipped with automatic steering. In consideration for redundancy and flexibility, two tractors including a rotating brush shall be deployed. Only in case of significant performance drop due to extraordinary soiling caused for instance by sandstorms, additional cleaning cycles shall be considered.

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, rather uses motorized brushes or pressurized air to clean the panels. Various reports and studies completed recently in desert-like environments recommend Dry Cleaning as the best cleaning option for such arid climatic zones. Below is a brief comparison between the different cleaning techniques:

The selected option for PV Module Cleaning is the automatic robotic dry-cleaning systems

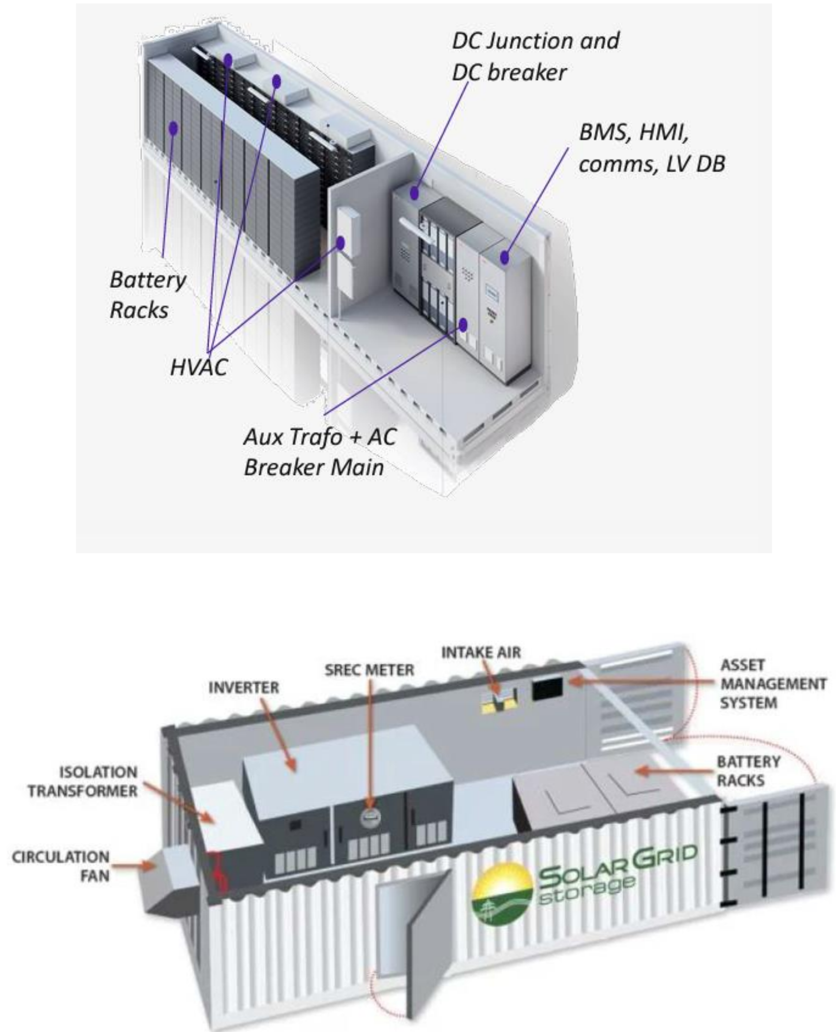
Table 26: Evaluation of the ways of module cleaning

Items	Wipe with dry cloth	Wipe with wet cloth	Washing	Robotic Cleaning
Tools and resources	Rotating brush / cloth carried by tractor; fuel	Rotating brush / cloth carried by tractor; water; fuel	Water truck; water; fuel	Cleaning machine, power
Number of workers	2 workers, one for each tractor per shift; two shift operation 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^2 with one battery load; depending on 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
Water volume	None	approx 0.4 – 0.6 ltr per module; in total 85 – 126 m^3 per cleaning cycle	approx 0.75 – 1.0 ltr per module	None
Working effort	Easy	Easy	Easy	Easy
Damage on glass surface	Scratch by dust on the surface might cause glass scratching	Stuck dust on the glass might remain and cannot be removed	No damage on the glass	No damage on the glass
Waste	Waste clothes	Waste clothes, wastewater for washing clothes	Potential wastewater generation	No waste water
Conclusion	Does not need any water, but longer maintenance time, possible damage on the surface and produce significant waste quantities.	Does not need much water, but longer maintenance time, dust might be stuck hard on panels.	High resource consumption and potential generation of wastewater	Continuous cleaning required for avoiding significant accumulation of soil stuck hard on panels

7.6 Battery Energy Storage System (BESS) Alternatives

- *Lithium Solid State Containerized Batteries*

  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 (35) below.



Source – Tesla MegaPack – Safety Overview

Figure 35: 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 (LiFePO4), 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 ^{0}C and 400 ^{0}C, in order to keep the electrodes in a molten state, which implies a heating system for the battery.

7.7 Water Sources Alternative

Water supply is required during construction activities and during operation activities for occasional panel cleaning, 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 80-120 m^3/day during peak construction. The O&M consumption on site is expected to be limited to 150 - 200 m^3/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:

7.7.1 Groundwater abstraction

The groundwater at the project area occurs at shallow depth from 30 to 36 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

7.7.2 Water trucking and pipeline supply

The required water would be trucked and stored in constructed or prefabricated tanks on site, located near sanitary and eating facilities. The max capacity of the tanks and associated infrastructure is planned to be 4 tanks, each 150 m^3. The same tank(s) will be used to store water required for sanitary purposes and domestic use. The water will be trucked to site when needed during operation. The site is nearby a water pumping station and potable water would be supplied through an installed pipeline extending to the site tanks. The pumping station has sufficient daily water capacity to supply the project during construction and operation. O&M consumption is expected to be 80-120 m^3/month, with dry cleaning used for PV modules.

This option is a preferred option for water supply.

7.7.3 Connection to the public water network

The public water network is conveniently located near the project site in the Naga Hammadi Industrial Zone, approximately 0.5 km east of the project area. This proximity makes it a viable option for the project’s water supply needs, ensuring easy access and potentially reducing the costs and logistics associated with water trucking.

In this respect, this option can also be considered for the project

7.8 Wastewater Alternatives

Wastewater volumes are estimated at 40-60 m³/day during construction. This includes water used for concrete mixing, dust suppression, site preparation, sanitation facilities, kitchens, and other amenities provided for construction workers. During O&M, wastewater volumes are expected to be 8-12 m³/day.

For wastewater management during both the construction and operation phases involve using septic tanks on-site to collect wastewater, which will be handled by authorized external contractors for disposal for disposal at the nearest wastewater treatment facility.

8. Assessment of Environmental and Social risks and impacts and Mitigation Measures

8.1 Methodology

The assessment was carried out to predict the project's potential environmental and social risks and impacts. The assessment was carried out through four main steps, as follows:

1. Identification of environmental and social aspects of the project and its potential risks and impacts;
2. Evaluation and assessment of the impacts in terms of their significance and sensitivity of environmental receptors;
3. Identification/ recommending mitigation measures to avoid/ prevent/ minimize the significant risks and impacts; and
4. Evaluation of residual risks and impacts.

The current assessment is carried out through the following methodology.

- The main environmental and social aspects of the project are identified based on the undertaken activities during the construction and operation phases.
- Environmental and social risks and impacts are identified as irrelevant if there is no interaction between the project's aspects and the receptors. These irrelevant impacts are scoped out of the assessment.
- The significance of relevant risks and impacts is assessed based on the following:
  - Frequency of the impact and whether it is direct or indirect.
  - Sensitivity of the receptor, which is identified depending on the baseline environmental conditions, importance, usage, and authority plans (if any). Sensitivity is classified to low, medium and high.
  - Characteristics of the environmental and social aspect associated with the project activities. These include pattern (continuous or intermittent) and severity as compared with national standards.

After excluding the irrelevant impacts and identification of the positive impacts, the remaining potential negative impacts on the area of influence (i.e., mainly the project area and immediate surroundings) were assessed based on the following criteria.

- The ***temporal scale*** or ***duration*** of the risk/impact;
- The ***spatial scale*** or ***size*** of the impact;
- The ***severity scale*** or intensity of the impact;
- The MAGNITUDE of the impact, based on assessing the above three criteria;

Based on the above, the overall SIGNIFICANCE of the impact is assessed as follow:

The overall SIGNIFICANCE of the impact, considers the magnitude of an impact 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 for the adopted methodology is provided below.

1. The ***temporal scale*** defines the significance of the impact at various time scales, as an indication of the duration of the impact (Table 27).

Table 27: Temporal scale category description

Category	Description
Short-term	Less than 5 years. Impacts 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 and/or irreversible	Over 40 years and resulting in a permanent and lasting change that will always be there.

2. The ***spatial scale*** (size) defines the physical extent of the impact (Table 28).

Table 28: Spatial scale category description

Category	Description
Localized	At a localized scale and a few hundred meters in extent
Study area	The project area and its immediate surroundings
District	District level – Markaz
Regional	Provincial level – Governorate
National	Countrywide – Egypt
Global	Global scale

3. The ***severity scale*** (intensity) is used to scientifically evaluate how severe negative impacts would be on a particular affected system or a particular affected party (Table 29).

Table 29: Severity scale category description

Category	Description	
	Negative impacts	
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.	
Moderately severe	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.	

Category	Description	
	Negative impacts	
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.	

4. The MAGNITUDE scale evaluates the importance of a particular impact, taking into account the temporal, spatial, and severity scales.

   The MAGNITUDE of an impact can be one of the following:
   - Large
   - Medium
   - Small
   - Negligible

   Table (30) provides the adopted matrix of the impact's significance.

Table 30: Significance Evaluation Matrix

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

The following provides definition of each of the above ***s***ignificance level.

Significance	Definition
	Highly significant. Impacts with an "**Extreme**" 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.
Major	**Significant**. Impacts with a "**Major**" significance is 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.
Moderate	**Significant**. Impacts with a "**Moderate**" 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.
Minor	**Detectable but not significant**. Impacts with a "**Minor**" 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.

Significance	Definition
Insignificant	**Not Significant**. 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.

8.2 Mitigation Measures

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 / insignificant / acceptable.

As much as possible, the avoidance and prevention of impacts is favoured over minimization, mitigation or compensation. 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 integrated within the management plans of the project.

8.3 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

The above methodology is implemented on the project as clarified in the following sections.

8.4 Risks and Impacts Identification of the Proposed Project

Interaction between the different activities and the environmental 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 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 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 significance of the different risks and 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.

8.4.1 Scoped Out Impacts

The potential risks and impacts of the project are identified based on the analysis of impacts of surrounding environment aspects. This step would facilitate eliminating and scoping out irrelevant risks and 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 risk and 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 10.5 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.

Interaction with birds' migration route

There are 17 migratory soaring birds likely to cross over the project area. The project has no interaction with the bird migration routes. It has no elevated structures that can interfere with the migration routes. Typically, for a single-axis horizontal tracking system (1p - single row system), the height can range from approximately 1.2 to 1.5 meters above ground level; and O&M building structures shall not exceed 5 meters of height. Moreover, it is not expected to have birds roosting and perching on the photovoltaic panels. Moreover, there has been no sufficient evidence that PV is reflective to be mistaken by lake surfaces to attract birds[15].

[15] Guidelines to minimize the impact on birds of Solar Facilities and Associated Infrastructure in South Africa. Smit, Hanneline A., BirdLife South Africa, 2012

On the other hand, the interaction of migrating birds with the OHTL, associated with the project, cannot be excluded. However, the incremental risks on these birds is expected to be minor:

- The newly built segment will be in a resource poor landscape, and birds will not be expected to use land resources, and thus fly closer to the ground, especially since the more resource rich Nile valley is at a very close flying distance..
- Birds in the segment where only a new line/capacity will be added to existing structures are expected to be denser and have reasons to fly at lower altitudes given the resource richer surroundings.

However, this will be further investigated in the OHTL ESIA (to be prepared by EETC).

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 30 to 36 m close to the cultivated lands and the depth increases toward the plateau to reach more than 70 m and will not be endangered by the potential spills from the project site.

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.

Therefore, the potential impact on archaeological and cultural heritage is considered irrelevant (out of scope).

8.4.2 Positive Impacts

Environmental Impacts:

1. The project aims to produce 1GW of solar energy, delivering a substantial quantity of clean, renewable electricity. This will reduce the region's reliance on fossil fuels for power generation and reduce CO2 emissions by approximately 2.68 million metric tons annually compared to a fossil fuel (diesel) power plant.[16].
2. The solar plant will not produce air pollutants like nitrogen oxides, sulfur oxides, and particulate matter during operation, unlike fossil fuel power plants.

[16] https://www.iea.org/data-and-statistics/charts/annual-direct-co2-emissions-avoided-per-1-gw-of-installed-capacity-by-technology-and-displaced-fuel

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 Battery Energy Storage System (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 during the peak construction phase.
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.

8.5 Assessment of Potential Negative risks and Impacts and Proposed Mitigation Measures

8.5.1 Potential risks and 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 Impacts on the Physical Environment

- ***Potential risks 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 greenhouse gas) emissions from construction vehicles and machinery; Fuel combustion in construction power generators. Exhaust emissions are likely to include nitrogen oxides (NO_x), carbon monoxide (CO), Sulphur oxides (SO2), 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 17 months (<u>short-term</u>), with a medium air quality impact (***slight***), the magnitude 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 is about 5 km north of the project site. Therefore, this impact is considered **MINOR.**

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 included in the contractors' agreements.

The following mitigation measures usually participate in minimizing 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 awareness of safe driving and maintaining good practices in machinery usage;
- Emissions from power generator stacks will comply with law 4/1994 and its relevant executive regulations.

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 Nagaa Hammadi industrial zone, which is 0.5 km east of the project area, the impact will be localized. The duration of the impact is expected to be short-term, lasting 17 months, and the severity is considered medium (moderately severe). 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[17]	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 risks 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.

In general, the construction activities are unlikely to result in soil contamination that will need future decontamination and clean-up activities.

The impact is ***slight,*** *localized*, and short-term. Impacts of the construction phase on soil are thus considered of **SMALL** magnitude. As the proposed

[17] Noise Reduction System - IQIP

project will be carried out within the region of the Western Desert., the sensitivity of the receptors is Medium.

Therefore, the overall significance of the impact is assessed as **MINOR**.

Mitigation Measures

Despite the impacts 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.
- 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 Impacts on the Biological Environment

The project site is predominantly characterized by bare ground, consisting of areas with mostly sandy soil and very sparse or no vegetation. No flora was observed within the project site during the site visit. This is reflected on the presence of fauna, which has usually a scattered distribution and mainly includes species adapted to these harsh conditions.

Consequently, the impact on the biological environment is expected to be localized and short-term, with a small magnitude and the severity is Slight. As the proposed project will be carried out within the region of the Western Desert., the sensitivity of the receptors is LOW.

Therefore, the overall significance of the impact is assessed as **INSIGNIFICANT**.

Mitigation Measures

- 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.
- Implement awareness measures targeting all personnel on site, as follows:
  - All project workforce will be given a an induction training by the project's HSE teams before commencement of works to include recognition of the main species of conservation concern;
  - Personnel onsite will be made aware of species that are prohibited from being hunted, captured or killed as per Annex 4 of the ER of Law 4/1994, amended by decree 1095 /2011; and
  - Provide awareness to the workers on the negative impacts of disturbing any wild fauna.
  - To achieve these targets, organize a brief training session targeting the middle management staff able to convey the training outputs to workers.

  In addition, display throughout the site:
  - Posters demonstrating commitment to the conservation of biodiversity;
  - Warning signs indicating that collection, hunting or disturbance of wildlife is strictly prohibited within and outside the site;
  - Signs prohibiting unauthorized wandering into the surrounding area outside the project boundaries; and
  - Reminders of proper handling of solid, liquid and hazardous waste and other material hazardous to wildlife.

Residual Impacts

By implementing the above mitigation measures, the residual impacts of the construction activities on the biological environment will be **INSIGNIFICANT**.

C. Risks and Impacts on Socio economic Environment

- ***Water Resources***

  During the construction phase, the site will require 80-120 m^3/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.

  Workers will be sought form the surrounding communities. In addition, a workers camp will be constructed at site., with an estimated water demand of 50 liters per person per day.

  The project’s water consumption is minimal compared to the water plant capacity, resulting in limited impact.

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 comprehensive 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**.

- ***Worker Influx***
  A substantial influx of workers can strain local resources such as water, food, and housing, potentially leading to shortages and increased prices for local communities. Additionally, it 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 can also disrupt local communities, leading to potential conflicts, changes in social dynamics, and increased pressure on local services. Furthermore, the increased human presence associated with construction activities can lead to habitat destruction, soil erosion, and pollution if not properly managed.

  Worker influx for the project is expected to be smaller than its demand for labor, given the size of the population at a commuting distance from the project site, and the availability of construction workers both skilled and unskilled. Moreover, the hiring policy entails maximizing utilization of local employment, while higher qualifications, potentially not available locally, will be sought from outside the surrounding communities. The bulk of non-local workers will be accommodated on the on-site labour camp, with minimal social interaction with the community, although required resources such as food and water will still be sourced locally. Only a limited part of the work force, mainly managers and engineers, will be accommodated in rental facilities at commuting distances, which not only include near-by communities but also urban centres such as Nagaa Hammadi and Qena.

  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 rends 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 risk during construction is ***Slight,*** and <u>short-term</u>. Impacts are thus considered of **Moderate** magnitude.

Therefore, the overall significance of the impact is assessed as Minor

<u>Mitigation measures</u>

- Prioritize hiring local workers to reduce the number of incoming workers and minimize social disruption.
- Provide adequate housing and sanitation 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

<u>Residual impacts</u>

By implementing the above mitigation measures, the residual impacts of the construction activities on the social environment will be **Insignificant.**

- ***risks 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.

  <u>Mitigation measure</u>

  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. Risks and 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.

  The impact is ***SMALL,*** *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**.

  Residual Impacts

  By implementing the above mitigation measures, there will be no residual impacts.

- ***Traffic***

  Approximately a number of (1 620 750) PV modules and (3975) inverters are required for this project.

  Trucks of various sizes will be required for transportation of the project's components. About 75 equipment/construction material vehicles/day are expected at peak construction and for workers transportation from Nagaa Hammadi and the surrounding communities.

  The main road leading to the site, the Giza- Luxor roads, is a double lane road accommodating different types of transport means and services provided to the industrial area neighbouring the project, the Aluminium company north of the proposed project site as well as other undergoing infrastructure projects.

  The impact 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 impact is assessed as **MODERATE**.

Mitigation Measures

Obelisk has developed Transportation Management Procedures which applies to Obelisk projects and operations as well as their contractors and subcontractors. The procedure defines the minimum safety requirements for Obelisk's transportation activities. The requirements are supplementary to national regulatory specifications and project or business unit specifications and/or insurance requirements.

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.
- Electrocution 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 ***moderately severe***. Accordingly, the magnitude of the risk is considered MEDIUM. (High sensitivity receptors).

Based on the above, the overall SIGNIFICANCE of the impact 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 labeling 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 Impacts

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**.

- **Contribution to Climate Change**

  Greenhouse gas (GHG) emissions from onsite equipment usage have not been fully investigated despite their relatively reduction potential worldwide. A study[18] 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 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 tCO2eq, with 282.17 tCO2eq for fair site conditions.

  In addition, photovoltaic (PV) 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[19] of CO2 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[20].

[18] Greenhouse Gas Emissions from Onsite Equipment Usage in Road Construction, August 2012 Journal of Construction Engineering and Management 138(8):982-990, https://www.researchgate.net/publication/273432700_Greenhouse_Gas_Emissions_from_Onsite_Equipment_Usage_in_Road_Construction

[19] 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

[20] https://www.sciencedirect.com/science/article/abs/pii/S0048969720370595

As per the EBRD Environmental and Social Policy (April 2019), projects meeting either of the following criteria will quantify their GHG emissions using the EBRD Protocol for Assessment of Greenhouse Gas Emissions:

- Projects with (or expected to have) gross annual emissions exceeding 100,000 tonnes of CO2-equivalent.
- Projects anticipated to cause a net change in emissions (positive or negative) of more than 25,000 tonnes of CO2-equivalent annually post-investment.

The projects that have or are expected to have gross emissions exceeding 100,000 tonnes of CO2-equivalent annually need to quantify and report these emissions using the EBRD Protocol for Assessment of Greenhouse Gas 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 impact assessment matrix for the construction phase.

Table 32: The risk and Impact Assessment Matrix for the Construction Phase

Risks/Impacts		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	
Construction Phase (17 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		Short term	Localized	Slight	Small	Low	Insignificant	No Residual impacts
Social Environment	Water resources	Short term	Localized	Slight	Small	Low	Insignificant	No Residual impacts
	Worker Influx	Short term	Localized	Slight	Small	Low	Minor	Insignificant
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

8.5.2 Potential risks and Impacts during Operation Phase

A. Potential risks and Impacts on the Physical Environment

- ***Potential risks and Impacts on Ambient Air Quality***

  Potential risks 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 is a greenhouse gas, however, it 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 greenhouse gases 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**.

  <u>Mitigation Measures;</u>

  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.

  <u>Residual Impacts</u>

  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 workplace

Table 33: Expected noise levels from different Instrumentation in workplace

Noise source	Noise level (dB(A)	Location
Invertors	75dB	Inside of the inverter room
Transformer	64dB	Outside transformer room

**At 10m from 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 the suitable personal protective equipment (PPEs).

Residual Impacts

Residual noise during operation activities is unlikely to have an impact on the public. Furthermore, the impact of noise on workplace will be negligible with implementing the above mitigations measures and health and safety procedures.

B. 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, as indicated in section 2.5.1 above, is about 5-6.5m^3/day (150-200m^3/month) 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 (about 4.5m^3/day), 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.

Residual Impacts

By implementing the above mitigation measures, No residual impacts.

- ***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.

- ***Glare and Glint***

  To maximize electricity generation, solar PV modules are designed to absorb light and reflections are contrary to their central purpose. However, panel glass remains relatively smooth and homogenous and may be physically capable of producing a concentrated reflection similar to a calm lake on a wind-free day.

  The project site is located roughly more than 2 km from the road and thus potential glare is not significant.

  The closest airport Luxor is at a distance of 50 km and its runway runs NNE to SSW.

C. 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. It is not expected that issues such as child and forced labour, GBV would exist during the operation phase. However, the project specific E&S management system will include details of the minimum specifications of working conditions and worker recruitment, including controls to avoid forced and child labour. The contracts with all suppliers will include legally binding obligations for them to undertake their contracted scope in accordance with the project’s E&S management system.

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
- Provision of suitable PPE

Residual impacts

By implementing the above mitigation measures, no residual impacts are anticipated.

Table (34) shows the impact assessment matrix for the operation phase

Table 34: The Impact Assessment Matrix for the Operation Phase

Impacts	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							
Air Quality	Long term	*Localized*	*Slight*	*Small*	*Low*	*Minor*	*Insignificant*
Ambient Noise and Vibration	Long term	*Localized*	*Slight*	*Small*	*Low*	*Minor*	*Insignificant*
Social Environment (Water resource)	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*

8.6 Risk and Impact of the Environment on the project

- ***Potential Impact of Sandstorms***

  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 Hours:

  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.

  Raising Sand Hours:

  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. Additionally, sand can accumulate on the panels, which may reduce their efficiency and necessitating more frequent cleaning or protective measures.

  Dust Storm Hours:

  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 raising sand, but the accumulation of fine particles can require **frequent maintenance** and cleaning.

  Sand Storm Hours:

  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, and strategic panel placement to minimize exposure to the prevailing winds and weather conditions that carry dust and sand.

  These impacts are long-term, and localized, with a moderate impact (Moderately severe), the magnitude of the impact is considered MEDIUM. As the proposed project will be carried out within Vacant land in 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.

Residual impact
With appropriate design materials and with implementing proper maintenance and cleaning procedures the impact of dust will be minimized. Therefore, the residual impacts of the operation activities of the proposed project on soil quality are deemed to be **MINOR.**

- ***Conetxtual Riska: Imapct 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 the solar panels and 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

A hydrological study identified the potential risks of the floods from outside the project. The full study is included as Annex 2 of this report. For modelling the potential flood impacts, the following models were used:

- GIS techniques (Arc-Hydro Tools, Spatial Analyst, etc…) were used to delineate the watersheds, estimate watershed characteristics and develop runoff coefficient maps.
- HEC-SSP 2.3 was used to conduct a frequency analysis for the collected rainfall data records.
- HECHMS (by USACE) and some developed in-house spreadsheet (MS Excel) is used to estimate the peak flow and to estimate the other hydrologic parameters whenever needed.
- HECRAS 2D (by USACE) in determining the boundaries of the valleys that affect the study area for a return period of 25, 50 and 100 years.

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.

Data for the Luxor station was collected between 1961 and 2020. This station was chosen because it is close to the site of the project with data available as it covers about 60 years, which is sufficient for statistical analysis for periods of higher frequency.

Statistical analysis of the maximum values of daily rainfall was performed and statistical distributions were used and tested to obtain rainfall values at different return periods.

These values were used to develop the intensity, duration and frequency curves of the station using Bells’ ratios due to the absence of short-term rainfall data in the study area. Moreover, the impact of climate change on IDF curves and floods was taken into consideration by applying a 10% increase to the precipitation values for each return period.

Different morphological parameters of the streams were identified. These parameters are:

1) Drainage basin boundaries.
2) Longest flow path of the stream.
3) drainage basin area.
4) Stream slope
5) Shape of drainage basin.
6) Time of concentration

The maximum velocities and depths were calculated for 25,50 and 100 year return period. Those of 100 year return period are shown in Figure 36 below.

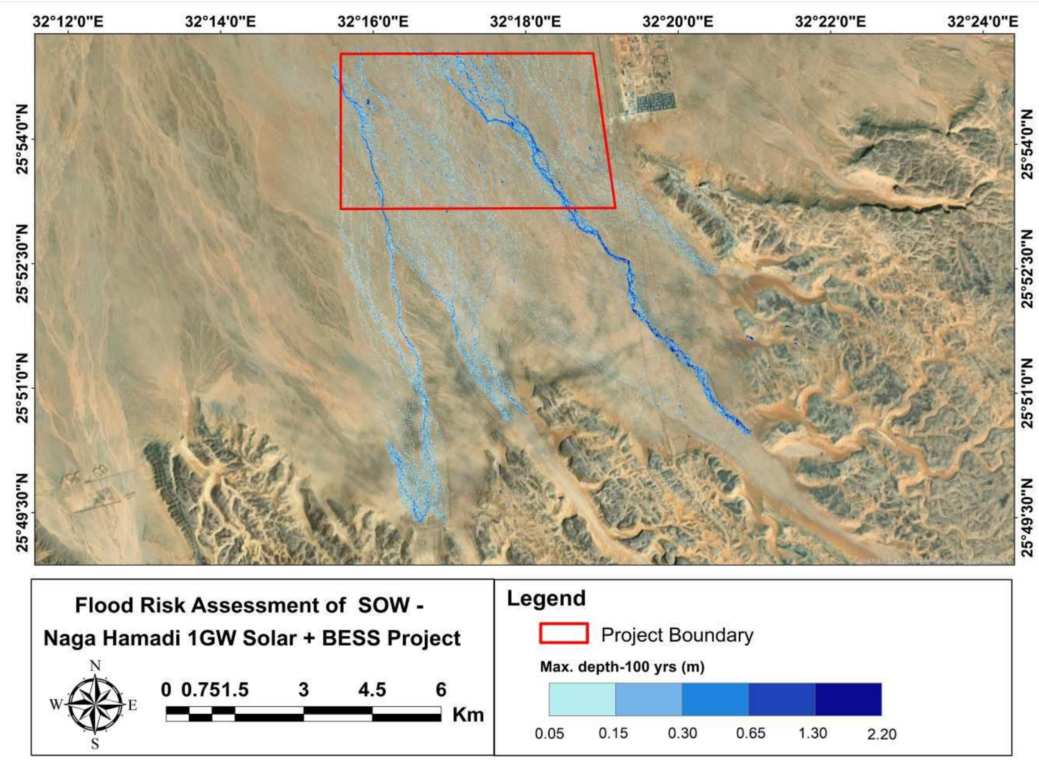


Figure 36: Maximum Depth for 100 year return period

Figure 37 shows the maximum velocity for 100 year return period.

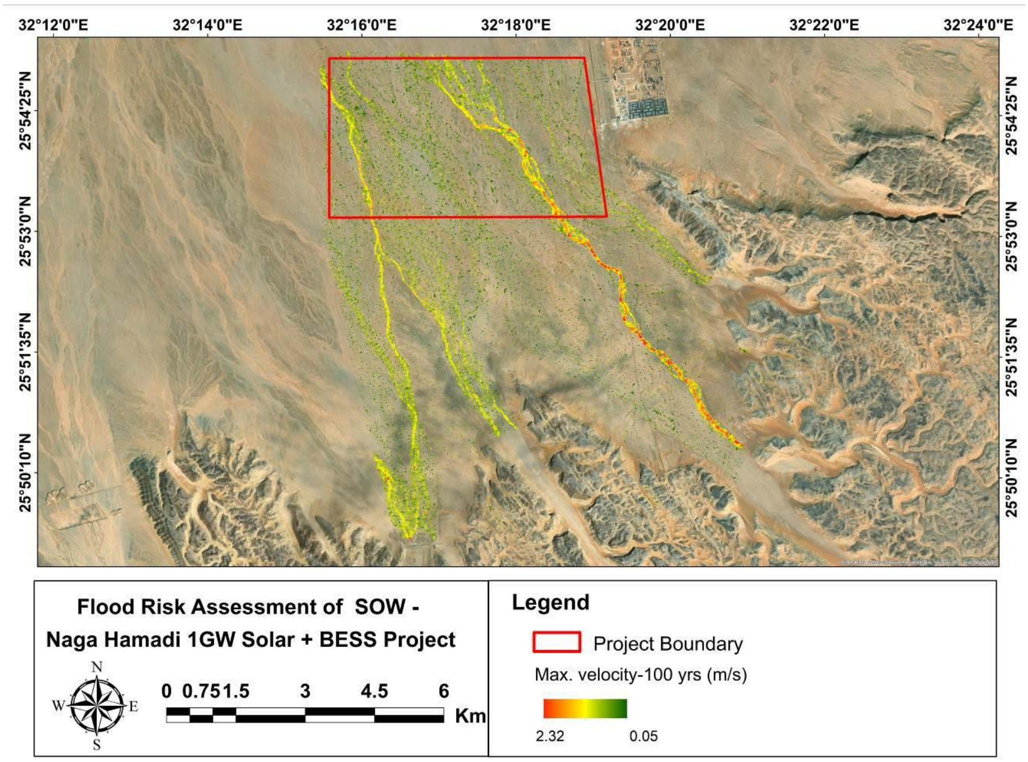


Figure 37: Maximum velocity for 100 year return period

According to the results of hydrological studies, streams affecting the project boundary require a protection works to protect the project from the flood risk. Accordingly, protection measures were recommended based on impact points as shown in Figure 38 below.

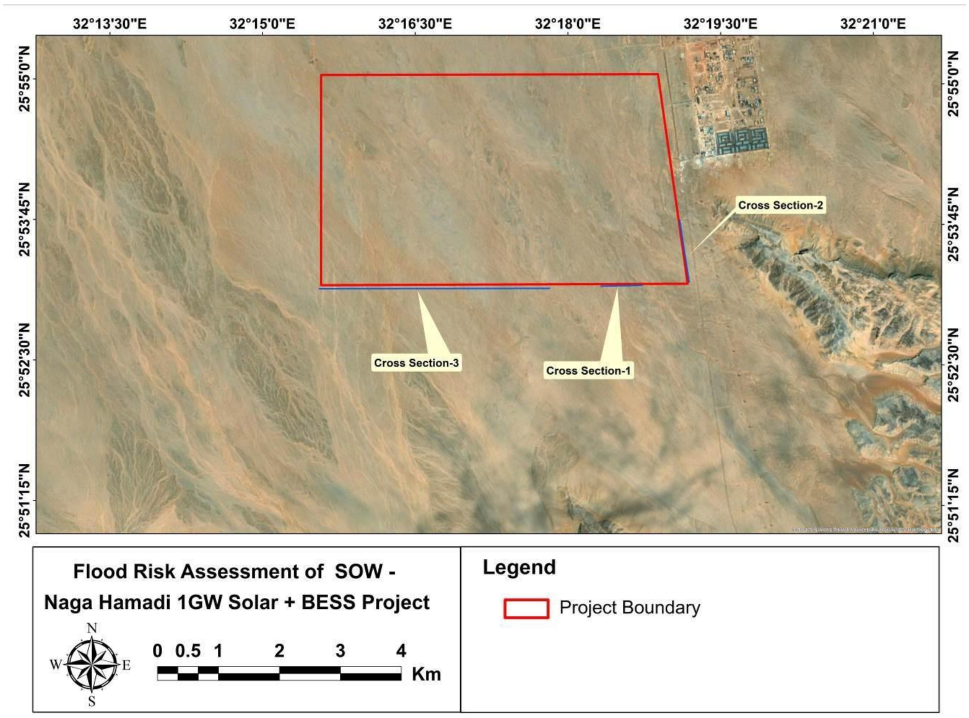


Figure 38: Impact points on project site boundary

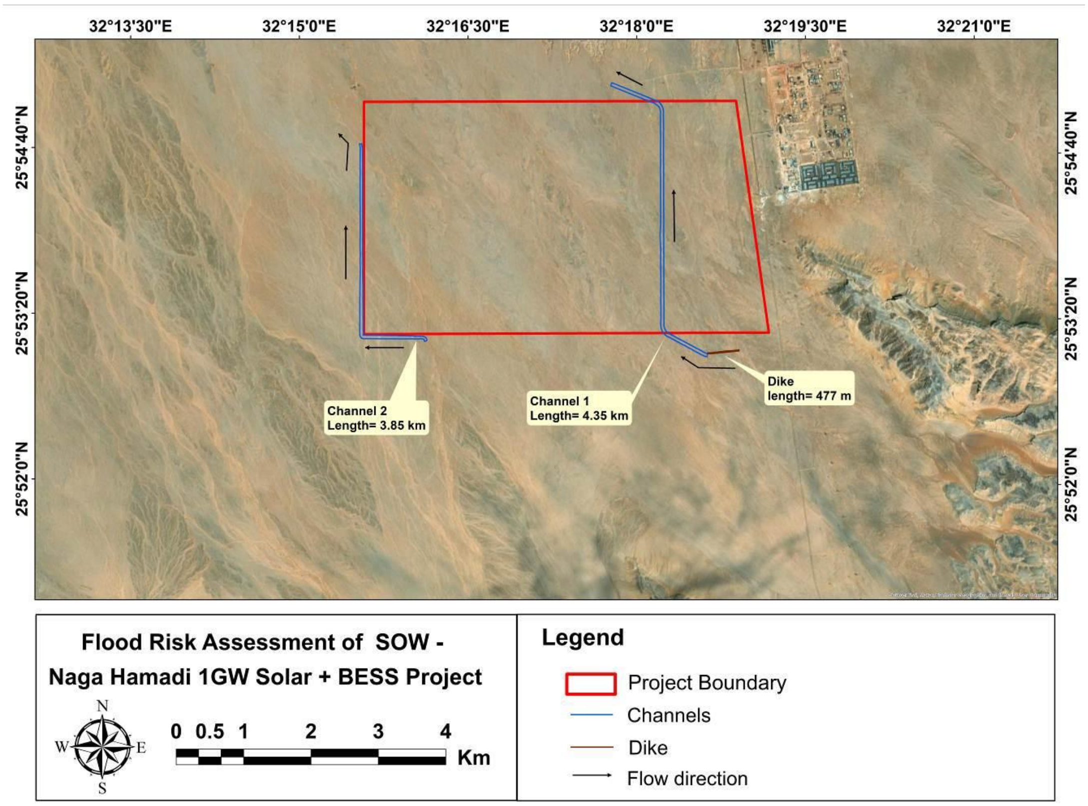


Figure 39: Proposed protection measures

Open channels within the project boundary are recommended to convey flow downstream, following the same direction as the natural wadi as shown in Figure 39. Moreover, dikes are proposed to divert water inside the channels. Details of the protection measures including dimensions of the proposed channels can be found in Annex 2 of this report.

8.7 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 or 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 would largely depend on the time frame within which the different neighbouring projects are expected to be constructed. No other power projects are planned to be established in the area. As indicated below projects under construction, planned mainly include residential and utilities infrastructure projects such as water and wastewater plants.
Potential cumulative impacts may include:

- ***Impact on water resources and wastewater treatment capacity***
  Cumulative effects rising from parallel construction activities within the project, for example the light industries zone east of the site and undergoing projects for upgrading the infrastructure in the area mainly water and wastewater treatment plants). The construction water demand for the different projects may have an impact on the water resources in the area. The same applies to wastewater treatment. However, the potential impacts of construction activities are short term and localized. Thus, the potential cumulative impacts would be insignificant.

- ***Traffic and logistics management***
  Transportation of construction materials and PV project components (panels, mounting systems, BESS, etc…) would require considerable use of transportation vehicles which may increase the traffic loads on the nearby access roads. However, the potential impacts of construction activities are short term. Thus, 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 are limited to the site boundaries and its immediate vicinity. Thus, potential construction activities taking place in parallel with the OV project are not expected to have cumulative impact on the airshed of the area.

  Moreover, the construction activities are short term compared to the projects' lifetime.

- ***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 project specific skills, as their number is significant for construction, and it is more economically viable. Moreover, availability of workers in the nearby villages and the wider region was confirmed during the stakeholder meetings. Whereas the required highly skilled labor may not be from the local communities.

Given the approach and arrangements concerning worker influx (section 8.5.1 above), the number of non-local workers interacting with host communities will be minimized and will not be in a position to disrupt the local culture, norms and traditions in Upper Egypt and their impact on these communities is, thus, not significant as discussed above, Gender-Based Violence (GBV) and Sexual Harassment are not expected to be an impact of the project, and are rather individual occurrences should they take place. Labour management plans and codes of conduct will elaborate the means to control, monitor and sanction such occurrences.

9. Environmental and Social Management Plan

This Environmental and Social Management Plan (ESMP) has been developed in accordance with national laws and international standards for the proposed Solar Photovoltaic (PV) Plant and Battery Energy Storage System (BESS) project.

The project's ESMP consists of a set of mitigation, and monitoring measures that will be considered during the construction and operation phases 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.

The purpose of the project's ESMP is to:

- Ensure continuing compliance with the relevant legislations 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.

9.1 Summary of risks, Impacts and Mitigation Measures

Table (35) below summarizes the environmental aspects, mitigation measures and residual impacts as assessed for the different project phases.

Table 35: Summary of the Environmental Aspects, Mitigation Measures and Residual Impacts

Environmental Aspect	Expected risks and Impacts	Mitigation Measures Summary	Residual Impacts
Construction Phase			
Air Quality			
• Air Quality	MINOR	- Implementing policies to reduce idling times for vehicles and machinery; - Maintaining machinery and vehicles in good working conditions to minimize fugitive emissions and exhaust; - Speed restriction on site to minimize dust emissions; - Ensuring workers with awareness of safe driving and maintaining good practices in machinery usage; and, - Conducting periodic measurements for stacks of generators to ensure their compliance with law 4/1994	INSIGNIFICANT
Ambient Noise			
• Equipment and machinery • Vehicles Movement • Power Generators	MINOR	• 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; • Schedule high-noise activities to take place in morning hours, as possible; and, • Provide hearing protection equipment to workers exposed to high noise levels.	INSIGNIFICANT
Impacts on Soil			
• Domestic wastewater tanks, material and wastes storage, and accidental spills	MINOR	• Conduct maintenance of vehicles, trucks, and construction equipment off-site to reduce on-site emissions and spills; • Collect and dispose of spillages from tank filling or generator operation as hazardous waste; • 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: and,	INSIGNIFICANT

Environmental Aspect	Expected risks and Impacts	Mitigation Measures Summary	Residual Impacts
		• Implement precautionary measures to protect local wildlife from construction activities. • **Non-Hazardous Solid Waste:** ○ Collect waste at designated collection points and store it in appropriate containers following regulations; and, ○ Use licensed contractors for collection and disposal of non-hazardous waste. • **Hazardous Waste:** ○ Establish marked and physically separated bunded storage areas for hazardous waste; ○ Use licensed contractors for the collection and disposal of hazardous waste; and,	
Impacts on the Biological Environment			
• Habitat disruption, flora, fauna, and avifauna	INSIGNIFICANT	• 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.	INSIGNIFICANT
Impacts on the Social Environment			
• Water Resources	INSIGNIFICANT	• A comprehensive water management plan will be developed	INSIGNIFICANT
• Worker Influx	MINOR	• Prioritize hiring local workers to reduce the number of incoming workers and minimize social disruption; • 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.	INSIGNIFICANT
Infrastructure			
• Landuse	INSIGNIFICANT	• 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	INSIGNIFICANTN
• Traffic	MODERATE	• Obelisk has developed Transportation Management Procedures that apply to Obelisk projects and operations as well as their contractors and subcontractors. The procedure defines the minimum safety requirements for Obelisk's transportation	MINOR

Environmental Aspect	Expected risks and Impacts	Mitigation Measures Summary	Residual Impacts
		activities. The requirements are supplementary to national regulatory specifications and project or business unit specifications and/or insurance requirements	
Occupational Health and Safety			
• Impacts on workforce health and safety	MODERATE	• 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) for close inspection and management of the construction activities; • Ensure proper training for operators, regular maintenance of equipment, and implementation of safety protocols. • 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; • Use of personal protective equipment (PPE) • 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. • Implement fire prevention measures, maintain fire extinguishers on-site, and conduct fire safety training.	MINOR
Operation Phase			
Air Quality			
• Emissions from emergency generator	MINOR	• Optimize the operation of backup generators to reduce usage and emissions.	INSIGNIFICANT
Ambient Noise & Vibration			

Environmental Aspect	Expected risks and Impacts	Mitigation Measures Summary	Residual Impacts
• Operation of Transformers, and other operational components of battery energy storage systems. • Use of backup generators during power outages	MINOR	• 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). • A grievance mechanism will be adopted for assessing complaints, which would cover operation noise, if any	INSIGNIFICANT
Impact on the Social Environment			
• Water Resources	INSIGNIFICANT	• Wastewater generated during the operation phase is minimal and will be collected by an approved contractor and discharged to designated treatment plants.	No residual impact
Impacts on Occupational Health and Safety			
• Impacts on workplace	INSIGNIFICANT	• A health and safety policy will be applied • Abide by all national occupational health and safety regulations, Law 12/2003 • Provision of suitable PPE • Sufficient drinking water supply	INSIGNIFICANT

9.2 Environmental and Social Responsibilities

9.2.1 Establishment of Health, Safety and Environment (HSE) Department

The guidelines require appointing roles and responsibilities of the HSE department. In this context, the company will assign at least five HSSE dedicated personnel for HSE issues.

The social aspects will be under the responsibility of the contractor (supervised by the company) during the construction phase and under Scatec responsibility.

9.2.2 Staff Responsibilities

The HSSE personnel will be responsible for daily safety work (walks-over) at the site, for inspecting the safety, housekeeping, personal protection, control unsafe practices/conditions, update environmental register, and assess the environmental performance of the facility. When construction and operation work pose 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 potential hazard.

- ***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 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 in 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 behaviours;
- 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
  - Auditing the site during the construction and operation & maintenance phases
  - Provide on-site training on E&S matters

9.3 Institutional Arrangements

9.3.1 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.

9.3.2 Health, Safety and Environment Policy

Obelisk has developed comprehensive health, safety and environment (HSE) policies and procedures in accordance with the international requirements and national regulations, as available. The construction contractors will be required to abide with 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 providing 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.

Obelisk will require from the construction Contractor 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 meetings, audit reports and incident reporting.

9.3.3 Human Resources Policy

Obelisk has developed a Human Resources (HR) policies and procedures and in line with local and international laws/legislation and best practice as well as 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 is clear and understandable to all employees. Accordingly, an HR policy covers 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
- 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 [21] . In this context, Obelisk policies and procedures ensure management and monitoring the performance of third-party performance.

[21] 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

9.4 Environmental Management Plans

Within its commitment to ensure environmental protection and maintain efficient environmental performance as well as social integrity, Obelisk 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 dimensions will be incorporated throughout the project phases. In this regard, the environmental plans to be developed will address:

9.4.1 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;
- 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.

9.4.1.1 Health, Safety and Environment (HSE) Plan

This includes developing detailed plans for HSE issues for the construction phase. The plan will ensure:

- Addressing HSE risks 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.

9.4.1.2 Transportation Management Plan

Obelisk has developed an overarching transportation policy and procedures that are to be adopted for all Obelisk projects. The purpose of this policy is to ensure 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 to vehicles and their use
- Maintenance program
- Local road transportation safety Requirements and additional Obelisk safety requirements
- Driving time and rest period

9.4.1.3 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, such;
- Workers shall be provided with adequate PPE (ear plugs), and ensuring that workers are always wearing PPE while working near equipment that emit high noise levels.

9.4.1.4 Solid waste management

Domestic solid waste generated from the construction labour will be collected, properly stored according to the national regulations and finally disposed by a licensed waste contractor.

Construction wastes will be collected in a separate onsite location and periodically disposed 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 in other construction sites.
Solid waste management will be proceeded in accordance with the requirements of laws 4/1994 and 202/2020.

9.4.1.5 Hazardous waste management

The following briefs the management plan concerning hazardous waste (HW) of the proposed project.

HW generation
Different hazardous waste will be generated from the construction activities. The type of generated hazardous waste is mentioned in section 3 above.

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 were 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 containers content and the required precaution instructions.

HW disposal
The HW will be transported to El Nassreya HW landfill in Alexandria, via a certified contractor. On the other hand, spent oils will be disposed 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.

9.4.1.6 Water and wastewater management

A project specific 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.

9.4.1.7 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.

Obelisk 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 normal state.
- Mitigation: the activities which eliminate or reduce the probability of disaster.

9.4.1.8 Chance Find Procedure

As indicated in section 6 above, there are no registered antiquities or cultural heritage sites within or near 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/Cultural Finds, Insignificant Chance Finds, Potentially Significant Archaeological Find s 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.

9.4.1.9 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 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 on potential environmental impacts of various construction activities.

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.

9.4.2 Environmental Management Plans During the Operation Phase

Obelisk 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 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 annual basis. Obelisk will make both registries 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.

9.4.2.1 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 disposal of broken PV panels through recycling.

9.4.2.2 Solid Wastes Management

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.

9.4.2.3 Preventive and corrective maintenance

The main objective of maintenance is to maximize utilization of the equipment in their 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 Obelisk.

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, electric system, weather stations, monitoring system and 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 enough trained 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.

9.4.2.4 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.

9.4.2.5 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 on 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 the 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.

9.4.2.6 Housekeeping and Cleanliness

With regard to the housekeeping and cleanliness of the site, good housekeeping and cleanliness activities will be applied, such as:

- Obstacles may 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.

9.4.2.7 Emergency response plans

<u>Identify specific risks</u>

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 the magnitude of risks that could induce fire, personnel fatality, or building collapse.

These risks include the following:

- Activities that may pose risks on 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.

Obelisk will develop a reporting system for accidents, including injuries, damage to property, and environmental damages. 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 follow:

- 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 was managed, a throughout survey of the affected site must be carried out to ensure that the hazard is completely eliminated, and that the situation is restored to its original state. Follow up procedures include the following:

- Identify the causes of emergency;
- Assess the efficiency of emergency response procedures;
- Propose corrective action and remedial measures necessary to prevent reoccurrence 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.

9.5 Social Management Plan

It is of key importance for Obelisk to have a 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) is also developed for the project. Main aspects of the plan are summarized in the following sections.

9.5.1 Obelisk's SEAH and GBV Management Plan

Diversity, Equity, Inclusion, and Belonging (DEIB) Policy: Obelisk'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): Obelisk is committed to human rights and equal opportunities, with a comprehensive stance against all forms of GBV.

Integration with HR Policies: Obelisk 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 has expressed interest in appointing a female Community Liaison Officer, providing a significant opportunity for female leadership within the project.

9.5.2 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 Law 12/2003 and the general international workplace health and safety guidelines.

9.5.3 On-going Consultation

Obelisk has already undertaken various activities to communicate and engage with key stakeholders and is willing to continue its engagement activities Annex 3 includes the stakeholders consultation activities.

Discussions took place with Qena governorate during the stakeholders consultation process on potential CSR projects aiming at supporting the community. The governorate is already involved with various NGOs on different projects, as the 1 million trees development – carbon credits project and is willing to liaise with the project in due time.

9.5.4 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 that may cause disturbances (e.g. dust, traffic, etc.); key contacts for the project; and other information, as needed.

9.5.5 Grievance Management

A grievance management plan will be developed to address the external and internal grievance mechanisms.

9.5.6 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;

9.5.7 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 that will be renewable as long as the proper predictive maintenance measures are taken, and all the necessary revamps and upgrades are done. 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.

Table (36) below provides a comprehensive overview of the projects management plan including potential environmental aspects identified in the Environmental and Social Impact Assessment (ESIA) for both the construction and operation phases of the project as well as the proposed mitigation measures designed to minimize these impacts.

Table 36: Overview of the ESMP Plan

Aspect	Issues of concern	Actions	Party Implementing the Action	Indicator of completion	Estimated Cost	Required completion Date
Construction Phase						
Air Quality	Dust emissions	- Reduce idling times for vehicles and machinery; - Maintaining machinery and vehicles in good working - Speed restriction on site s; - Ensuring workers with awareness of safe driving and maintaining good practices in machinery usage; and, - Periodic measurements for stacks of generators	Construction contractor	- Monitoring plan - Air quality measurements	Cost of measurements in monitoring plan below	Throughout the construction phase period
	working conditions of machinery	- Ensure good working conditions through frequent inspection of all construction equipment	Construction contractor	Maintenance logs	Cost of maintenance	
Noise Level	working conditions of machinery	- Regular maintenance of construction equipment - Use low-noise equipment, where possible; - Schedule high-noise activities to avoid simultaneous operations that could amplify noise levels; - Schedule high-noise activities to take place in morning hours	Construction contractor	Noise measurements and Maintenance logs	Cost of measurements in monitoring plan + cost of maintenance	Throughout the construction phase period
	Provision of PPEs	- Providing necessary PPEs for workers	Construction contractor			
Soil	housekeeping practices	- Develop and implement site management plan and a solid waste management plan	Construction contractor Developer (include provisions in the construction contracts. Developers to ensure contractors compliance)	- Solid/hazardous waste and wastewater management contract - Contractor follow up documents	- Part of construction activities management - Cost of transportation and disposal of waste	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
Construction Phase						
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
Biological Environment	waste management	- Developing a solid waste management plan	Construction contractor	Solid waste management contract	Cost of transportation and disposal	Throughout the construction phase period
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

Aspect	Issues of concern	Actions	Party Implementing the Action	Indicator of completion	Estimated Cost	Required completion Date
Operation Phase						
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
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

9.6 Environmental and Social Monitoring Plans

9.6.1 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 2, 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 (2) of this study.

  The following parameters shall be measured:
  - Carbon monoxide, CO
  - Sulfur dioxide, SO_2
  - Nitrogen oxides, NO_x
  - PM_{10}

- **Workplace Monitoring**
  Labour Audit
  Labour audits are the most common spot-check mechanism used today 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 may also extend to supply chains. 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 (37) provides the proposed monitoring plan. The costs only cover analysis and field measurements. However, they do not include specific sample collection costs.

Table 37: Proposed Environmental Monitoring Plan
(the provided cost estimates are tentative and should be confirmed at the time of implementation to take into account prices increases and currency devaluations)

Receptors / Source of impact	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 Obelisk	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 Obelisk	Third party (research entity or certified lab)	~ 35,000 EGP
Estimated total annual cost during construction)							45,000 EGP
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_2, NO_2, CO, PM_{10})	Compliance with point source air emissions standards	Annually	Project	Third party (research entity or certified lab)	~ 25,000 EGP
Estimated total annual cost during operation							35,000 EGP

9.6.2 Social Management Plan

The main aspects of the social management plan are summarized in the following sections.

9.6.2.1 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 12/2003 and the general international workplace health and safety guidelines.

9.6.2.2 On-going Consultation

Obelisk has already undertaken various activities to communicate and engage with key stakeholders and is willing to continue its engagement activities (Annex 3)

9.6.2.3 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 that may cause disturbances (e.g. dust, traffic, etc.); key contacts for the project; and other information, as needed.

9.6.2.4 Grievance Management

A project grievance management plan will be developed will include external and internal grievance mechanisms.

9.6.3 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;

9.6.4 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.

10. Stakeholders Consultation

Consultation with the community and stakeholders is an important element in the ESIA process. The current chapter presents details of the individual consultations carried out by Environics 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 scoping meeting took place with the head of the environmental department - EEAA and the on 7th October 2024 to present the project, confirm its categorization and obtain their requirements and concerns regarding the ESIA.

In addition, a set of consultation meetings took place with different stakeholders twice during the preparation of the ESIA.

The first set of meetings took place on 1st of October 2024 at the early stage of the ESIA preparation with key stakeholders, including Qena governorate and the neighbouring activities. The meetings were carried out with the purpose of scoping the ESIA activities and identifying potential additional stakeholders.

The second set of meetings took place on 23rd -24th of October 2024 with the aim to disclose the outcome of the ESIA and obtain the views and concerns of the stakeholders regarding the project and its associated facilities, namely the OHTL. The disclosure meetings took place with various categories of stakeholders including:

- The Industrial area management, investors, and employees. This was necessary as the closest activity to the project.
- The closest farms to the projects, to investigate whether there are perceived impacts that might have been overlooked.
- Local Women specifically targeted (over 50 women) 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 tot eh project
- The discussions that commenced with Qena Governorate and relevant authorities during the scoping stage continued throughout the ESIA process

Representatives of several NGOs (ex. CDA of Elderb, Hesset El-Kheir, Ataa Bela Hodood, Moaasaset Al Nedaa El Khaireya) and charity organizations (Ex. Baraka village Charity Organization).

The selection of these meetings was focused on the vicinity of the project and were made in consultation with the head of the El-Hew municipality (under which El-Baraka falls), and the Governorate officials. This was capitalizing on contacts made during scoping.

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 as it will add to the area another advantage in addition to the industrial area, the high-speed train and
    - 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, in terms of a police security, ambulance and firefighting facilities.

- ***Concerns about pressure on local resources***
    - There Is a possibility of a rise in apartment rentals, and accordingly it is advised to avoid concentration in one community, especially El-Baraka, a smaller community where apartments for rent is available but given its size, the effect will not be negligible.
    - The fueling of equipment could cause pressure on local gas stations and this will need to be coordinated to avoid shortages.
    - The trucking of water should be from water plants having excess capacity and in timings when local demand is lowest.
    - The supply of other commodities will be through suppliers who will not acquire these resources from the local outlets.
    - The impacts on traffic could be overcome through coordination of work shifts to avoid the times of other industries shifts (8 am), and the school schedule.

- ***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.
    - There are more channels for seeking candidates than the formal ones (the labour office), NGOs were proposed as well as adverts in the Aluminium Company which has the advantage of using the workers who come from all over the region to convey the existence of opportunities in their own communities.
    - It was clarified that the contractors will be advised to use these multiple channels to the maximum extent.

- ***Possible community investment projects***
  There was no commitment made in this respect except that these will be studied in due time. Obelisk having had a successful precedent in Benban
  - The Baraka village suffers from stray dogs as a result of solid waste mismanagement. Improving solid waste management will benefit the community.
  - There is a need for support of the mist marginalized groups, including women headed households as expressed by a widow in the women's meeting
  - The widening and lighting of the road serving the industrial area, which will also be serving the project[22]

  In addition, the attendees of different meetings contributed some important information including:
  - The need to protect the project form dusty winds
  - The depth and quality of ground water
  - The availability of rental apartments in El-Baraka village. As this is the closest residential area to the project, it highly simplifies the logistics of employee transportation

Annex 3, presents the detailed minutes of meetings of the stakeholders consultation process.

[22] This proposal was received after the meetings using the WhatsApp number provided to the attendees

11. References

Abd El-Ghani, M.M. (2000). Floristics and Environmental Relations in Two Extreme Desert Zones of Western Egypt' *Global Ecology and* Biogeography, *9*(6), pp. 499 - 516.

Baha El Din, S. (2006) *A Guide to the Reptiles and Amphibians of Egypt*. The American University in Cairo Press, Cairo – New York.

Basuony, M.I., Gilbert, F. and Zalat, S. (2010) *Mammals of Egypt: Atlas, Red Data Listing & Conservation*. Ministry of State for Environmental Affairs, Cairo.

BirdLife International (2024) *Important Bird Area Factsheet.* Available at: https://datazone.birdlife.org/ Accessed on: [17/9/2024]

BirdLife International (2024) *Soaring Bird Sensitivity Map*. Available at: https://maps.birdlife.org/MSBtool/ Accessed on: [18/9/2024]

CULTNAT (2022) *Egyptian Archeological Map* Available at: https://archmap.cultnat.org/Map.aspx Accessed on: [17/9/2024]

CULTNAT (2023) *Abu-Amuri: Archaeological Mound in Qena*
Available at: https://archmap.cultnat.org/AllSites.aspx
Accessed on: [28/10/2024]

CAPMAS (2017) G*eneral Census for Population, Housing and Establishments 2017 – Qena Governorate*
Available at: https://censusinfo.capmas.gov.eg/metadata-en-v4.2/index.php/catalog/621
Accessed on: [17/09/2024]

CAPMAS (2021) *Annual Bulletin of Pure Water & Sanitation Statistics - 2019/2020* Available at: https://censusinfo.capmas.gov.eg/Metadata-ar-v4.2/index.php/catalog/1814/download/6410 Accessed on: [17/09/2024]

CITES (2024) *Appendices I, II, and III* Available at: https://cites.org/eng/app/appendices.php Accessed on: [17/09/2024]

Copernicus (2024) *Global Land Cover – Land Cover Classification* Available at:

https://lcviewer.vito.be/2019 Accessed on: [28/9/2024]

EEAA (1995) *Egypt Country Study on Biological Diversity.* Publications of the National Biodiversity Unit, Number 3, EEAA/UNEP.

EEAA (2022) General Administration for Air Quality*. Air quality report for the year 2022*. Available at https://www.eeaa.gov.eg Accessed on: [17/09/2024]

EEAA (2023) *General Administration for Air Quality. Air quality report for December 2023*. Available at: https://www.eeaa.gov.eg Accessed on: [17/09/2024]

El-Gabbas, A., Baha El Din, S., Zalat, S. and Gilbert, F. (2016) 'Conserving Egypt's reptiles under climate change' *Journal of Arid Environments*, *127*, pp. 211-221.

El-Ramady, H., Alshaal, T., Bakr, N., Elbana, T., Mohamed, E. and Belal, A. (2019) *The Soils of Egypt*. Springer Nature Switzerland AG. ISSN 2211-1263

Gaber, A., Mohamed, A. K., ElGalladi, A., Abdelkareem, M., Beshr, A. M., and Koch, M. (2020) 'Mapping the groundwater potentiality of West Qena Area, Egypt, using integrated remote sensing and hydro-geophysical techniques' *Remote* Sensing, *12*(10), 1559.

GAEB (2003) *Geotechnical Encyclopedia of Egypt.* Geotechnical Research Center at Cairo University, Faculty of Engineering, Egypt. ISBN: 977-6079-23-7

Goodman, S.M., Meininger, P.L., and Mulli, W.C. (1986) 'The Birds of the Egyptian Western Desert' *Miscellaneous Publications of the Museum of Zoology, University of Michigan*, *172*.

Hoath, R. (2009) *A Field Guide to the Mammals of Egypt.* The American University in Cairo Press, Cairo – New York.

IFC (2012) Performance Standard 6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources, International Finance Corporation, World Bank Group, January 1, 2012

IBAT (2004) *Integrated Biodiversity Assessment Tool* Available at: https://www.ibat-alliance.org/ Accessed on: [17/9/2024]

IUCN (2024) The IUCN Red List of Threatened Species. Version 2023-1. Available at: https://www.iucnredlist.org. Accessed on: [17/9/2024]

Katavoutas, G., Founda, Varotsos, K.V. and Giannakopoulos, C. (2023) 'Diurnal Temperature Range and Its Response to Heat Waves in 16 European Cities - Current and Future Trends' *Sustainability, 15*(17).

Khalafallah, O.K. (2020) 'Total solar radiation and ideal incline angles of a south-facing solar panel in Qena/Egypt' *Resources and Environment, 10*, pp. 10 - 17.

Meteoblue (2024) *Simulated historical climate & weather data for Qina* Available at: https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/qina_egypt_350550 Accessed on: [16/9/2024]

MSBT (2024) *Soaring Bird Sensitivity Mapping Tool* Available at: https://maps.birdlife.org/MSBtool/ Accessed on: [18/9/2024]

Mohamed, S.A. (2019) 'Application of satellite image processing and GIS-Spatial modeling for mapping urban areas prone to flash floods in Qena governorate' *Egypt J African Earth Sci, 158*(15)

PlantLife International. (2024). Plantlife Important Plant Areas. https://www.plantlifeipa.org/. Accessed on: [17/9/2024]

Qena Governorate (2024). *Qena Governorate Official Website.* Available at https://qena.gov.eg. Accessed on: [17/9/2024]

Saber, S.A. and Masood, M.F. (2011) 'Ecology and conservation of the herpetofauna of El-Omayyed Protected Area, Egypt' *Al-Azhar Bull. Sci., 22*(1), pp. 93 - 115.

Saleh, M.A. (1993) *Habitat Diversity and Land Vertebrates*. In: Kassas, M. (ed.) Habitat Diversity: Egypt. Publications of National Biodiversity Unit. No.1 - Cairo.

Obelisk (2024). Preliminary Environmental and Social Findings report. Solar+ BESS, Nagaa Hammadi, Egypt.

Solargis (2021) *Solar resource map, Egypt*. Available at: https://solargis.com. Accessed on [24/9/2024]

SIS (2016) *Qena Governorate* Available at: https://www.sis.gov.eg/Story/68570/Qena-Governorate?lang=en-us. Accessed on: [17/9/2024]

UNESCO-ICH (2023) *Date palm, knowledge, skills, traditions and practices* Available at: https://ich.unesco.org/en/RL/date-palm-knowledge-skills-traditions-and-practices-01902

Accessed on: [28/10/2024]

UNESCO-ICH (2023) *Tahteeb, Stick Game* Available at: https://ich.unesco.org/en/RL/tahteeb-stick-game-01189

Accessed on: [28/10/2024]

UNESCO-ICH (2023) *Handmade weaving in Upper Egypt* Available at: https://ich.unesco.org/en/USL/handmade-weaving-in-upper-egypt-sa-eed-01605 Accessed on: [28/10/2024]

UNESCO-ICH (2024) *Al-Sirah Al-Hilaliyyah Epic* Available at: https://ich.unesco.org/en/RL/al-sirah-al-hilaliyyah-epic-00075 Accessed on: [28/10/2024]

UNESCO (2024) *List of Intangible Cultural Heritage* Available at: https://ich.unesco.org/en/state/egypt-EG?info=elements-on-the-lists. Accessed on: [17.09.2024]

UNESCO (2024a) *World Heritage List, Egypt.* Available at: https://whc.unesco.org/en/statesparties/eg. Accessed on: [18/9/2024]

Weatherbase (2024) *Qena, Egypt* Available at: https://www.weatherbase.com/weather/weather.php3?s=601817 Accessed on: [17/9/2024]

Zhang, M., Jin, S., Ma, Y., Fan, R., Wang, L., Gong, W. and Liu, B. (2021) 'Haze events at different levels in winters: A comprehensive study of meteorological factors, Aerosol characteristics and direct radiative forcing in megacities of north and central China' *Atmospheric Environment, 245*

Annex 1: EEAA approval

الإدارة المركزية ... تقييم التأثير البيئي
٢٠٢٤/١٢/٨
إدارة وثائق تقييم التأثير البيئي
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وزارة البيئة MINISTRY OF ENVIRONMENT

335218

الموضوع: دراسة تقييم تأثير بيئي (ب) محددة
رقم الإيصال: ٢٠٥٧٠٦

السيدة المهندسة / إيمان إبراهيم رمضان
مدير عام الدراسات الهندسية والاقتصادية والبيئية – هيئة تنمية واستخدام الطاقة الجديدة والمتجددة

تحية طيبة وبعد،

بالإشارة إلى كتاب سيادتكم الوارد لنا بتاريخ ٢٠٢٤/١١/٢٤ والمرفق به دراسة تقييم التأثير البيئي (ب) محددة المقدمة لمشروع/ إنشاء وتشغيل محطة توليد الطاقة الكهربية باستخدام تكنولوجيا الخلايا الكهروضوئية بقدرة (١٠٠٠ميجاوات)، والمزودة بنظام تخزين الطاقة بالبطاريات سعة (٢٠٠ ميجاوات / ساعة)، المساحة الكلية للمحطة (٣٨٨٨ فدان)، الموقع/ منطقة صحراوية في نطاق مركز نجع حمادي – محافظة قنا، مالك المشروع/ شركة أوبليسك للطاقة الشمسية.

أتشرف بالإحاطة بأنه بعد مراجعة الدراسة المقدمة، و بناءا على رأي قطاع حماية الطبيعة والاجتماع المنعقد بتاريخ ٢٠٢٤/١٢/٥ بمقر الوزارة ، فإن جهاز شئون البيئة **يوافق** على إقامة المشروع، بشرط الالتزام بجميع المواصفات والإجراءات التي وردت بالدراسة المقدمة والالتزام بجميع الأسس والاشتراطات التي نص عليها القانون رقم (٤) لسنة ١٩٩٤ بشأن حماية البيئة ولائحته التنفيذية رقم (٣٣٨) لسنة ١٩٩٥وتعديلاتهما وقانون تنظيم إدارة المخلفات رقم (٢٠٢) لسنة ٢٠٢٠ولائحته التنفيذية رقم (٧٢٢) لسنة ٢٠٢٢مع الالتزام بالاشتراطات الآتية:

١. الإلتزام بموقع وإحداثيات المحطة بالمنطقة الصحراوية الواقعة في نطاق مركز نجع حمادي – محافظة قنا، كما ورد بالدراسة.

النقاط	خط طول	خط عرض
١	٣٢,٢٦٢١٤٤	٢٥,٩١٣٨٧
٢	٣٢,٣١١١٧٥	٢٥,٩١٦٧١
٣	٣٢,٣١٧٢٨١	٢٥,٨٨٧١٩٧
٤	٣٢,٢٦٩١٨٨	٢٥,٨٨٦٩٣٣

٢. الالتزام بأن يقتصر المشروع على إنشاء وتشغيل محطة توليد الطاقة الكهربية باستخدام تكنولوجيا الخلايا الكهروضوئية بقدرة (١٠٠٠ميجاوات)، والمزودة بنظام تخزين الطاقة بالبطاريات سعة (٢٠٠ ميجاوات/ ساعة) بمساحة كلية للمحطة (٣٨٨٨ فدان)، مع الالتزام بعدم انشاء خطوط نقل الكهرباء التابعة للمحطة المقترحة ومحطة المحولات أو القيام بإضافة أي أنشطة أخرى أو توسعات قبل الحصول على الموافقة البيئية المسبقة من جهاز شئون البيئة.

٣. الالتزام بالحصول على موافقات الجهات المعنية قبل البدء في تنفيذ المشروع.

٤. الالتزام بالمواصفات الفنية والمكونات الرئيسية للمشروع كما ورد بالدراسة، وهي كالآتي: –

- عدد (١,٦٢٠,٧٥٠) من ألواح الطاقة الشمسية (قدرة كل منها ٧١٠ وات)
- عدد (٣٩٧٥) عاكس (مغير للتيار) لتحويل التيار المتردد المستمر إلى تيار متردد بقدرة إجمالية (١١٣١ ميجا فولت امبير).
- أنظمة تتبع أحادية المحور بعدد ١٨٠٠٧ وحدة (٢/٣) سلسلة لكل طاولة.
- قواطع كهربائية بجهد (٣٣ كيلو فولت).
- عدد (٤٨) بطارية BESS (بطاريات أيون الليثيوم بقدرة (٢٠٠ميجاوات/ ساعة) لتخزين الطاقة الناتجة
- أنظمة التبريد لمنع ارتفاع درجات الحرارة بالبطاريات ... والتوزيع.

٥. الالتزام باستخدام التكنولوجيا ثنائية الوجه، كما ورد بالدراسة.

٦. الالتزام بطلاء أسطح الخلايا الكهروضوئية بطلاء مضاد للانعكاس وكذلك تلوين حواف الواح الخلايا بلون مغاير لتقليل تأثير (lake effect) على الطيور المهاجرة.

ل/ ابرانيا بولس

ع. أحمد ... ناجي

رئيس قطاع الإدارة البيئية

يعتمد

د/ شريف باز ٢٠٢٤/١٢/٨

هذه الموافقة من صفحتين (٢/١)

جمهورية مصر العربية
رئاسة مجلس الوزراء
وزارة البيئة
جهاز شئون البيئة

الإدارة المركزية ... ير البيئي
٢٠٢٤/١٢/٨
إدارة وثائق ... التأثير البيئي
٤٢٠٤٦

وزارة البيئة
MINISTRY OF ENVIRONMENT

335217

٧. الالتزام بعدم زيادة ارتفاع نظام تثبيت الالواح عن ١,٥ متر من الأرض كما ورد بالدراسة.
٨. الالتزام باستخدام الألومنيوم والصلب في أنظمة التركيب نظرا لقابلية إعادة تدويرها في نهاية المشروع مما يقلل من البصمة البيئية.
٩. الالتزام بإقامة سور حول المحطة بفتحات من الاسفل بارتفاع مناسب تسمح بمرور الكائنات الحية دون قيود.
١٠. الالتزام بالصيانة والتنظيف الدوري والمستمر للخلايا الشمسية ومكونات المشروع، مع استخدام التنظيف الآلي الجاف (robotic) للألواح الشمسية بدون استخدام مياه، كما ورد بالدراسة.
١١. الالتزام بوضع خطة لتجنب الإضرار بالطيور وتقليل احتمالات اصطدام الطيور بالألواح الشمسية والبنية الأساسية المرتبطة بها، مع ضرورة أن يكون هناك مسئول عن البيئة بالموقع لرصد مكونات التنوع البيولوجي بالموقع.
١٢. الالتزام بوضع أجهزة انذار على الخلايا لتقليل الاصطدام.
١٣. الالتزام بوضع ملصقات توضح ضرورة الالتزام بالحفاظ على التنوع البيولوجي في جميع انحاء الموقع.
١٤. الالتزام بعدم تجاوز الحدود القصوى لملوثات الهواء بما يتفق مع الملاحق أرقام (٦،٥) من اللائحة التنفيذية المعدلة بالقرار رقم (١٠٩٥) لسنة ٢٠١١، خاصة أثناء مراحل الإنشاء والتشييد.
١٥. الالتزام بعدم تجاوز الحدود القصوى لمستويات الضوضاء أثناء عمليات التركيب، بما يتفق مع الملحق رقم (٧) من اللائحة التنفيذية وتعديلاتها.
١٦. الالتزام بعدم استخدام المياه الجوفية في المشروع.
١٧. الالتزام بالتنسيق مع الإدارة العامة للمرور فيما يخص تحرك المركبات لنقل المعدات والمواد اللازمة خلال فترة الإنشاء والتشييد.
١٨. الالتزام بإعادة تأهيل الموقع لأصله في حالة الاغلاق للمشروع.
١٩. الالتزام بالتخلص من مخلفات الصرف الصحي عن طريق تجميعها في خزانات معزولة ومحكمة الغلق معدة خصيصا لهذا الغرض وتسليمها لمتعهد معتمد وحاصل على الموافقة البيئية للتخلص النهائي منها طبقا للمعايير والقوانين المنظمة لذلك، كما ورد بالدراسة.
٢٠. التداول السليم والأمن بيئياً للمواد الخطرة المستخدمة طبقاً للمادة رقم (٦٠) من القانون رقم (٢٠٢) لسنة ٢٠٢٠ بشأن تنظيم إدارة المخلفات.
٢١. الالتزام بالتخلص السليم بيئيا من المخلفات الغير قابلة لإعادة التدوير (المكونات الإلكترونية) عن طريق تجميعها وتسليمها لمتعهد معتمد حاصل على الموافقة البيئية لإعادة تدويرها أو التخلص الآمن منها في الأماكن المخصصة لذلك.
٢٢. الالتزام بالتخلص السليم بيئيا من المخلفات الصلبة الناجمة عن عمليات الإنشاء والتركيب والتشغيل بشكل دوري منتظم عن طريق تجميعها وتسليمها لمتعهد معتمد حاصل على الموافقة البيئية للتخلص منها في الأماكن المخصصة لذلك.
٢٣. الالتزام بالتخلص السليم والأمن من المخلفات السائلة الخطرة (الزيوت والشحوم) عن طريق تجميعها وتسليمها لمتعهد معتمد وحاصل على الموافقة البيئية للتخلص النهائي منها طبقا للمعايير والقوانين المنظمة لذلك، كما ورد بالدراسة.
٢٤. الالتزام بالتخلص السليم والأمن بيئياً من المخلفات الصلبة الخطرة الناتجة عن النشاط (هوالك الخلايا الشمسية، الخلايا المتقادمة، البطاريات المستهلكة، .... إلخ) بتجميعها وتسليمها لمتعهد معتمد حاصل على الموافقة البيئية للتخلص النهائي منها، طبقا للمعايير والقوانين المنظمة لذلك، كما ورد بالدراسة.
٢٥. الالتزام بخطة الإدارة البيئية والرصد الدوري، مع ضرورة تدوين نتائج القياسات في السجل البيئي
٢٦. إعداد السجل البيئي للنشاط طبقا للمادة (٢٢) من القانون (٤) لسنة ١٩٩٤، والمعدل بالقانون رقم (٩) لسنة ٢٠٠٩، وإعداد سجل للمخلفات الخطرة طبقاً للمادة رقم (٦٩) من القانون رقم (٢٠٢) لسنة ٢٠٢٠ بشأن تنظيم إدارة المخلفات، وجعلهم متاحين عند التفتيش البيئي.

هذه الموافقة من الناحية البيئية فقط دون الإخلال بالاشتراطات الإنشائية ودون الإخلال بأية قوانين أو قواعد أو قرارات أخرى تخص هذا النشاط، وفي حالة عدم الالتزام بأي شرط من الاشتراطات الموضحة بعاليه تعتبر هذه الموافقة لاغية.

له ارانيا يوس د. أحمد عبد العال

وتفضلوا بقبول فائق الاحترام ،،،

رئيس الإدارة المركزية لتقييم الأثر البيئي
(م/ فاطمة عبد الرحيم)

يعتمد،،،،
رئيس قطاع الإدارة البيئية
٢٠٢٤/١٢/٨
(م / نسرين محمد باز)

هذه الموافقة من صفحتين (٢-٢)

Annex 2: Flash flood

ONSHORE SUBSURFACE INVESTIGATION,
1GW SOLAR BESS – NAGA HAMADI, EGYPT

APPENDIX-F-1

HYDROLOGICAL STUDY

Prepared for

OBELISK SOLAR POWER SAE

Prepared by

HA ENGINEERING CONSULTING إتش إيه للاستشارات الهندسية

October, 2024

Rev 3

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Executive Summary

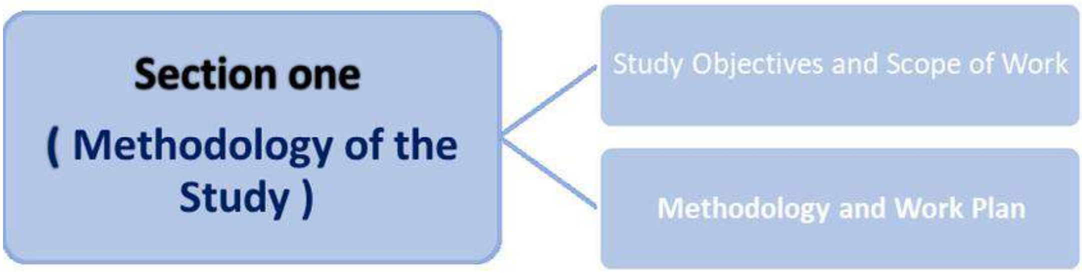
This document describes the results of work for the flood risk assessment to be undertaken for Naga Hamadi 1GW Solar + BESS project located in Egypt, Nagaa Hammadi in order to determine its vulnerability to flood hazards and proposed actions to protect the project boundary from the flood if necessary. Firstly, the collected data includes relevant maps, aerial imagery, and DSM Digital Surface Model for analyzing hydrological and meteorological information. Furthermore, the principles and design criteria used in the hydrological study are detailed. Next, the analysis of the collected data encompasses rainfall, the effects of climate change, and morphological analyses using the Digital Surface Model, and aerial imagery to determine topography and drainage basins. Finally, the output assesses the basic design of flood protection works and proposes additional measures. Figure 1 below presents the site location, as well as the GPS Coordinates.

Figure 1: Project location

The report includes two main parts. Part 1 includes 5 main sections as follows:

- **Section One: Methodology of the Study:** This section reviews the objective of the study and the steps taken in preparing the study.
- **Section two: Collected Data, Principles and Design Criteria:** This section reviews all available hydrological and meteorological information required for the hydrological analysis, relevant maps, aerial imagery, contour maps, topographical survey information required to define the project location, the extent, and characteristics of contributing catchments and to understand the presence and nature of any existing infrastructure (roads, power lines, etc.). The principles and design criteria used in the hydrological study of the project will be presented.
- **Section three: Description of the study area:** This section presents the description of the location of the study area.
- **Section four: Analytical Studies:** This section reviews the analytical studies of the collected data. The results of the metrological studies for the rainfall station affecting the study area. The results of the morphological analyzes of the study area using Digital Elevation Model, topographic maps available and recent aerial imagery, and contour maps to determine the overall topography of the study area and determine the streams and drainage basins affecting the project boundaries, if any, and to present the results of the hydrological study of the project.
- **Section five: Protection Works:** This section clarifies the assessment of the flood works in the basic design as well as the preliminary design for the proposed additional flood protection works.

The second part of the report contains the preliminary plans for the project.


Section one
(Methodology of the Study)
Study Objectives and Scope of Work
Methodology and Work Plan

1 Methodology of the Study

1.1 Study objectives and scope of work

The hydrological study aims to identify and define the hydrological conditions for the area of for Naga Hamadi 1GW Solar + BESS project, as well as identify the potential risks of the floods from outside the project.

The project's scope of work includes the following engineering tasks:

- Data collection;
- Design specifications and standards;
- Geological and geotechnical studies;
- Topographic and morphological studies;
- Design Return Period;
- Rainfall data analysis;
- Calculate the maximum flows and estimate the amounts of floods
- Proposed alternatives for the flood mitigation work.

1.2 Methodology and work plan

The integrated hydrological studies to prevent flood hazards are based on a series of steps that can be summarized in Figure 2, which also illustrates a simplified sketch of the relationship between the different elements of the study.

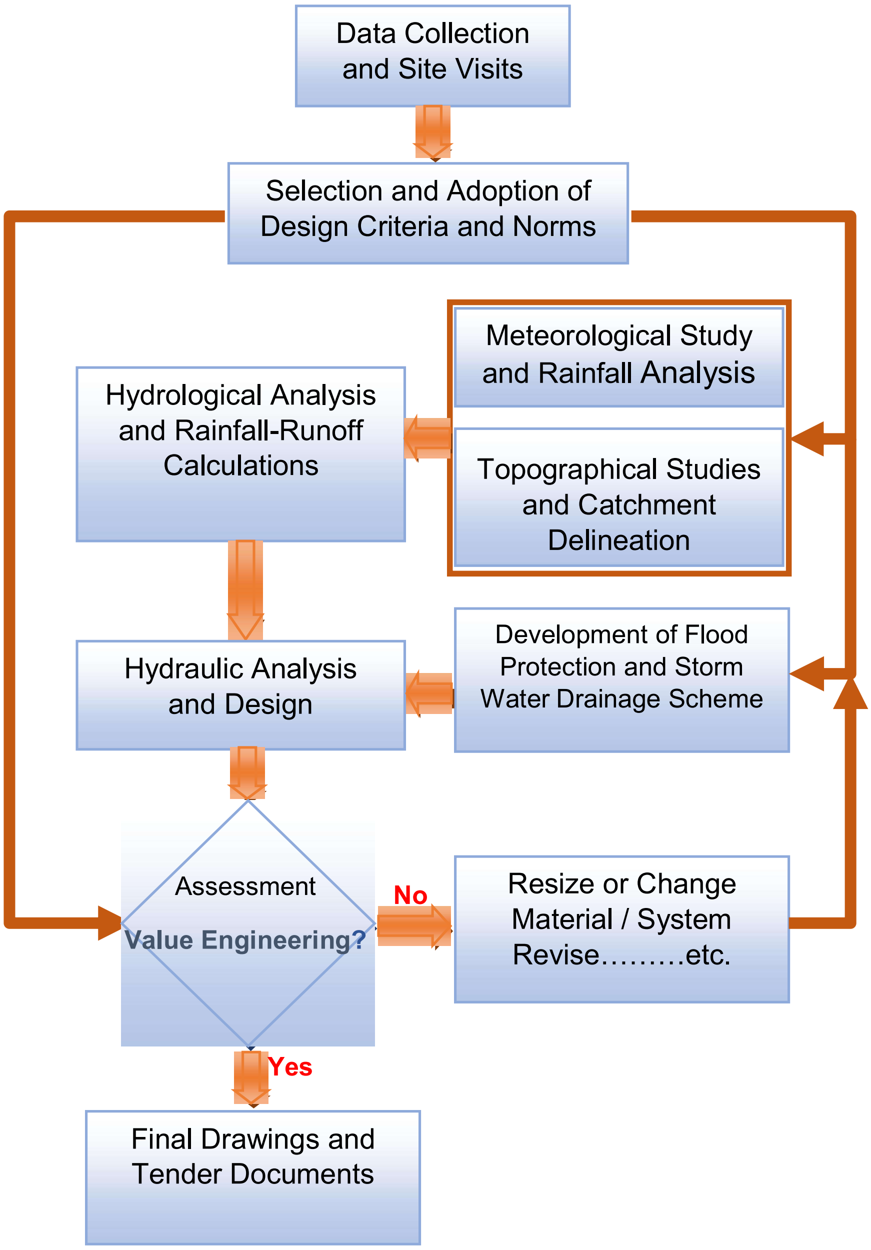


Figure 2: Work Plan Block Diagram


Section two (Collected Data, Principles and Design Criteria)
Data Collectiion
Principles and Design Criteria

2 Collected Data, Principles and Design Criteria

This section Reviews data collected from available geological maps, previous geological studies, land use maps and satellite images, and the characteristics of the land surface cover of the effective watersheds and loss coefficients of different catchments should be defined. If any testing is deemed to be required to obtain critical information for this aspect, these need to be performed and the results thereof provided. The principles and design criteria used in the hydrological study of the project will be presented.

2.1 Data collection

All data and information on the study were collected from the official authorities concerned with the study. The following is a list of the most important information and data collected for analysis and use in the hydrological study of the project:

- Project boundary.
- Rainfall station data affecting the study area.
- Soil and Land formation maps for the study area.
- Digital Elevation Model (DEM) ALOS 30*30 meter.
- Satellite images.
- Topographic maps of the study area.

Digital Elevation Models (DEM) for the whole study area were collected and obtained from the ALOS 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 ALOS data are widely used in the identification of drainage basins for hydrological analysis work in many research and advisory bodies. Figure 3 presents the digital elevation model used in the study.

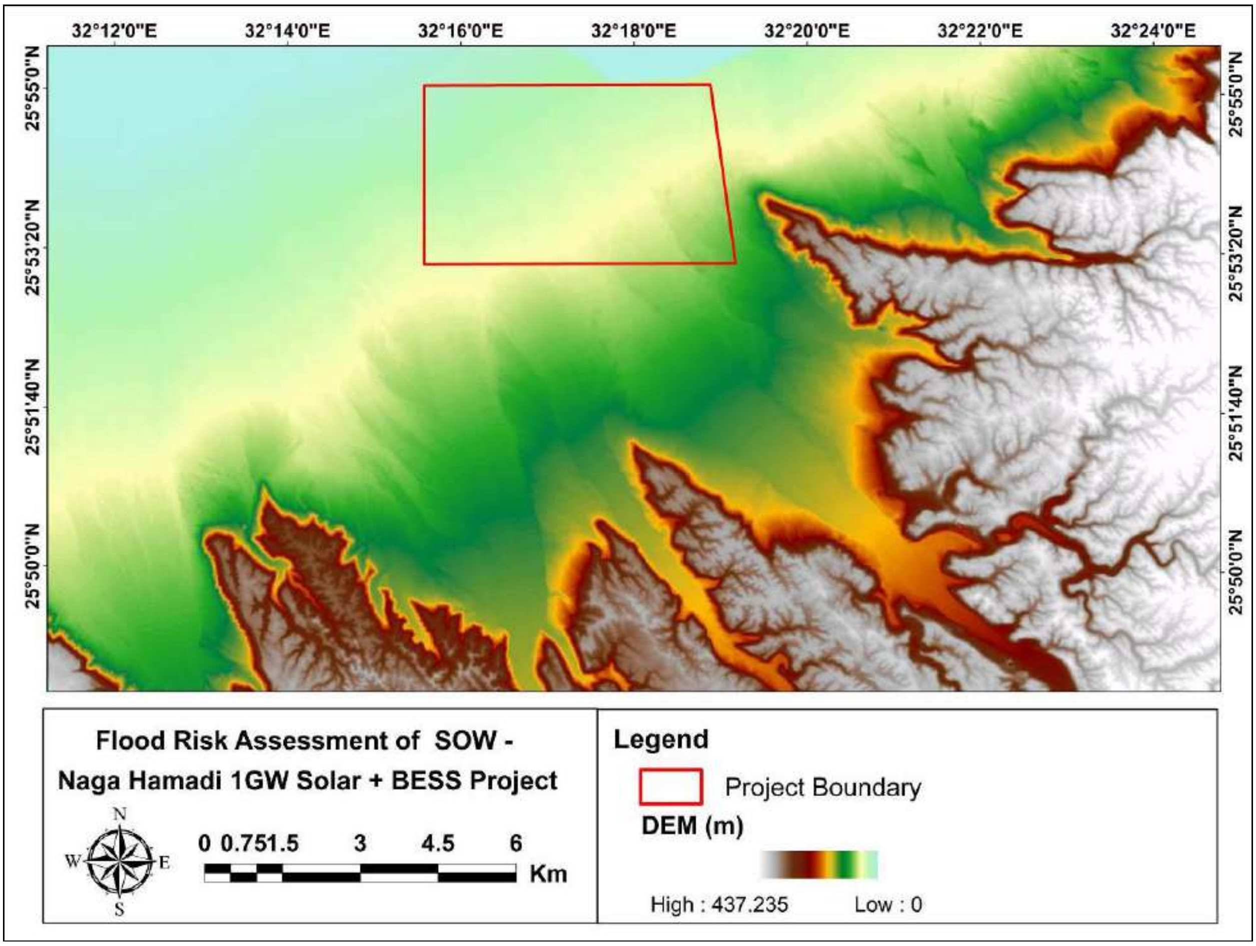


Figure 3 : Digital Elevation Models (DEM) for the study area

While Figure 4 shows the topographic map of the study area on a scale of 1: 50,000 obtained from the Egypt Geological Survey.

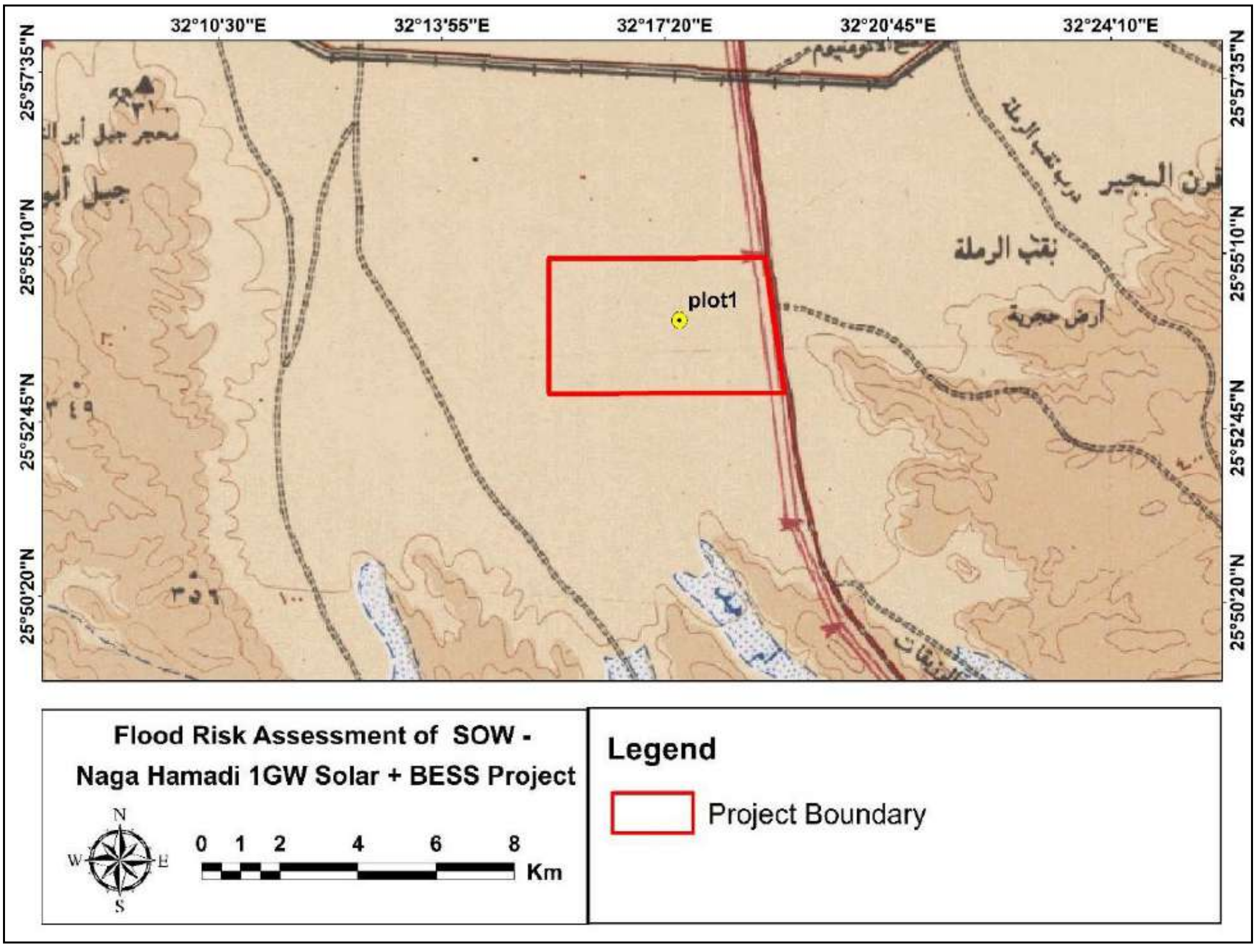


Figure 4: Topographic maps scale 1:50,000 For the study area

Satellite images were collected for the study area to be 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.

Figure 5 shows the satellite image collected for the study area and used to determine the nature of the surface cover and the surface soil because it is important in determining the runoff coefficients that are necessary to calculate the values of design discharges.

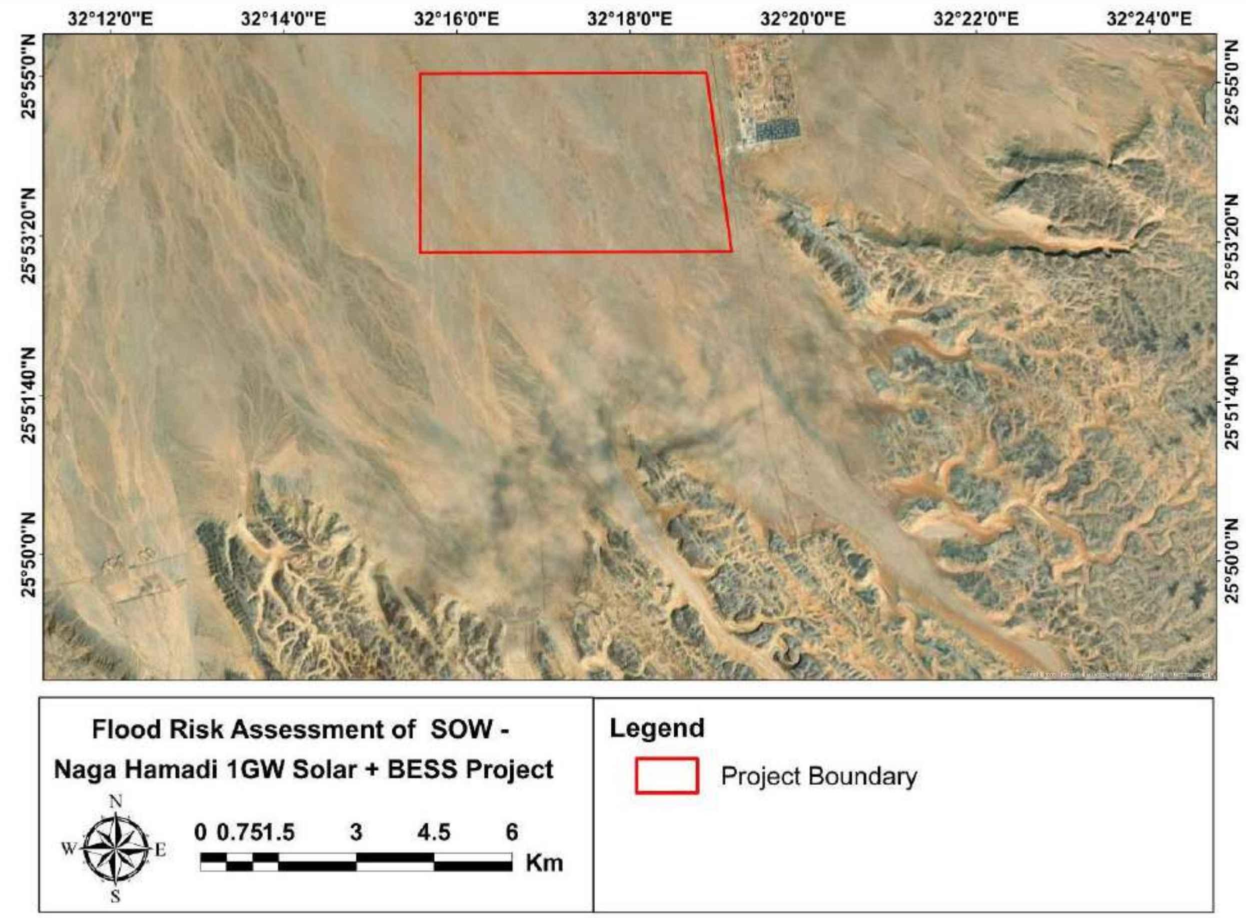


Figure 5: Satellite image of the study area

Figure 6 shows an example of the geological maps used in the preparation of the study.

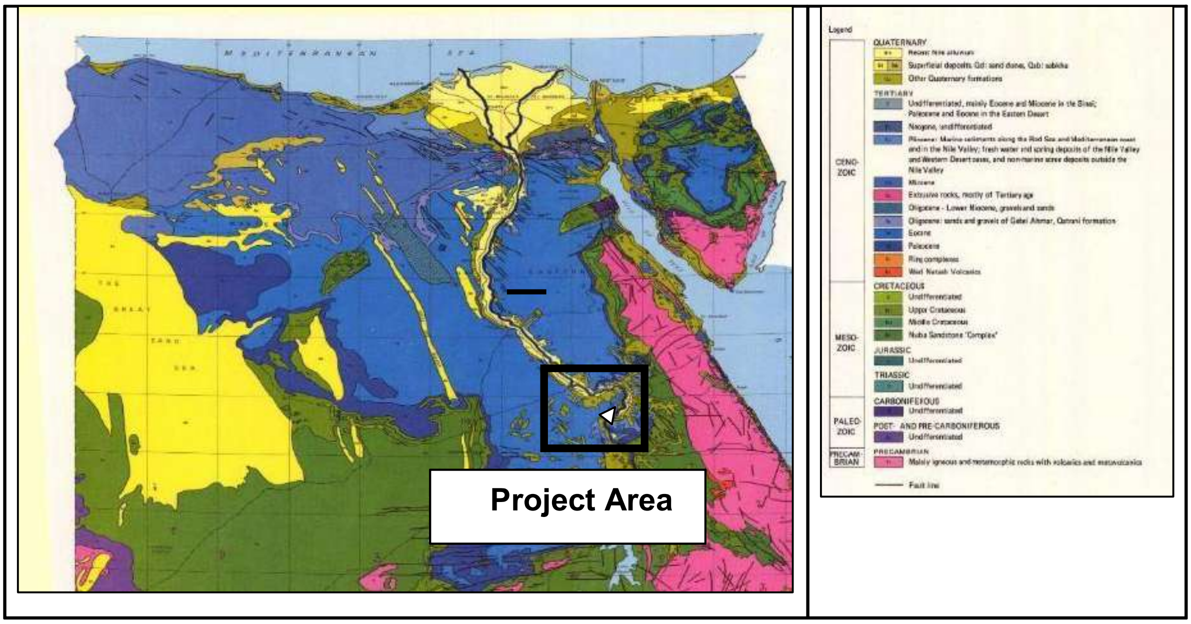


Figure 6: Geological map of Egypt

2.2 Principles and design criteria

The hydrological and hydraulic designs are based on the Egyptian code for flood hazard mitigation and consider the standard equations and methods used worldwide.

2.2.1 Computer Models and Software Packages

The most advanced programs and numerical models were used in the calculation, hydrological and hydraulic analysis of catchment areas and proposed protection works. The following are the main programs and models that were used in the conceptual stage of the study and which will be used in the detailed stage (next phase) as well:

- GIS techniques (Arc-Hydro Tools, Spatial Analyst, etc…) were used to delineate the watersheds, estimate watershed characteristics and develop runoff coefficient maps.

- HEC-SSP 2.3 was used to conduct a frequency analysis for the collected rainfall data records.
- HECHMS (by USACE) and some developed in-house spreadsheet (MS Excel) is used to estimate the peak flow and to estimate the other hydrologic parameters whenever needed.
- CulvertMaster to evaluate the existing culverts and to perform the hydraulic design of the proposed culverts and (FlowMaster) in the hydraulic design of the proposed channels and to determine the width of water in the roads (Water Spread)
- HECRAS 2D (by USACE) in determining the boundaries of the valleys that affect the study area for a return period of 25, 50 and 100 years.

2.2.2 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 in Egypt are (Rational Method) and (SCS Unit Hydrograph).

Table 1 shows the standards and limitations for using these methods according to the area of the catchment affecting the proposed project location.

Table 1: Limitations for the rainfall-runoff calculation methods

Catchments Area	Proposed Equation
A [illegible] 100 Ha.	Rational Method
A [illegible] 100 Ha.	SCS Method

The following is an explanation of both methods and how they are applied to estimate peak flows and runoff hydrograph for catchment areas affecting the project boundary.

2.2.2.1 Rational Method

As shown in Table 2, the rational method is recommended for catchments areas less than or equal to 100 hectares. It is a simple empirical formula that relates rainfall intensity to runoff and yields a peak discharge. The formula reads:

$$Q = \frac{C.I.A}{360}$$

Where:
Q, is the peak discharge, m^3/s;
I, Precipitation intensity or precipitation abundance (mm /hr.) which is calculated from the curves of intensity, duration and frequency (IDF Curves), which is the amount of precipitation during a specified time equal to the time of concentration (Tc) and corresponding to a storm with an appropriate return period.
A, is the drainage area, ha.
C, Runoff Coefficient: Runoff coefficient is the ratio of rainfall flowing from drainage basins. This coefficient is affected by the nature of the drainage basin such as land use, soil cover, vegetation cover, soil infiltration capacity and other hydrological obstacles. Flow coefficient is determined based on experience and engineering practice, available maps and satellite images.

The Runoff coefficient (C) is available from the Ministry of Transport (MOT) design manual is determined according to the conditions of the site as shown in Table 2.

Table 2: Runoff Coefficient for Rational method

A - Relief	B - Soil Infiltration	C -Vegetal Cover	D -Surface Storage
0.4 **Steep rugged terrain Average slopes greater than 30%**	**0.20** **No effective soil cover; either rock or thin mantle; negligible infiltration capacity**	**0.20** **No effective plant cover; bare or very sparse soil cover**	**0.20** **Negligible: surface depression few and shallow; drainage ways steep and small, no ponds or marshes 30%**
0.30 **Hilly with average slopes of 10 to 30%**	**0.15** **Slow to take up water; clay; or other soil of low infiltration**	**0.15** **Poor to fair; clean cultivated crops or poor natural cover; less than**	**0.15** **Low; well defined system of small drainage ways, no ponds of marshes.**

A - Relief	B - Soil Infiltration	C -Vegetal Cover	D -Surface Storage
	capacity such as heavy gumbo	10% of area under good cover	
0.20 Rolling with average slopes of 5 to 10%	**0.10** Normal, deep loam	**0.10** Fair to good, about 50% of area in good grass land woodland or equivalent cover	**0.10** Normal; considerable surface depression storage; typical of prairie lands, lakes, ponds, and marshes less than 20% of area
0.10 Relatively flat land average slopes 0 to 5%	**0.05** High, deep sand or other soil that takes up water readily and rapidly	**0.05** Good to excellent; about 50% of area in good grass land; woodland or equivalent	**0.05** High, surface depression storage high; drainage system not sharply defined, large flood plain storage; large number of ponds and marshes

In case of variable type areas then the average areal runoff coefficient is calculated as follows:

$$C = \frac{C_1 A_1 + C_2 A_2 + \ldots + C_n A_n}{A_2 + A_2 + \ldots + A_n}$$

Whereas $C_1 \ldots C_n$ are the runoff coefficients for the sub-catchments areas $A_1 \ldots A_n$ respectively.

The time of concentration is generally defined as the time required for runoff to travel from the remotest point in the watershed to the point of discharge and the most commonly adopted equation for calculation of time of concentration is kirpich equation which is:

$$Tc = 0.0195\left(\frac{L}{\sqrt{S}}\right)^{0.77}$$

$T_{c:}$ time of concentration (minutes)

L, is the horizontally projected length of flow, in m; and

S, is the longitudinal slope of the water path, in m/m, between the furthest point of the catchment and the outlet.

2.2.2.2 SCS Unit Hydrograph Method

This method is used to estimate surface runoff, determine the peak flows and runoff hydrographs after estimating the value of the different losses of rainfall falling on the catchment area according to soil characteristics and land uses. These losses are expressed by a factor called the (Runoff Curve Number), This method is used to calculate flows from catchments of area more than 100 ha or 1 km^2.

This method is based mainly on the accurate estimation of the following hydrological processes of the design storm:

- Storm distribution over time
- 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 maximum loss or storage that may occur in soil of drainage basin(S) as well as the initial abstraction value (Ia) expected to occur in the drainage basin is determined using the following equation:

$$S=25.4\ [1000/(CN-10)]$$

$$I_a = 0.2S$$

whereas:

S - maximum soil storage depth, mm;

CN - Curve number according to the nature of the drainage basin;

I_a - Initial abstraction (at the beginning of rainstorm) mm;

The values of the curve number are estimated according to the geological maps and the aerial photographs and according to Table 3 taken from the values of arid and semi-arid areas as mentioned in technical release No. 55 (TR-55), which is one of the most widely used standards in the field of hydrology.

Table 3: The Curve Number for Arid and Semi-Arid Regions as reported in Technical Release No. 55 (TR-55)

Cover description		Curve numbers for hydrologic soil group			
Cover Type	Hydrologic condition[2]	A[3]	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosote bush, black brush, bursage, PaloVerde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

[1] Average runoff condition, and Ia, = 0.2S.

[2] Poor: <30% ground cover (litter, grass, and brush).

Fair: 30 to 70% ground cover.

Good: > 70% ground cover.

[3] Curve numbers for group A have been developed only for desert shrub.

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 form resulted from (SCS-Unit hydrograph method) depends on the area of the drainage basin and the Lag time (T_{lag}), as the lag time is estimated to be 0.6 of the concentration time (Tc) of the basin.

The following equation is used to calculate the peak flows from the drainage basin (Qp) as a result of 1 mm runoff depth.

$$Q_p = \frac{2.08A}{T_R}$$

where:

Qp – unit peak flow, m^3 / s;

A - drainage basin area, km²;

T_R - The time required for the peak flow to occur (hour), it is equal to the lag time (T_{lag}) plus half the storm duration.

2.3 Hydraulic Design Standards

2.3.1 Open channels

Manning's equation is commonly used to determine the velocity in open channels/ gravitational storm drainage pipes under uniform flow conditions. The equation is expressed as follows:

$$V = \frac{1}{n} R^{2/3} S^{0.5}$$

Where

V, is the mean velocity of flow, in m/s;

n, is the Manning's roughness coefficient for open channel flow, n should be taken from appropriate tables, depending on channel types and materials, etc.

R, is the hydraulic radius in m; and S, is the slope of energy grade line, or channel bed slope, in m/m.
The capacity of an open channel has been determined from the continuity equation:

$$Q = A.V$$

Where

Q is the flow rate in m^3/s,

V, the velocity in m/s,

A is the flow area of cross section, A in m^2.

2.3.1.1 Acceptable Free board

The minimum permissible vertical distance from the maximum water surface of the channel to the top bank of the channel is 25 cm. and to be taken into consideration that the higher return period flows behavior and its effect on both sides of the channel, as well as the effect of horizontal curves in the channel path at the water depth in the water sector should be studied.

2.3.1.2 Design velocities for open channels and pipes

- The design velocities for the flow should be non-settling and non-eroding. Minimum velocities should be self-cleansing and prevent solids sedimentation in the drainage.

- A minimum velocity of 0.75 m/sec is required in channels for self-cleansing.

- Maximum velocities in channels with lined sides only, preferably no more than 3.0 m/s for grouted riprap and 4.5 m/s for reinforced concrete.

- Maximum velocities in fully lined channels preferably not more than 4.5 m/s for grouted riprap and 6.0 m/s for reinforced concrete.

2.3.2 Culverts

For the design of culverts, the following conditions must be considered:

- Minimum size of box culvert is one vent with dimensions of 1.5x1.5 m.
- Minimum cover above the culvert is 1 m.
- The maximum water level in the upstream before entering the culvert should not exceed 1.2 x (height of the culvert).
- Protection should be provided at the culvert outlet and inlet to prevent scour; loose riprap is recommended at earth channels, particularly when flow velocity is less than 6.5 m/s. and energy dissipaters when the velocity exceeds 6.5 m/sec.

In general, flow in culverts will take place under one of two conditions: outlet control or inlet control. In the case of inlet control, the inlet characteristics of the culvert are predominant in determining the headwater of the culvert. The following equations will be used for initial sizing of culverts as follow:

For Box Culverts

$$Q = n \times 1.5 \times W \times H^{1.5}$$

For Pipe Culverts

$$Q = n \times 1.232 \times D^{2.5}$$

Where

n, is the number of barrels;

W, is the width of box culvert in m;

H, is the height of box culvert in m,

D, is the diameter of pipe culvert in m.

Culvert Master software will be utilized to determine the size of the concerned culverts as well as to determine the headwater elevation and the outlet velocity. Also, design sheets developed using MS Excel were utilized to confirm the dimensions of the proposed culverts.

Reinforced concrete box culverts are recommended for watercourses where maximum flow and channel configuration permits. Box culverts of one barrel or multiple barrels are used in wadies and streams as needed. It is worth mentioning that in some wadies, culverts of multiple-barrels are used instead of bridges. This condition is recommended where the streambed is of very mild longitudinal slope, very wide, and the stream banks are not well defined. Several multi-barrel culverts could accommodate for the generated floods.

Inlet and outlet structures, with wing walls, have been provided to the ends of all culverts in order to reduce erosion of the embankment and the downstream slope, inhibit seepage, retain the fill, and make the ends structurally stable, as well as it may improve the hydraulic characteristics of the culvert.

2.3.3 Scour protection works

The scour and corrosion are a familiar situation occurring in the wadis and streams and at the drainage facilities such as the exits of the culverts and at the drainage points where the water velocity at the outlet in the culvert is greater than the velocity in the natural channels.

As mentioned above, the velocities at culverts exits are between 3 and 6 m / s and these values can be exceeded by culverts existing on steep slopes. Under these circumstances, a minimum level of protection should be provided against corrosion and scour factors. The aim of providing the required protection and quality is to resist the velocity of water flow taking into account the natural conditions of the site. Provided that the proposed protection facilities are capable of handling the design rainstorm (the design flows and the resulting velocities).

In general, appropriate protection works will be provided at the following locations:

- Inlet and outlet structures: loose riprap protection is recommended at the inlet and outlet structures of each culvert;
- Low points and depressions: Suitable types of protection, including grouted riprap and concrete lining, is recommended at the road embankment at low points and depressions where surface water is likely to collect or pond;
- Wadies: Suitable protection is recommended at the road embankment between culverts and their sides, particularly when used in wide streambeds, or at locations where the highway passes along streams.
- Protection works using concrete grooves in low areas of the road body
- Bridge foundations: It is recommended to use the necessary protective work at the retaining walls and the foundations of the bridges

The dimensions of riprap depend on the velocity at the inlet and outlet.
Isbach formula is used to estimate the D_{50} of riprap:

$$D_{50} = \frac{1}{\varphi^2} x \left(\frac{\gamma_w}{\gamma_s - \gamma_w} \right) x \frac{V^2}{2g}$$

Where
D_{50}: Mean diameter of riprap
φ : Empirical Coefficient (φ = 1.2)
γ_w : Specific gravity of water (γ_w = 1.00 t/m^3)
γ_s : Specific gravity of riprap stones (γ_s = 2.65 t/m^3)
g : Gravitational acceleration (g = 9.81 m/s^2)
V : Velocity of water (m/s)

The thickness of the riprap layer is considered equal to 2 x D_{50}.

The riprap length, as shown in the typical details, is considered equal to twice the height of the culvert.

2.3.4 The design return period

frequency of storms within a specified period of time 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 4 shows the adopted design return period for the different elements of the flood protection that can be used for the project.

Table 4: 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	10


Section three (Description of the study area)
General location of the study area

3 Description of the study area and site visit

3.1 Location of the study area

The project area is located in the Naga Hamadi, Egypt bounded by the Nile River 11.65 km from north and 41.40 km from east, the project is between 25.89 ° and 25.92 ° lat. and between 32.26 ° and 32.32 ° long as shown in Figure 7.

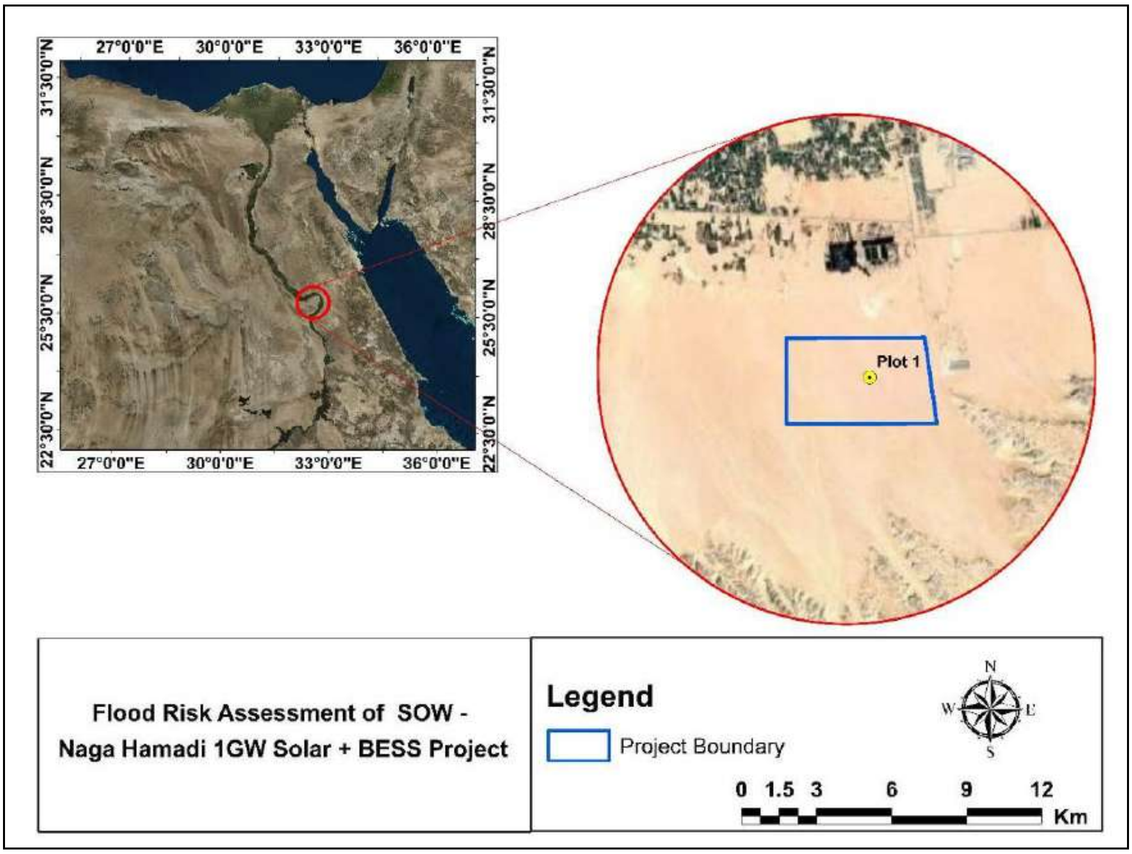


Figure 7: Project location


Section four (Analytical studies)
Meteorological studies (Rainfall analysis)
Morphological analysis

4 Analytical studies

4.1 Meteorological 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 8 shows the average distribution of the maximum daily rainfall depth values in Egypt, indicating that the averages range from 0 to 50 mm in different parts and reach over 50 mm on the west coast, Sinai Peninsula and the Red Sea Mountains.

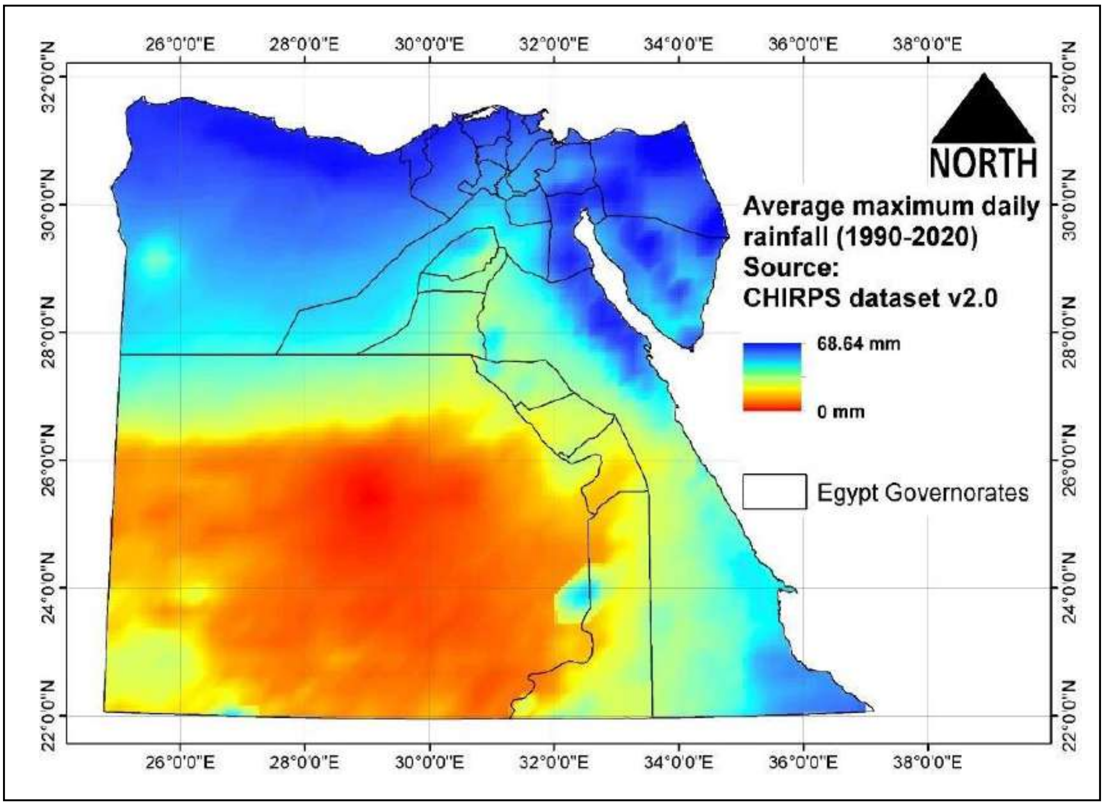


Figure 8: Distribution of average annual rainfall depth values for Egypt 1990-2020

As a result of the metrological studies of the region, the summers are long, hot, humid, arid, and clear and the winters are cool, dry, and mostly clear. Over the year, the temperature typically varies from 12°C to 35°C and is rarely below 7°C or above 36°C.

Luxor Station was chosen because it is close to the site of the project with data available as it covers about 60 years, which is sufficient for statistical analysis for periods of higher frequency. Figure 9 shows the Location of the station concerning the project site. Data for the station were collected between 1961 and 2020. Figure 10 and Table 5 show the daily values of the depth of rainfall (1961-2020) for Luxor station, the maximum value recorded during this period is 21 mm, which was recorded in 2008.

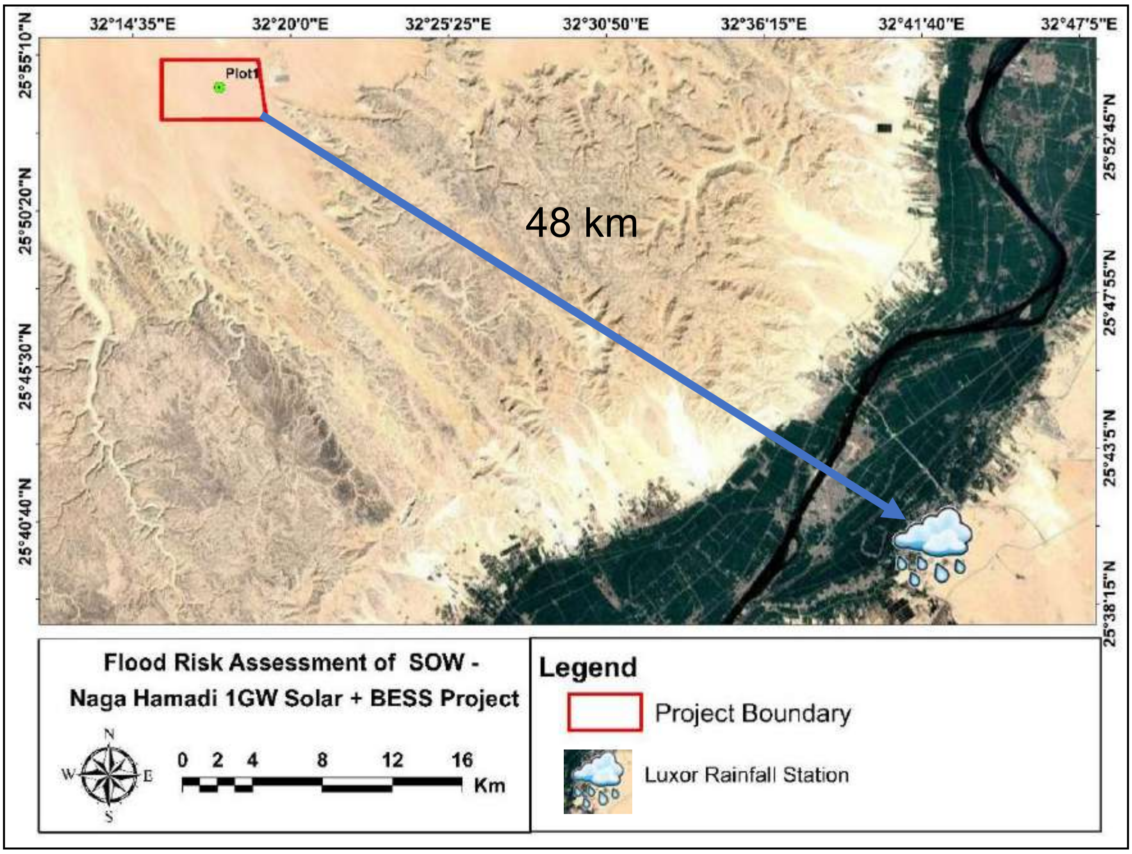


Figure 9: location of the rainfall station

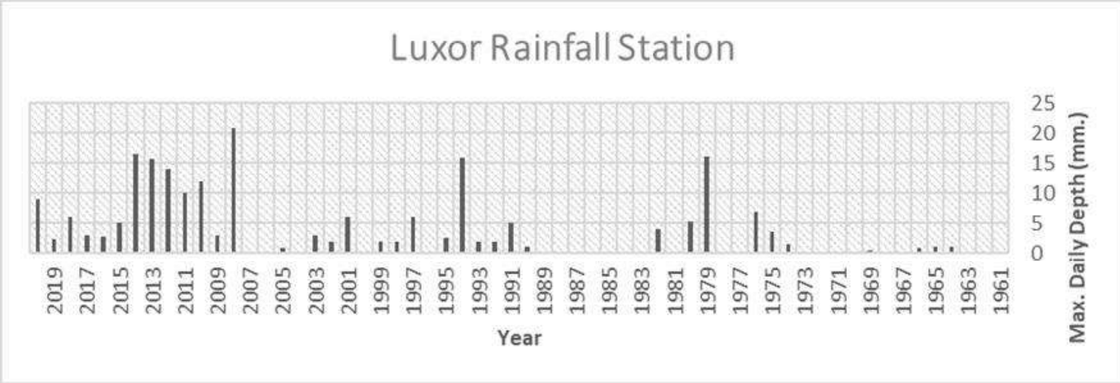


Figure 10: the max. Daily annual rainfall for city of Luxor

Table 5: The maximum daily annual rainfall in the period from 1961 to 2020 for city of Luxor

Year	Max Depth (mm)	Year	Max Depth (mm)
1961	0.0	1988	0.1
1962	0.0	1989	0.1
1963	0.1	1990	1.1
1964	1.0	1991	5.0
1965	1.0	1992	2.0
1966	0.9	1993	2.0
1967	0.1	1994	16.0
1968	0.1	1995	2.5
1969	0.5	1996	0.0
1970	0.1	1997	6.0
1971	0.1	1998	2.0
1972	0.1	1999	2.0
1973	0.1	2000	0.2
1974	1.6	2001	6.0
1975	3.6	2002	2.0
1976	7.0	2003	3.0
1977	0.1	2004	0.0
1978	0.1	2005	0.8
1979	16.2	2006	0.0
1980	5.2	2007	0.0
1981	0.0	2008	21.0
1982	0.4	2009	3.0
1983	0.1	2010	12.0
1984	0.1	2011	10.0
1985	0.1	2012	14.1
1986	0.1	2013	15.6

Year	Max Depth (mm)	Year	Max Depth (mm)
1987	0.1	2014	16.5
2015	5.0	2018	6.0
2016	2.8	2019	2.3
2017	3.0	2020	9.0

4.1.1 Daily Maximum Rainfall Analysis

Statistical analysis of the maximum values of daily rainfall was performed for the station and statistical distributions were used and tested to obtain rainfall values at different return periods. Using the statistical analysis software HEC-SSP and the application of a set of different statistical to choose the most appropriate to represent the data of rainfall station, such as:

- LOGPEAARSON III Statistical Distribution

The following Figure 11 shows the distribution of the Luxor station.

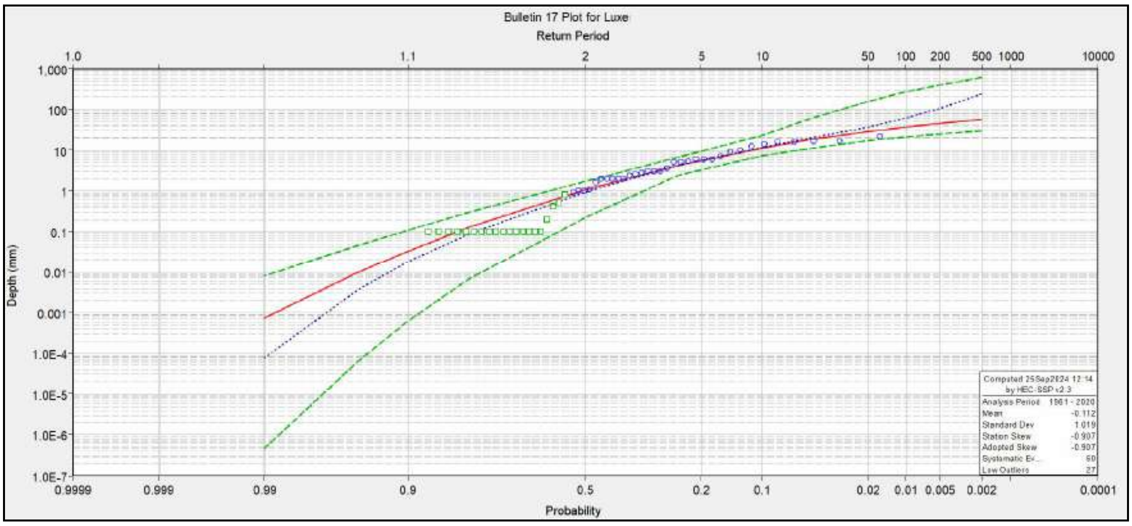


Figure 11: Statistical Distribution LOGPEAARSON III

According to the statistical characteristics of the distribution, the best statistical distribution was found to be **LOGPEAARSON III.** Moreover, based on Hydrological study procedure, the impact of climate change on IDF curves and floods was taken into consideration by applying a 10% increase to the precipitation values for each return period. Table 6 shows the result of the statistical analysis and the design storm values for the station for different return periods.

Table 6: Maximum daily annual rainfall depth corresponding to different return periods for rainfall stations

Return Period (Year)	200	100	50	25	10
Maximum daily annual rainfall depth (mm) without 10% climate change	52.67	**42.86**	**33.06**	**23.83**	13.00
Maximum daily annual rainfall depth (mm) with 10% climate change	57.94	**47.15**	**36.37**	**26.21**	14.30

These values were used to develop the intensity, duration and frequency (IDF) curves of the station as shown in Figure 12 using Bells' ratios shown in Table 7 due to the absence of short-term rainfall data in the study area.

Table 7: (Bells' Ratios)

Duration (minutes)	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

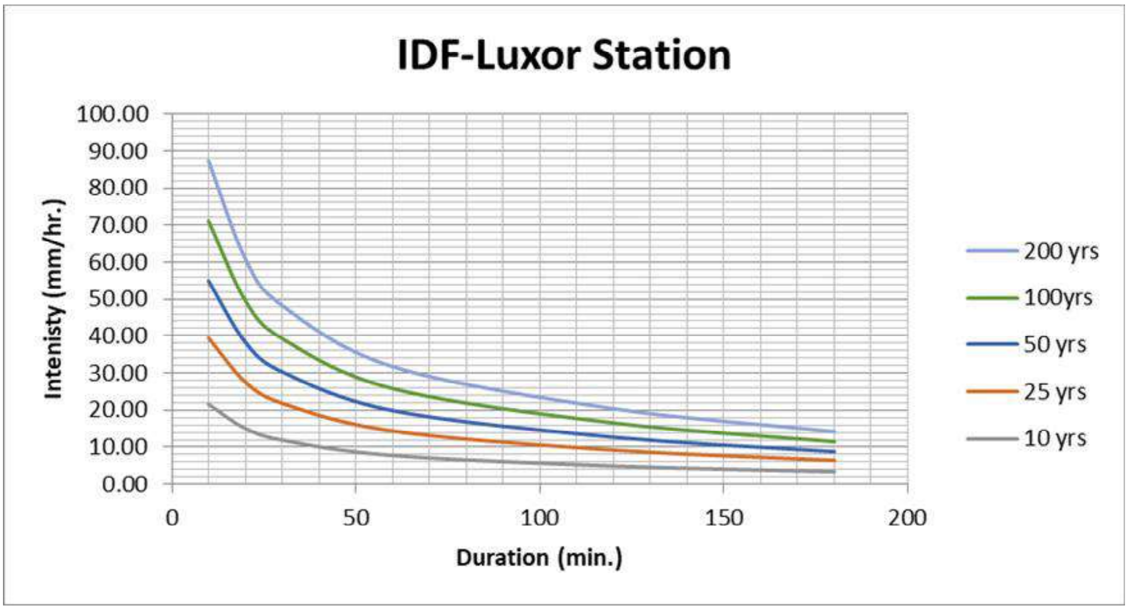


Figure 12: IDF Curve for city of Luxor

4.2 Geomorphological studies

4.2.1 Morphological studies

Morphological studies and identification of streams and drainage basins affecting the boundaries of the study area were performed using Digital Elevation Models (DEM) within ArcGIS using ArcHydro Tools as shown in Figure 13. The natural wadis are defined until the end of the mountains. Beyond this point, the wadi becomes very wide, acting like a sheet flow with no defined streams. This issue is simulated in the HEC-RAS 2D model shown in the appendix. Moreover, it is observed from flood inundation resulting from HEC-RAS 2D model that there is sand dunes and natural obstacles that trapping the flow.

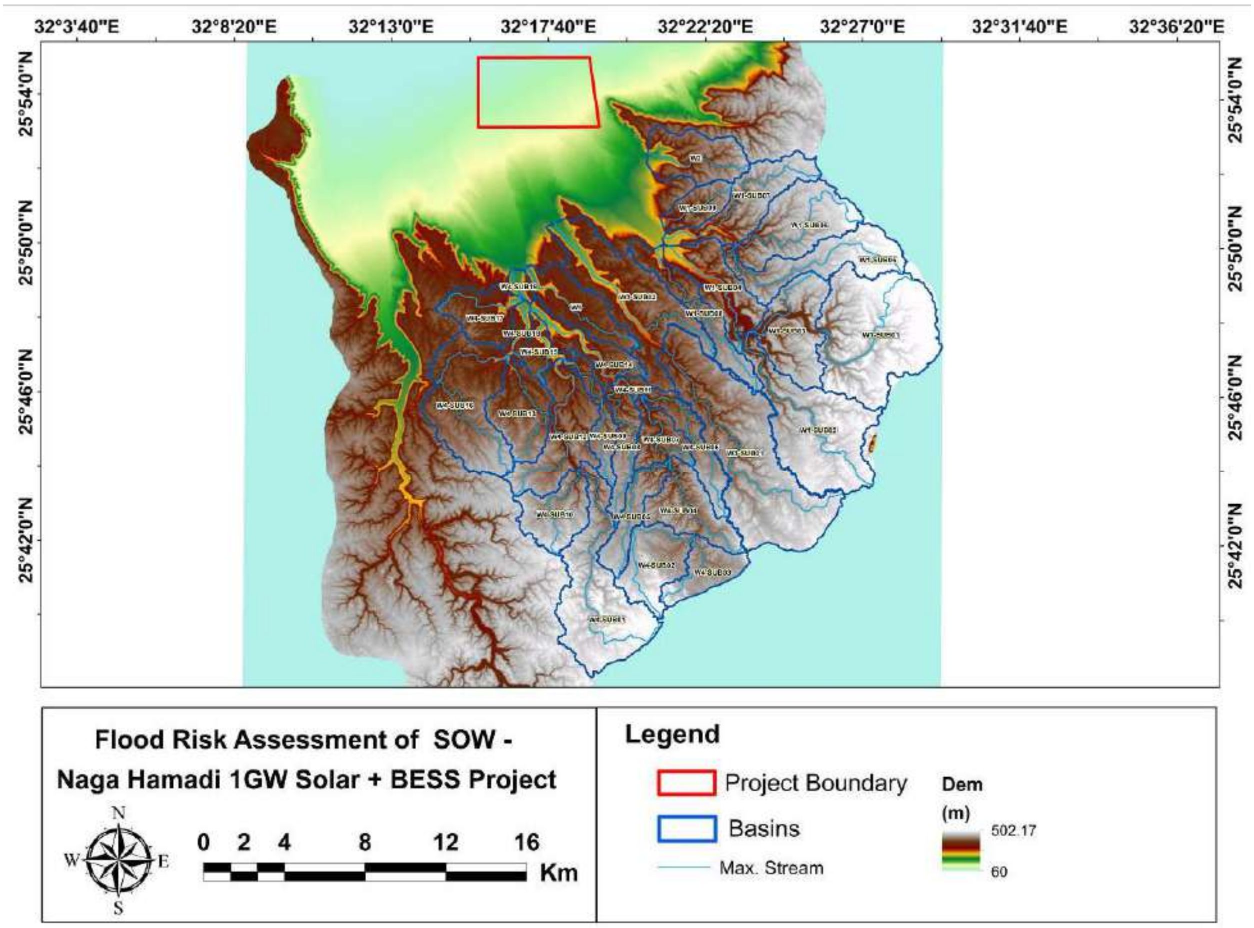


Figure 13: The drainage basins and its sub-basins that affecting the study area using digital elevation models and ArcGIS

The topographic maps collected with scale 1:50,000 and recent satellite images were used to check the results of the GIS software. 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 shows the elevations and contour lines, which is 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 such as (area, longest flow path, slope, ...etc.), also the topographic maps shows some important elements such as roads, power lines and others. Figure 14 & Figure 15 shows the main streams and the main catchment areas affecting the study area after being checked and verified by using topographic maps and satellite images.

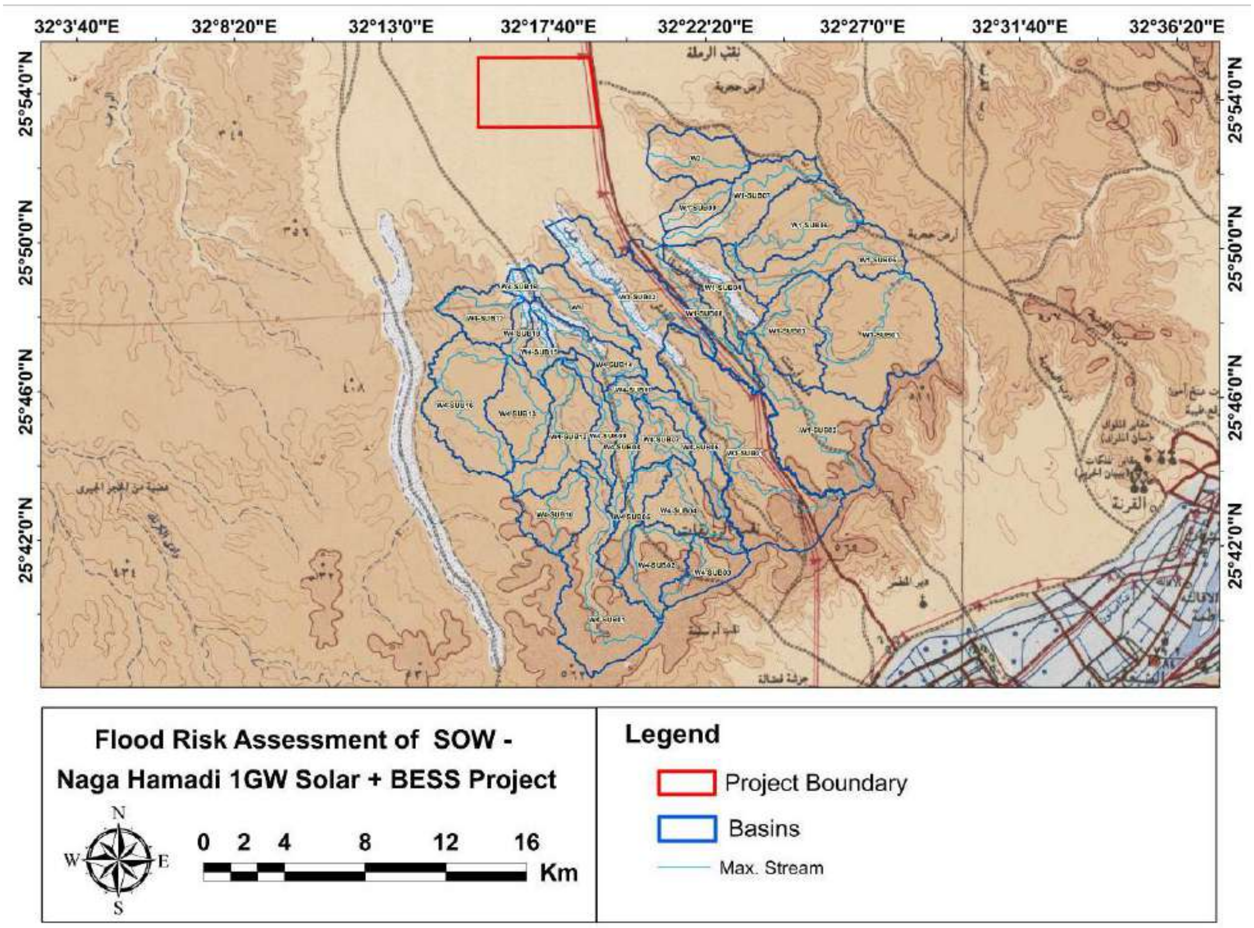


Figure 14: The drainage basins and its sub-basins that affecting the study area on topographic maps

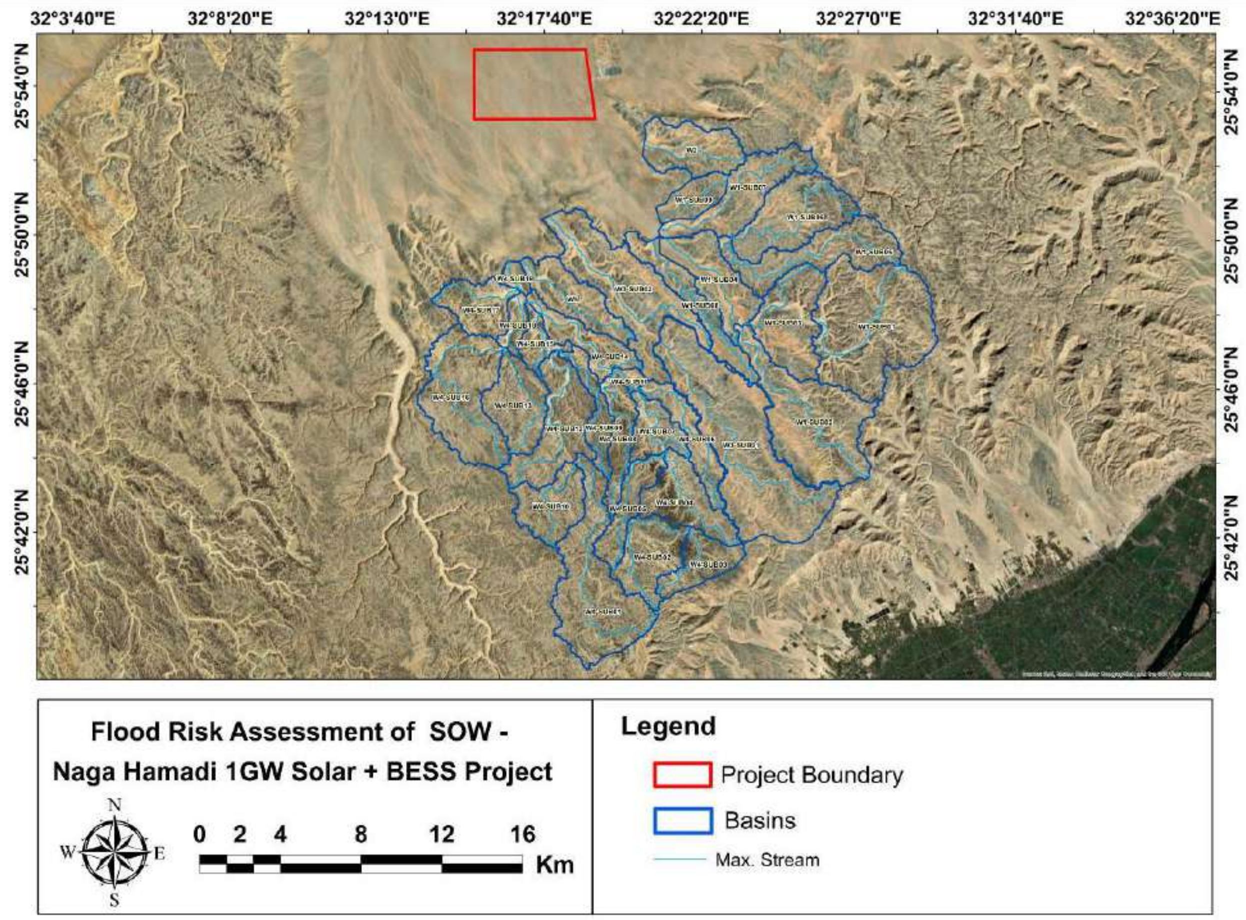


Figure 15: The drainage basins and its sub-basins that affecting the study area on Satellite image

The results of the geomorphological study for the study area were shown by using the digital elevation models, the satellite images and the topographic maps on scale 1: 50,000. There are 8 drainage basins that attack the project area with different characteristics. Different morphological parameters of the streams were identified. These parameters are:

1- Drainage basin boundaries.
2- Longest flow path of the stream.
3- drainage basin area.
4- Stream slope
5- Shape of drainage basin.
6- Time of concentration

4.2.2 Geological study

The geological and geotechnical characteristics of the study area should be determined in order to determine the general soil type in the study area, the composition of the rock, the infiltration rates and the groundwater condition. This helps directly determine the runoff coefficient for the soil. This information can also be verified by site visits from specialists and satellite images.

The geological study of the area was conducted to identify the nature of soil and its constituent layers using geological maps as shown in Figure 16

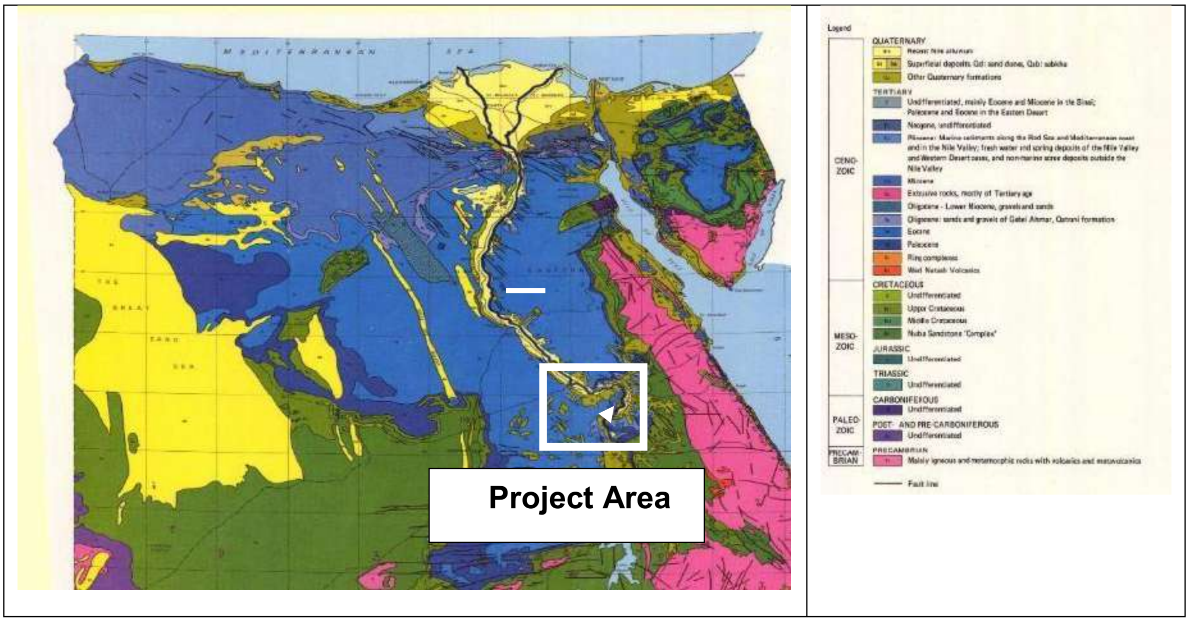


Figure 16: Geological map – Egypt

Table 8 shows the Geomorphological parameters of catchment areas that affecting the project boundary

Table 8: Geomorphological parameters of catchment areas that affecting the project boundary

Watershed	Watershed area (ha)	Longest flow path (m)	Slope (%)	C	CN	Time of concentration (min)	Lag time (min)
W1	SCS	-	-	-	-	-	-
W1-SUB01	SCS	11731	0.01	-	84.61	195.54	117.32
W1-SUB02	SCS	14846	0.01	-	80.46	234.30	140.58
W1-SUB03	SCS	7355	0.01	-	83.31	109.88	65.93
W1-SUB04	SCS	9109	0.01	-	82.56	137.45	82.47
W1-SUB05	SCS	14365	0.01	-	83.48	213.94	128.36
W1-SUB06	SCS	12243	0.01	-	82.94	187.52	112.51

Watershed	Watershed area (ha)	Longest flow path (m)	Slope (%)	C	CN	Time of concentration (min)	Lag time (min)
W1-SUB07	SCS	12197	0.02	-	81.28	172.11	103.26
W1-SUB08	SCS	12653	0.01	-	80.08	185.35	111.21
W1-SUB09	SCS	4938	0.02	-	78.81	63.81	38.28
W2	SCS	6681	0.03	-	77.75	84.96	50.98
W3	SCS	-	-	-	-	-	-
W3-SUB01	SCS	18506	0.01	-	81.30	311.15	186.69
W3-SUB02	SCS	15155	0.01	-	80.23	218.83	131.30
W4		-	-	-	-	-	-
W4-SUB01	SCS	16907	0.01	-	79.07	270.46	162.28
W4-SUB02	SCS	9969	0.01	-	80.18	179.55	107.73
W4-SUB03	SCS	5697	0.01	-	84.41	105.57	63.34
W4-SUB04	SCS	8252	0.01	-	83.06	146.90	88.14
W4-SUB05	SCS	9241	0.01	-	81.33	152.43	91.46
W4-SUB06	SCS	10653	0.01	-	79.96	161.11	96.67
W4-SUB07	SCS	7936	0.01	-	82.64	137.94	82.77
W4-SUB08	SCS	10143	0.00	-	83.97	250.44	150.27
W4-SUB09	SCS	9442	0.01	-	83.78	144.42	86.65
W4-SUB10	SCS	6429	0.02	-	80.07	98.13	58.88
W4-SUB11	SCS	2984	0.02	-	84.43	46.44	27.86
W4-SUB12	SCS	11647	0.01	-	81.92	169.41	101.64
W4-SUB13	SCS	8300	0.01	-	79.53	116.33	69.80
W4-SUB14	SCS	10056	0.02	-	79.89	150.51	90.31
W4-SUB15	SCS	4931	0.00	-	81.54	199.88	119.93

Watershed	Watershed area (ha)	Longest flow path (m)	Slope (%)	C	CN	Time of concentration (min)	Lag time (min)
W4-SUB16	SCS	13551	0.01	-	80.60	202.97	121.78
W4-SUB17	SCS	6409	0.03	-	78.29	95.54	57.32
W4-SUB18	SCS	3755	0.01	-	80.65	65.38	39.23
W4-SUB19	SCS	2222	0.01	-	83.75	65.08	39.05
W5	SCS	8672	0.02	-	78.29	120.08	72.05

4.3 Hydrological study

Hydrological studies represent the foundation for the selection of Flood protection works. Metrological, morphological, geological, site visits and by taking into account 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 17 shows Distribution of a storm in a SCS Storm type II method for 24 hours.

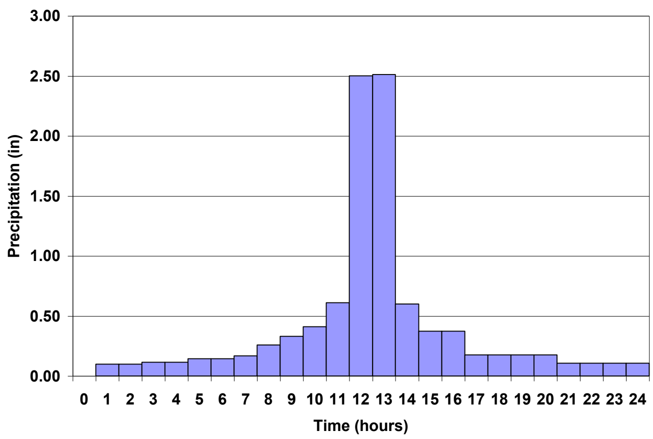


Figure 17: Distribution of SCS type II storm for 24 hours

In order to calculate the maximum discharge of the flood, the Rational method was applied for the watersheds with areas less than 100 hectares. And the SCS Method was used for watersheds with areas greater than 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.

4.3.2 Hydrological Model Results

The HEC-HMS program was used to calculate the maximum discharge from drainage basins larger than 1 km^2 and to use an Excel sheets to calculate the discharge from watersheds of area less than 1 km^2 for different return periods of 25, 50, and 100 years using a 24-hour design storm and using the distribution of SCS Type II where it is the most suitable distribution of dry areas. Table 9 shows the results of the hydrological Model. Figure 18, Figure 19 & Figure 20 shows an example of W-2 drainage basin hydrograph for 25, 50 and 100 years.

Table 9: Results of hydrological study for catchments that affecting the project boundary

Watershed number	Method	longest flow path (m)	Watershed area (ha)	Rational Runoff Coefficient (C)	Curve Number (CN)	Time of Concentration (minutes)	Lag time (minutes)	Peak flow (100 Year) (m^3/s)	Peak flow (50 Year) (m^3/s)	Peak flow (25 Year) (m^3/s)	Volume (100 Year) (m^3/s)	Volume (50 Year) (m^3/s)	Volume (25 Year) (m^3/s)
W1	SCS	-	-	-	-	-	-	65.00	34.10	13.50	2051.30	1155.80	485.60
W1-SUB01	SCS	11731	3158.72	-	84.61	195.54	117.32	32.90	18.10	7.20	539.80	317.00	144.10
W1-SUB02	SCS	14846	2534.33	-	80.46	234.30	140.58	15.70	7.70	2.40	318.30	170.70	64.60
W1-SUB03	SCS	7355	1401.82	-	83.31	109.88	65.93	20.20	10.60	3.70	218.10	124.80	53.90
W1-SUB04	SCS	9109	1151.66	-	82.56	137.45	82.47	13.10	6.70	2.30	169.60	95.50	39.90
W1-SUB05	SCS	14365	1440.35	-	83.48	213.94	128.36	12.70	6.80	2.50	226.80	130.20	56.60
W1-SUB06	SCS	12243	1551.23	-	82.94	187.52	112.51	14.40	7.50	2.70	234.90	133.30	56.70
W1-SUB07	SCS	12197	1302.67	-	81.28	172.11	103.26	11.10	5.50	1.70	174.30	95.30	37.60

Watershed number	Method	longest flow path (m)	Watershed area (ha)	Rational Runoff Coefficient (C)	Curve Number (CN)	Time of Concentration (minutes)	Lag time (minutes)	Peak flow (100 Year) (m^3/s)	Peak flow (50 Year) (m^3/s)	Peak flow (25 Year) (m^3/s)	Volume (100 Year) (m^3/s)	Volume (50 Year) (m^3/s)	Volume (25 Year) (m^3/s)
W1-SUB08	SCS	12653	927.27	-	80.08	185.35	111.21	6.60	3.10	0.90	113.00	60.10	22.30
W1-SUB09	SCS	4938	511.65	-	78.81	63.81	38.28	7.00	3.00	0.60	56.40	29.00	10.00
W2	SCS	6681	1075.96	-	77.75	84.96	50.98	10.60	4.30	0.80	108.70	54.20	17.40
W3	SCS	-	-	-	-	-	-	27.00	14.00	4.90	812.40	440.50	170.70
W3-SUB01	SCS	18506	3930.65	-	81.30	311.15	186.69	21.40	10.80	3.70	526.60	288.10	113.70
W3-SUB02	SCS	15155	2316.01	-	80.23	218.83	131.30	14.80	7.10	2.20	285.70	152.40	56.90
W4		-	-	-	-	-	-	50.60	25.50	8.40	1367.20	732.80	277.30
W4-SUB01	SCS	16907	2430.84	-	79.07	270.46	162.28	11.80	5.50	1.60	273.60	141.60	49.50
W4-SUB02	SCS	9969	1069.72	-	80.18	179.55	107.73	7.90	3.80	1.10	131.50	70.00	26.10
W4-SUB03	SCS	5697	711.50	-	84.41	105.57	63.34	11.70	6.30	2.40	119.90	70.10	31.60

Watershed number	Method	longest flow path (m)	Watershed area (ha)	Rational Runoff Coefficient (C)	Curve Number (CN)	Time of Concentration (minutes)	Lag time (minutes)	Peak flow (100 Year) (m^3/s)	Peak flow (50 Year) (m^3/s)	Peak flow (25 Year) (m^3/s)	Volume (100 Year) (m^3/s)	Volume (50 Year) (m^3/s)	Volume (25 Year) (m^3/s)
W4-SUB04	SCS	8252	1101.32	-	83.06	146.90	88.14	12.50	6.50	2.30	168.20	95.70	40.90
W4-SUB05	SCS	9241	699.23	-	81.33	152.43	91.46	6.50	3.20	1.00	93.90	51.40	20.30
W4-SUB06	SCS	10653	755.86	-	79.96	161.11	96.67	5.90	2.80	0.80	91.30	48.40	17.80
W4-SUB07	SCS	7936	630.75	-	82.64	137.94	82.77	7.20	3.70	1.30	93.40	52.70	22.10
W4-SUB08	SCS	10143	690.14	-	83.97	250.44	150.27	5.60	3.10	1.20	112.60	65.30	29.00
W4-SUB09	SCS	9442	561.66	-	83.78	144.42	86.65	6.90	3.70	1.40	90.50	52.30	23.00
W4-SUB10	SCS	6429	947.90	-	80.07	98.13	58.88	10.90	5.00	1.30	115.50	61.40	22.70
W4-SUB11	SCS	2984	132.64	-	84.43	46.44	27.86	4.00	2.20	0.80	22.40	13.10	5.90
W4-SUB12	SCS	11647	1496.65	-	81.92	169.41	101.64	13.70	6.90	2.30	210.10	116.60	47.40

Watershed number	Method	longest flow path (m)	Watershed area (ha)	Rational Runoff Coefficient (C)	Curve Number (CN)	Time of Concentration (minutes)	Lag time (minutes)	Peak flow (100 Year) (m^3/s)	Peak flow (50 Year) (m^3/s)	Peak flow (25 Year) (m^3/s)	Volume (100 Year) (m^3/s)	Volume (50 Year) (m^3/s)	Volume (25 Year) (m^3/s)
W4-SUB13	SCS	8300	1089.20	-	79.53	116.33	69.80	10.40	4.70	1.20	127.10	66.60	23.90
W4-SUB14	SCS	10056	774.72	-	79.89	150.51	90.31	6.30	3.00	0.80	93.10	49.20	18.10
W4-SUB15	SCS	4931	377.86	-	81.54	199.88	119.93	2.90	1.50	0.50	51.60	28.40	11.30
W4-SUB16	SCS	13551	2057.18	-	80.60	202.97	121.78	14.40	7.00	2.20	261.10	140.50	53.50
W4-SUB17	SCS	6409	805.56	-	78.29	95.54	57.32	7.80	3.30	0.70	85.10	43.10	14.30
W4-SUB18	SCS	3755	267.71	-	80.65	65.38	39.23	4.40	2.10	0.50	34.20	18.40	7.00
W4-SUB19	SCS	2222	158.33	-	83.75	65.08	39.05	3.50	1.90	0.70	25.40	14.60	6.40
W5	SCS	8672	983.40	-	78.29	120.08	72.05	8.00	3.40	0.80	103.80	52.60	17.50

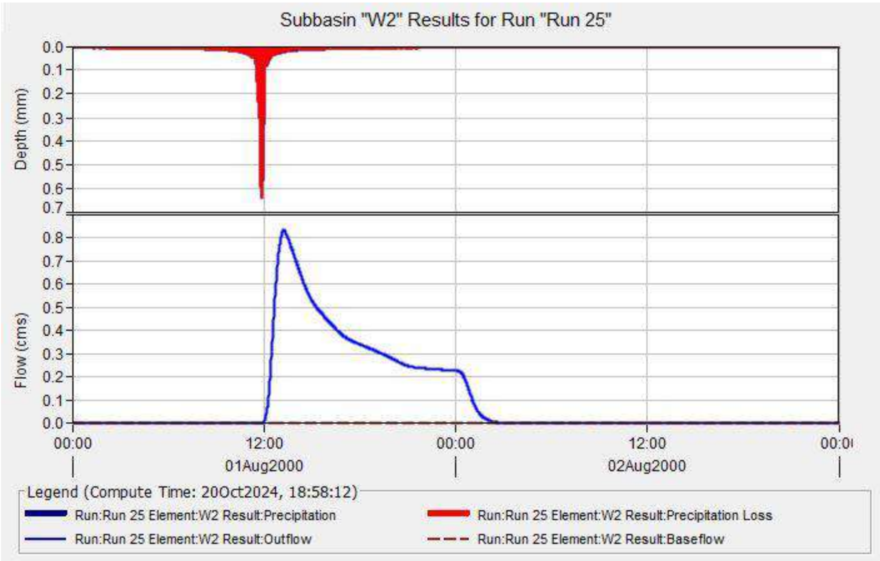


Figure 18: Runoff hydrograph for watershed no. W-2 for 25 yrs

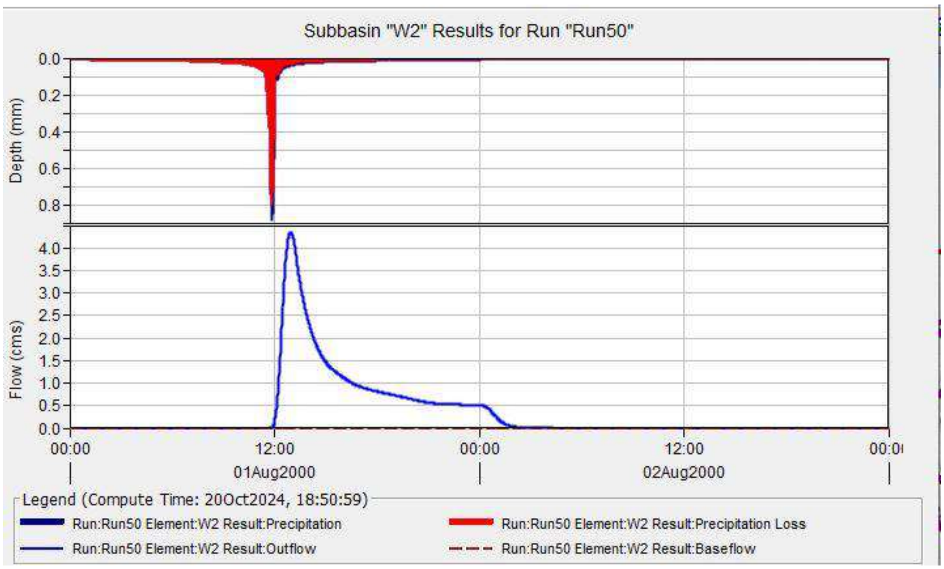


Figure 19: Runoff hydrograph for watershed no. W-2 for 50 yrs

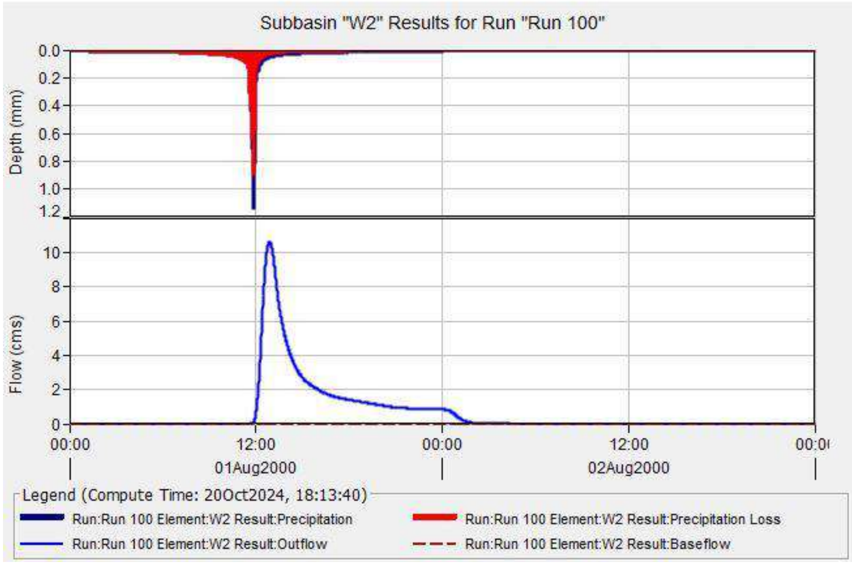


Figure 20: Runoff hydrograph for watershed no. W-2 for 100 yrs

Table 10, Table 11 and Table 12 present the hydraulic properties of the flow at the points of impact affecting the project boundary.

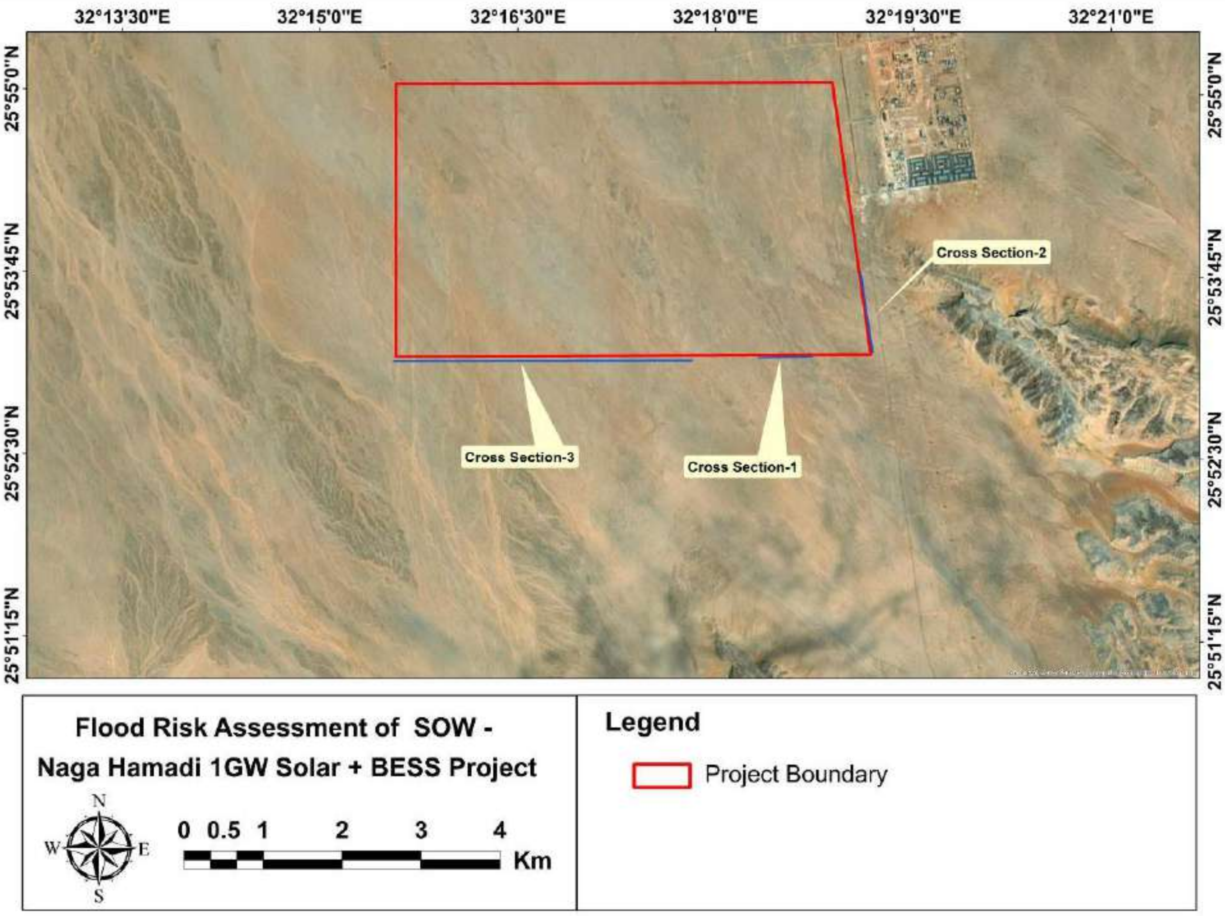


Figure 21: Point of impact cross sections

Table 10: Point of impact properties for 25 yrs at difference sections

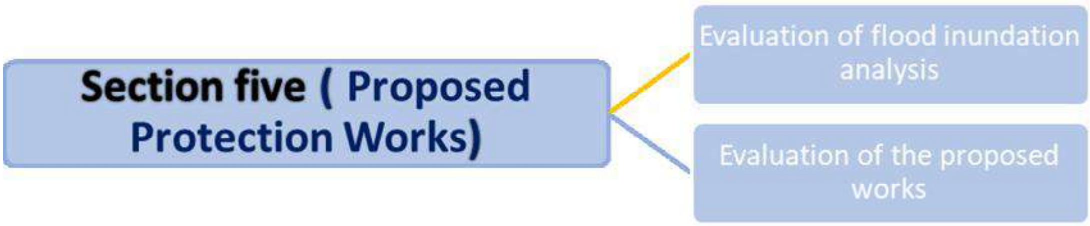
25 years			
Properties	Cross Section 1	Cross Section 2	Cross Section 3
Flow(m3/s)	13.40	0.45	6.77
Depth(m)	0.97	0.23	1.20
velocity(m/s)	0.98	0.56	0.60
Pressure(t/m2)	0.97	0.23	1.20

Table 11: Point of impact properties for 50 yrs at difference sections

50 years			
Properties	Cross Section 1	Cross Section 2	Cross Section 3
Flow(m3/s)	34.50	2.55	20.93
Depth(m)	1.12	0.27	1.28
velocity(m/s)	1.35	0.43	1.17
Pressure(t/m2)	1.12	0.27	1.28

Table 12: Point of impact properties for 100 yrs at difference sections

100 years			
Properties	Cross Section 1	Cross Section 2	Cross Section 3
Flow(m3/s)	66.7	8.06	41.21
Depth(m)	1.33	0.36	1.35
velocity(m/s)	1.65	0.97	1.18
Pressure(t/m2)	1.33	0.36	1.35


Section five (Proposed Protection Works)
Evaluation of flood inundation analysis
Evaluation of the proposed works

5 Flood Protection Works

5.1 Existing Structures

Based on our field experience and satellite imagery, it has been confirmed that there is a dam located upstream to the west of the project. However, it does not have any significant impact on the project boundary. Further, the received DEM (5 x 5 m) doesn't reflect the Dam height or its upstream storage pond. Therefore, it is difficult to know the natural dam breaches occupations.

5.2 Flood inundation analysis

HEC-RAS 2D 6.4.1 software was used to build up a complete 2D hydrodynamic model to perform the flood inundation analysis required to identify the inundated locations to the risk of flood hazards from the precipitation and discharge hydrographs produced from the hydrological analysis of the 25, 50 and 100 yrs return periods storms.

The 2D component of HEC-RAS, a freely available hydraulic modelling package will be utilized for the course of this investigation. The Hydrologic Engineering Center's (HEC) River Analysis System (HEC-RAS) software allows the user to perform one-dimensional (1D) steady and two-dimensional (2D) unsteady river flow hydraulic calculations. HEC-RAS is an integrated system of software and is comprised of a graphical user interface, separate hydraulic analysis components, data storage and management capabilities, graphics, mapping (HEC-RAS Mapper) and reporting facilities.

The first input to such models is the digital terrain model (DTM 5 x 5 m), which is derived from the same digital elevation model used in the morphological analysis. The DTM is fed into HEC-RAS Mapper and an appropriate mesh size is selected in Cartesian coordinates, see Figure 22. The geometric properties of the generated mesh are listed in Table 13. In addition, a variable Land cover and CN data were incorporated into the model to account for the spatial variability of soil infiltration and Manning roughness factor between the flood plains and the Wadis

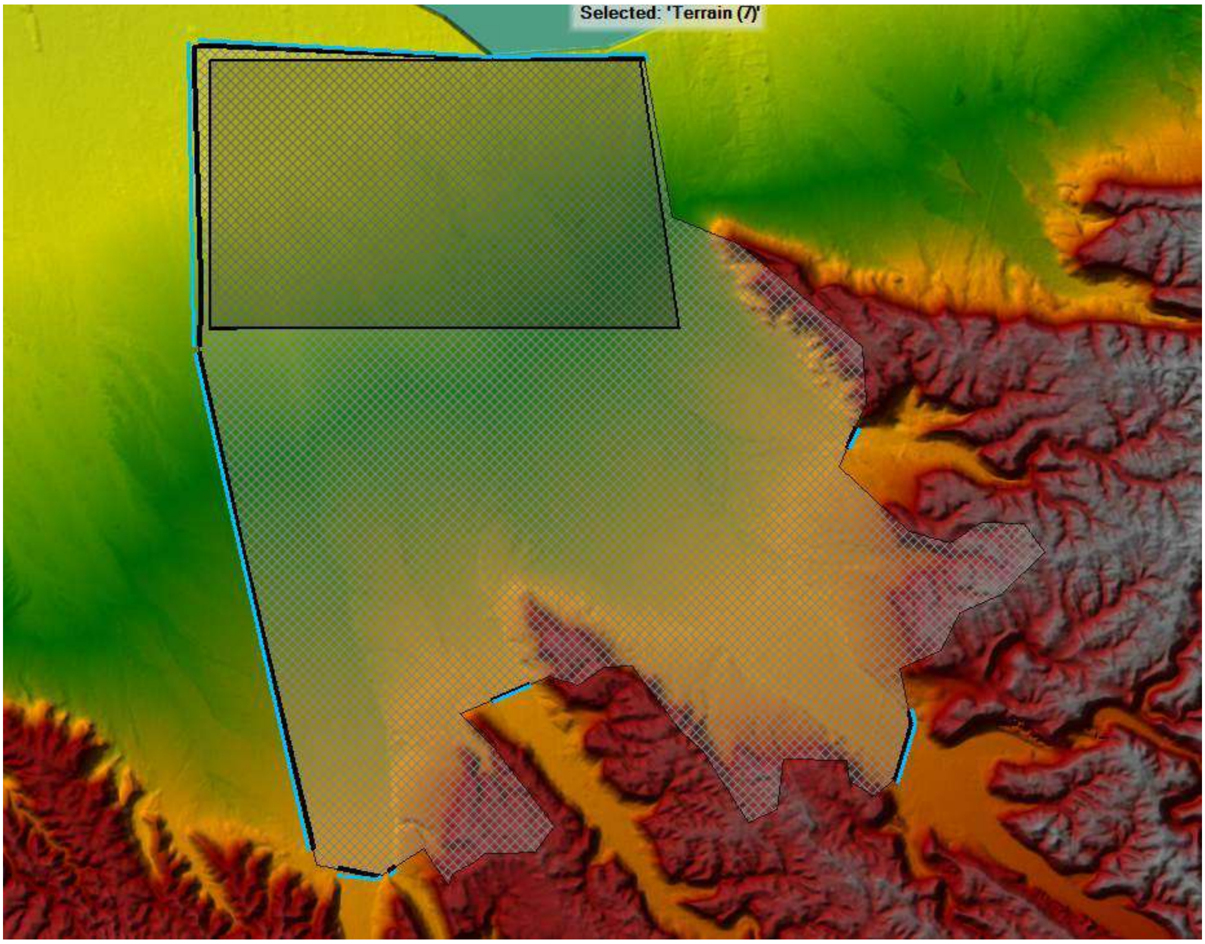


Figure 22: 2D Mesh generated from the DTM

Table 13: Hydraulic Properties of the 2D Mesh

No. of Cells	Min. Elev. (m)	Max. Elev. (m)	Parent Mesh Cell Size (m*m)	Manning's Value
80459	64.46	503.45	5 x 5	0.035

According to the results of hydrological studies, which showed that there are streams affecting the project boundary, as explained above, which requires a protection works to protect the project from the flood risk.

5.2.1 Open channel

Existing open channels within the project boundary are used to convey flow downstream, following the same direction as the natural wadi as shown in Figure 23. The following Table 14 shows the channels specifications.

5.2.2 Dike

Moreover, Proposed dike is used to divert water inside channel one as presented in Figure 23 and Table 15.

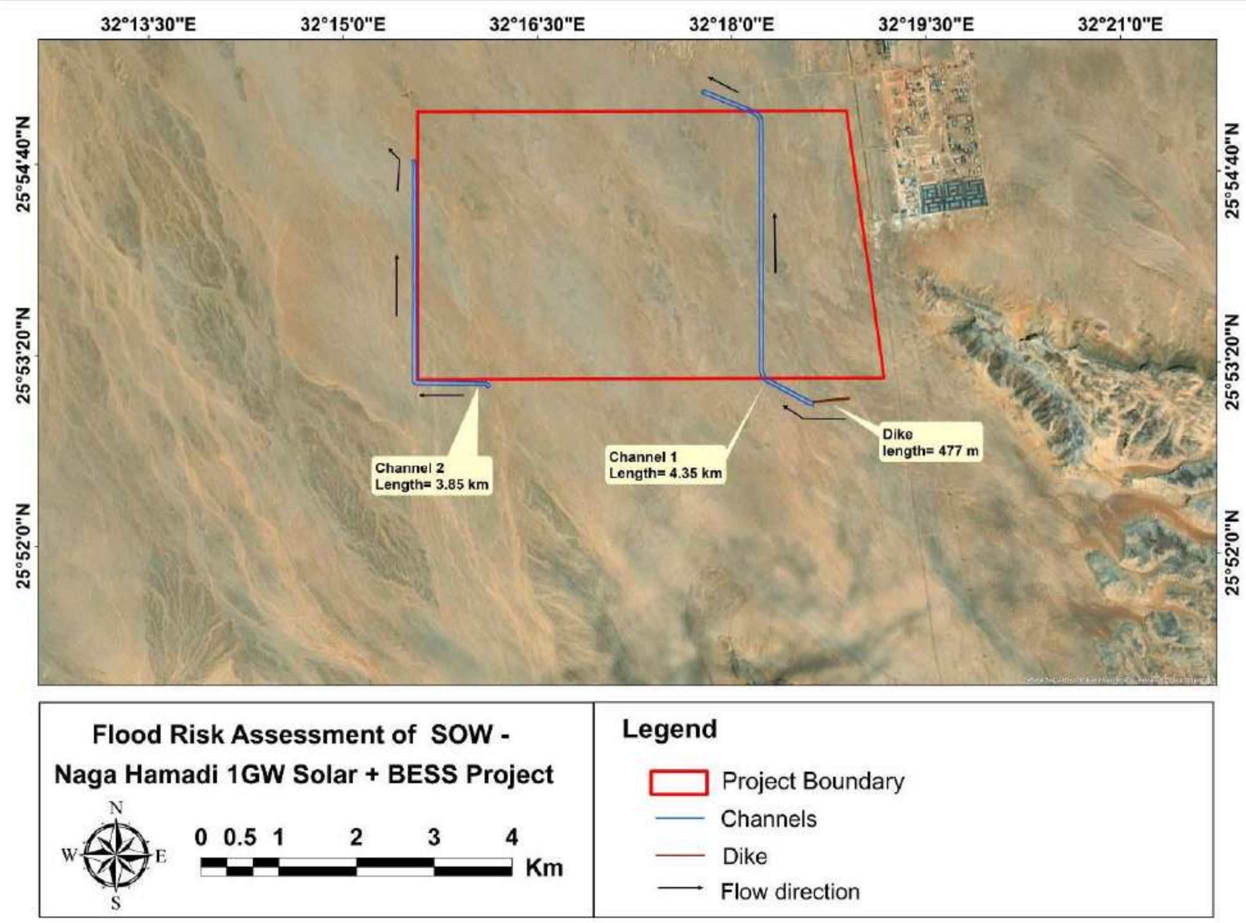


Figure 23: Flood mitigation works

Table 14: Open channel technical specification for 25, 50 and 100 yrs

Name	Channel Section	Material	Longitudinal Slope	Width (m)	Depth (m)	Side slope
Channel-01	**Trapezoidal**	**Concrete**	0.01	40	1.0	2:1
Channel-02	**Trapezoidal**	**Concrete**	0.01	20	1.0	2:1

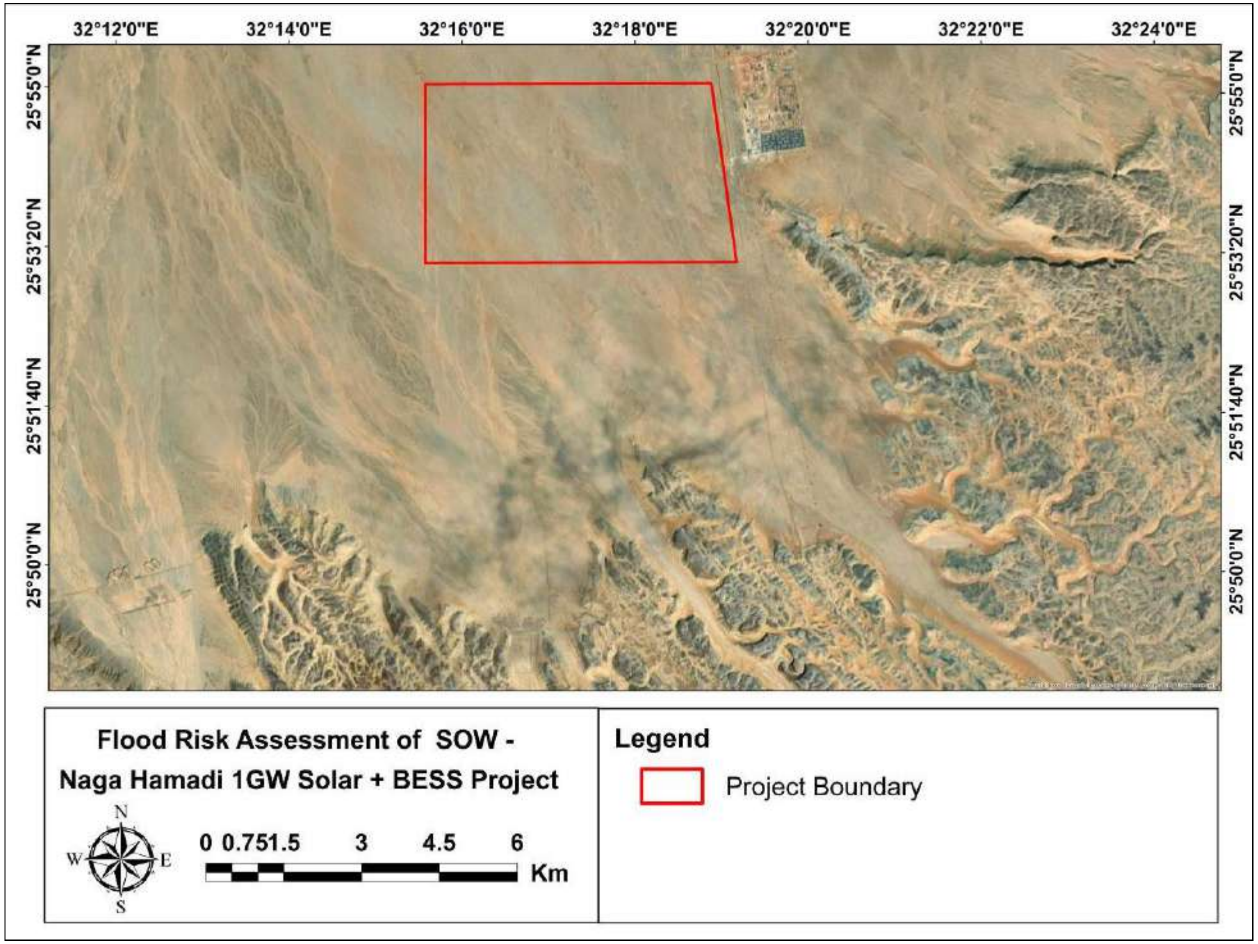
Table 15: Dike technical specification for 50 yrs

Name	Material	Side Slope (m/m)	Crest Width (m)	Depth (m)
Dike	**Concrete**	2:1	2	2.5

6 Conclusion and Recommendation

- The Consultant presented a conceptual overview of the hydrological conditions of the whole project area;
- The Consultant presented the adopted design criteria for the technical methodology.
- The Consultant carried out the main analytical studies to investigate the design storm values, and morphological parameters of the watersheds and finally calculate the resultant runoff hydrographs.
- The Consultant evaluates existing flood protection works in order to protect the study area from flood hazards.
- The flood protection scheme is composed of diversion and conveyance works that divert and convey the incoming flows from the upstream watersheds to the main Wadi.

7 Annex (A)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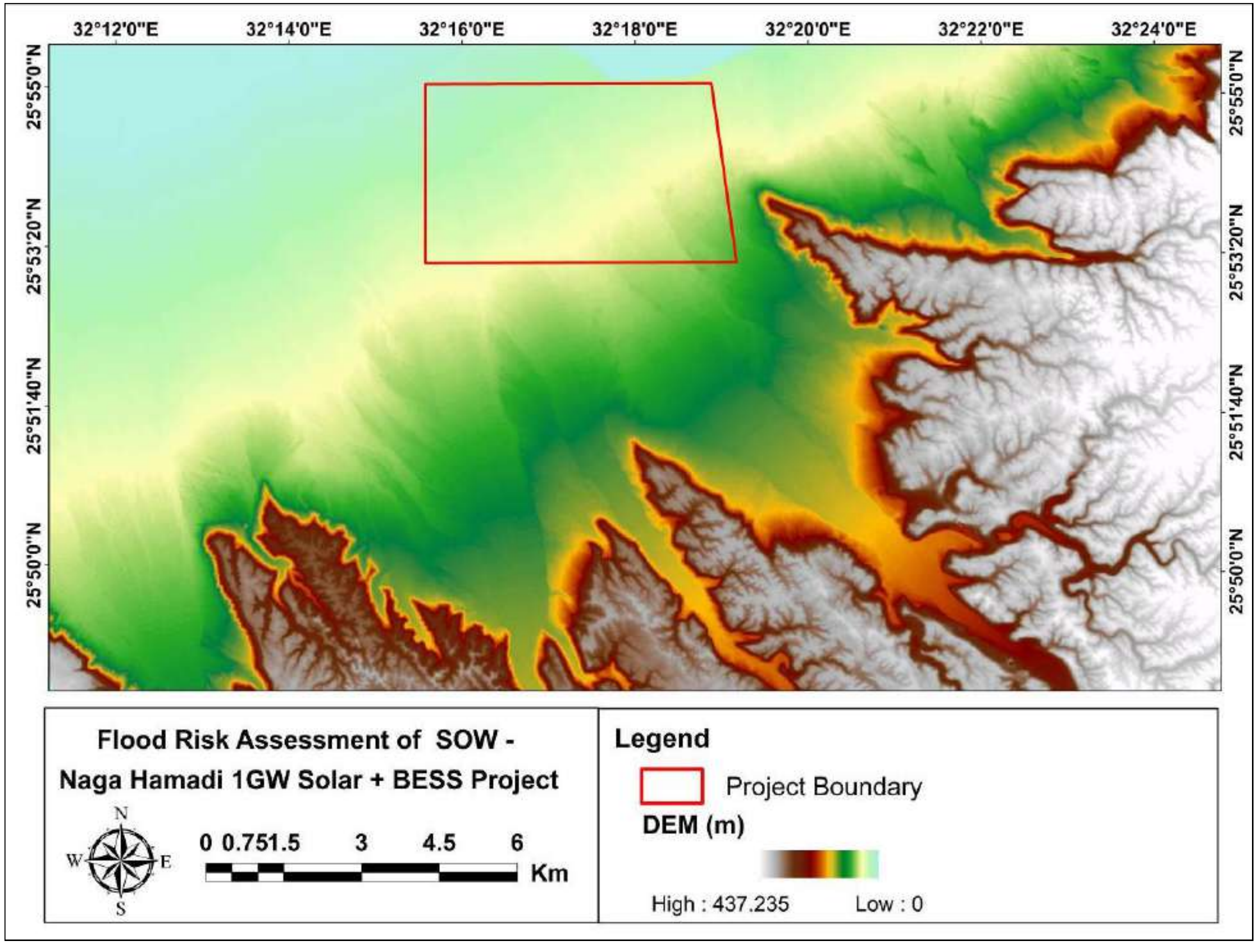
25°55'0"N
25°53'20"N
25°51'40"N
25°50'0"N
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
N
W
E
S
0 0.751.5 3 4.5 6
Km
Legend
Project Boundary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25°51'40"N
25°50'0"N
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
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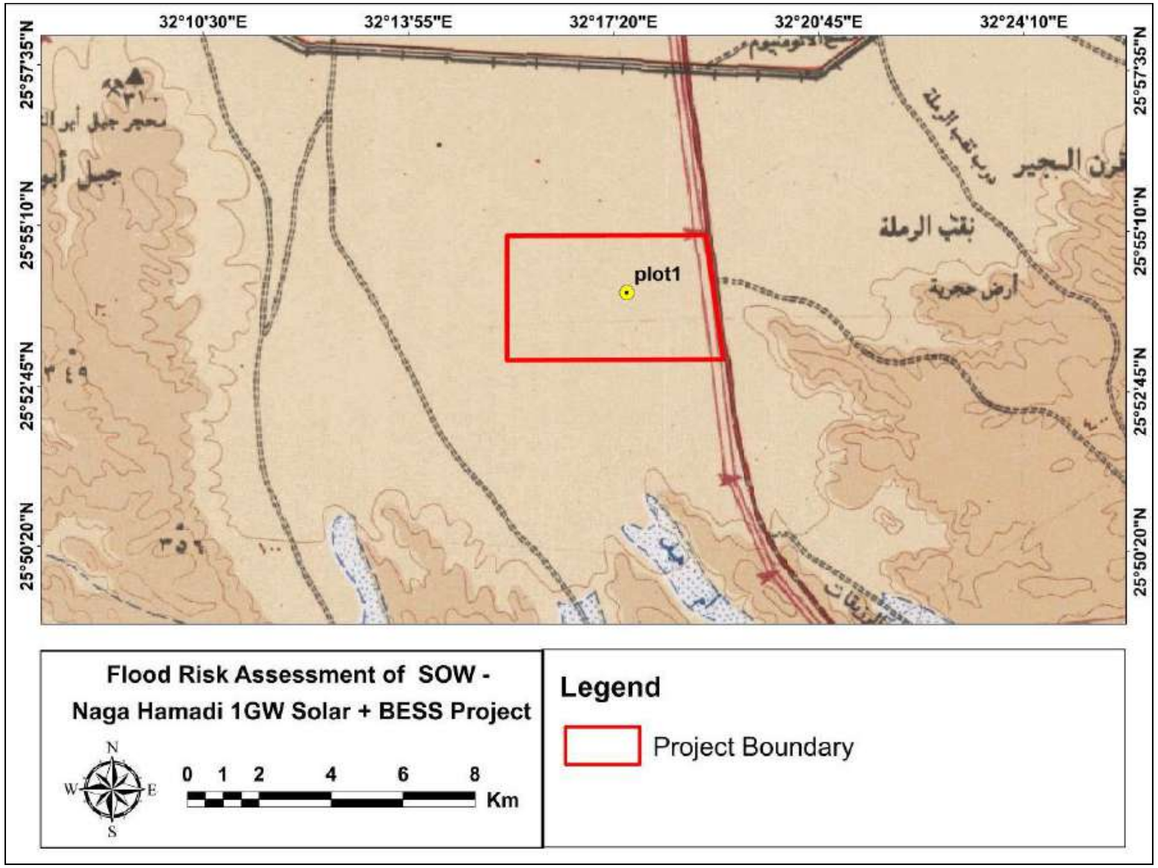
Km
Legend
Project Boundary
DEM (m)
High : 437.235
Low : 0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25°50'20"N
plot1
نقب الرملة
أرض حجرية
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
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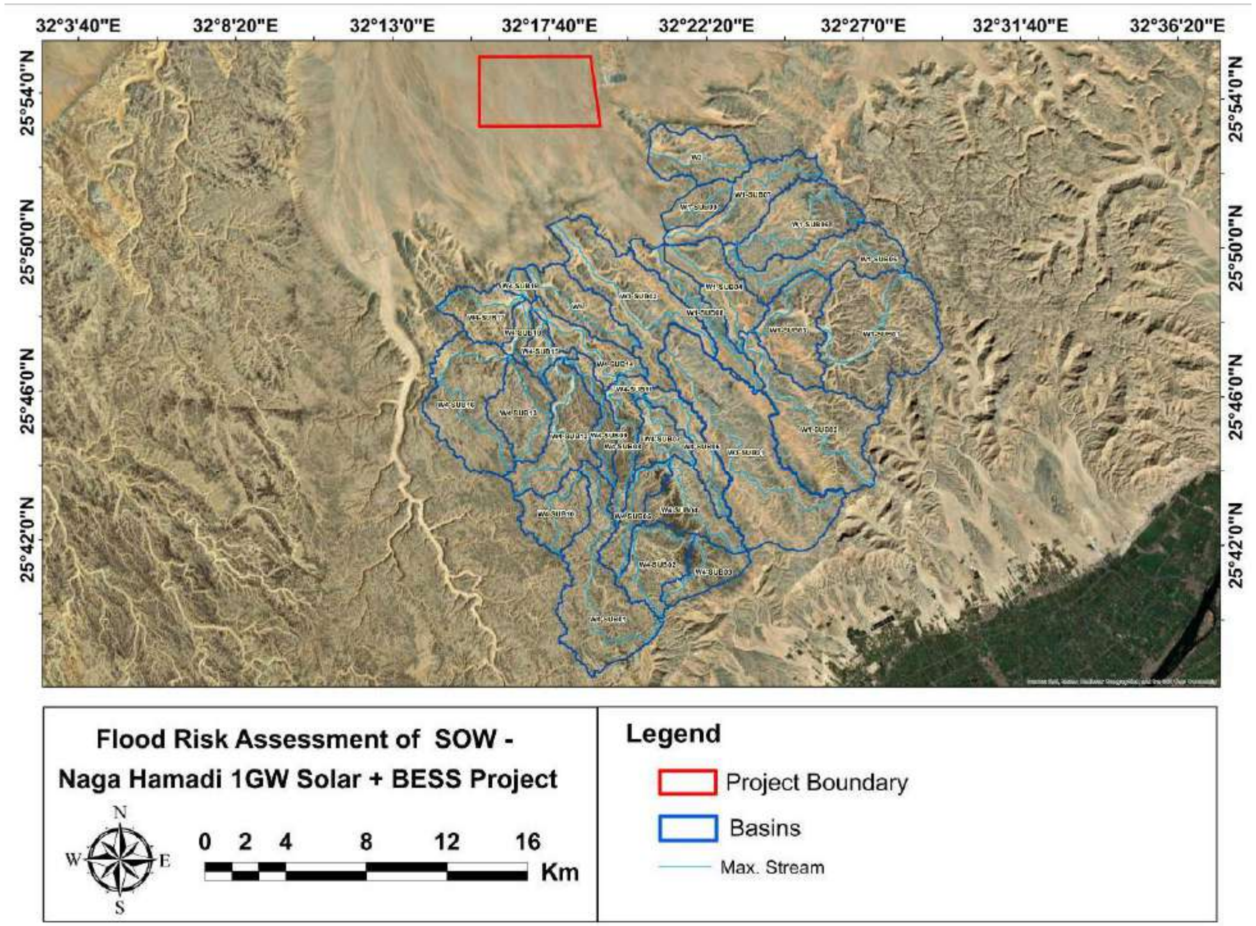
Km
Legend
Project Boundary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25°54'0"N
25°50'0"N
25°46'0"N
25°42'0"N
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
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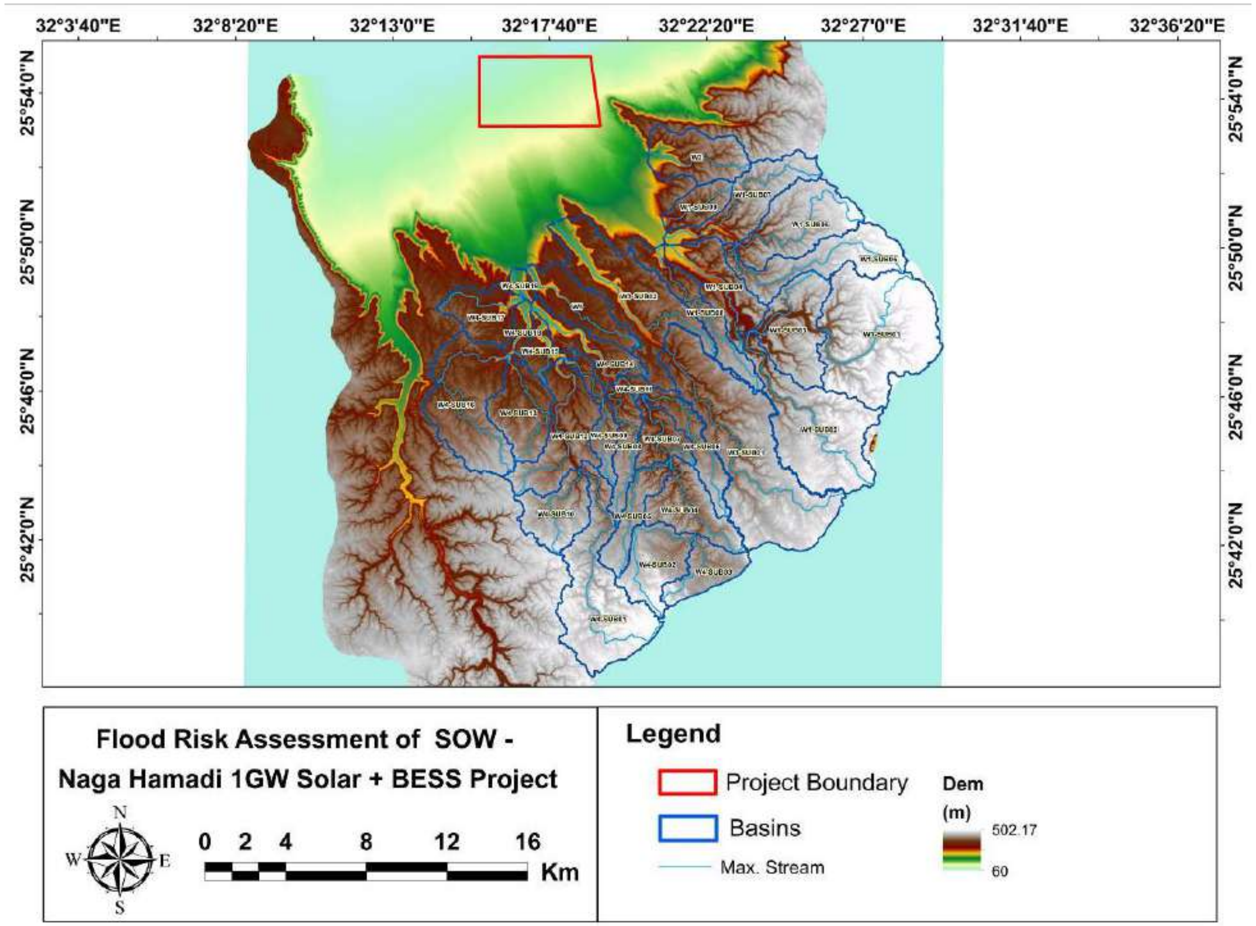
0 2 4 8 12 16
Km
Legend
Project Boundary
Basins
Max. Stream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25°54'0"N
25°50'0"N
25°46'0"N
25°42'0"N
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
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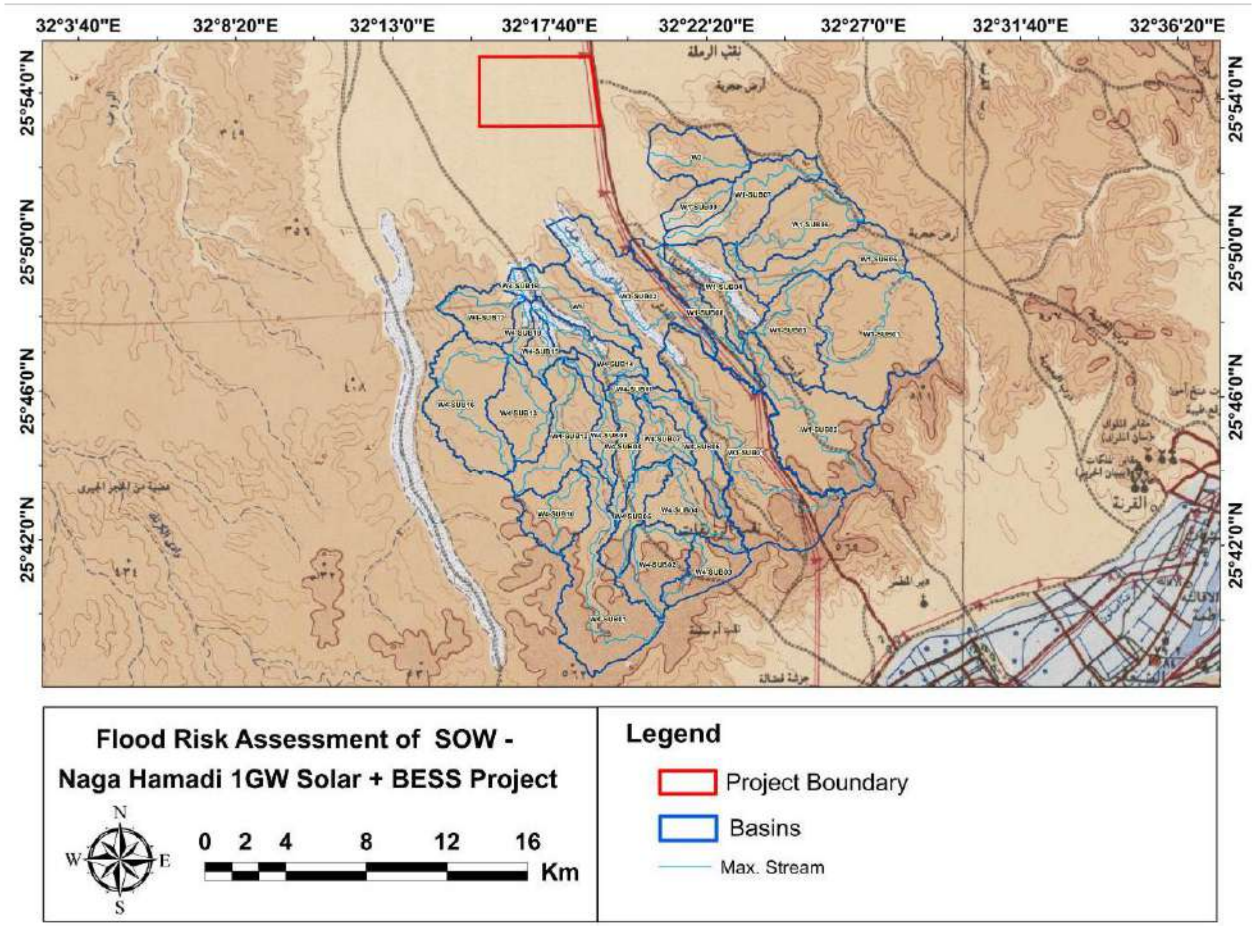
Km
Legend
Project Boundary
Basins
Max. Stream
Dem
(m)
502.17
60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25°54'0"N
25°50'0"N
25°46'0"N
25°42'0"N
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
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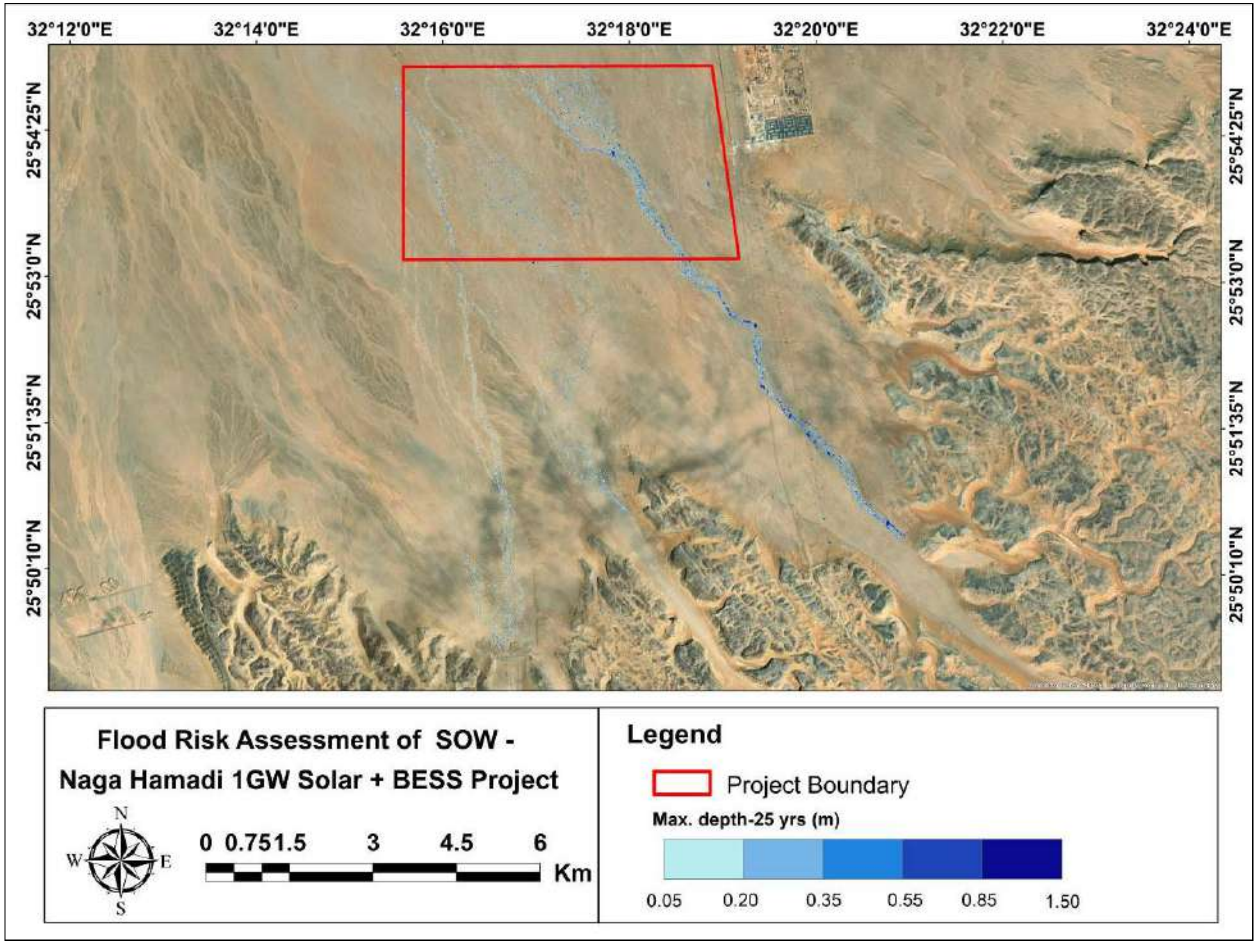
0 2 4 8 12 16
Km
Legend
Project Boundary
Basins
Max. Stream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25°53'0"N
25°51'35"N
25°50'10"N
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
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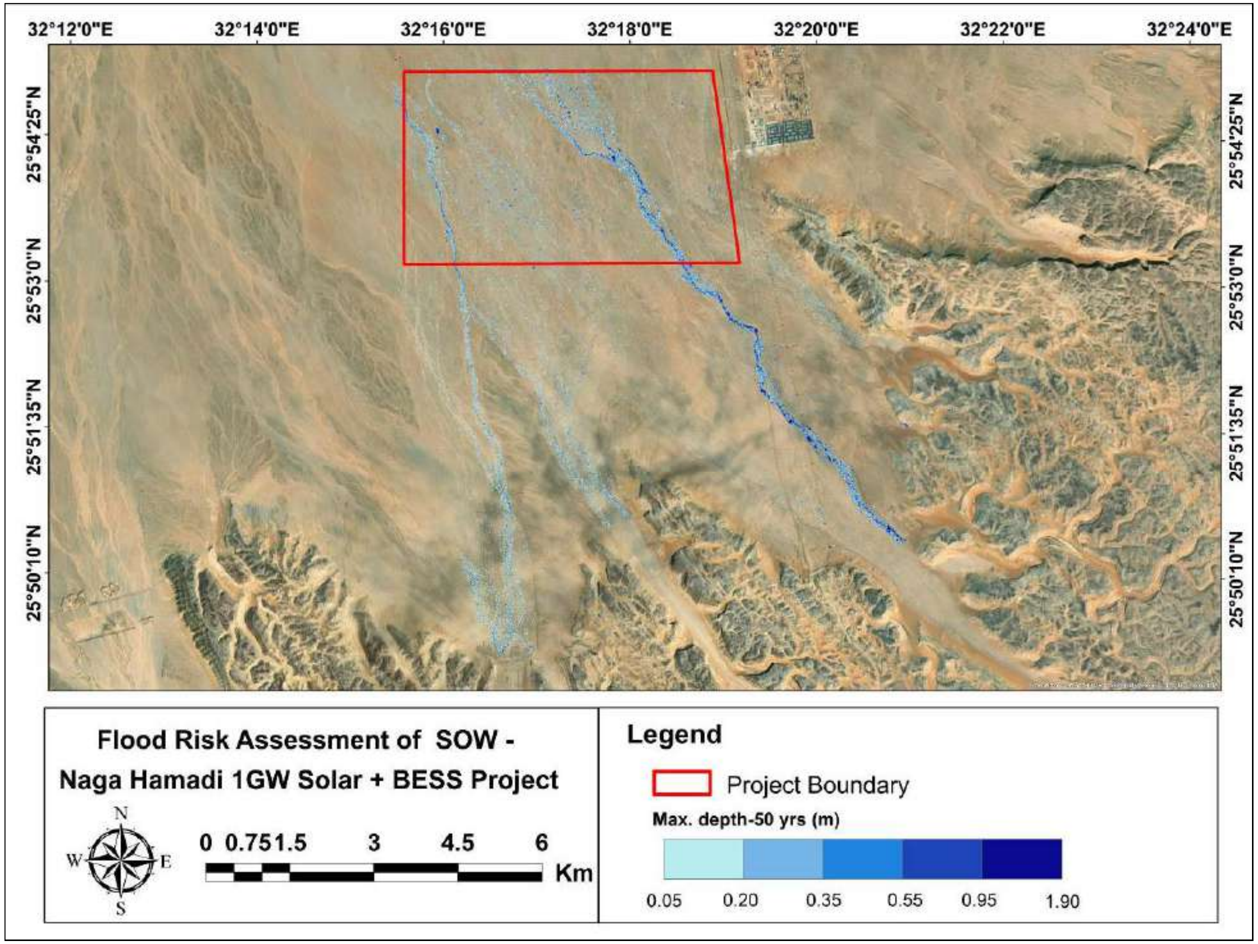
Legend
Project Boundary
Max. depth-25 yrs (m)
0.05
0.20
0.35
0.55
0.85
1.50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25°50'10"N
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
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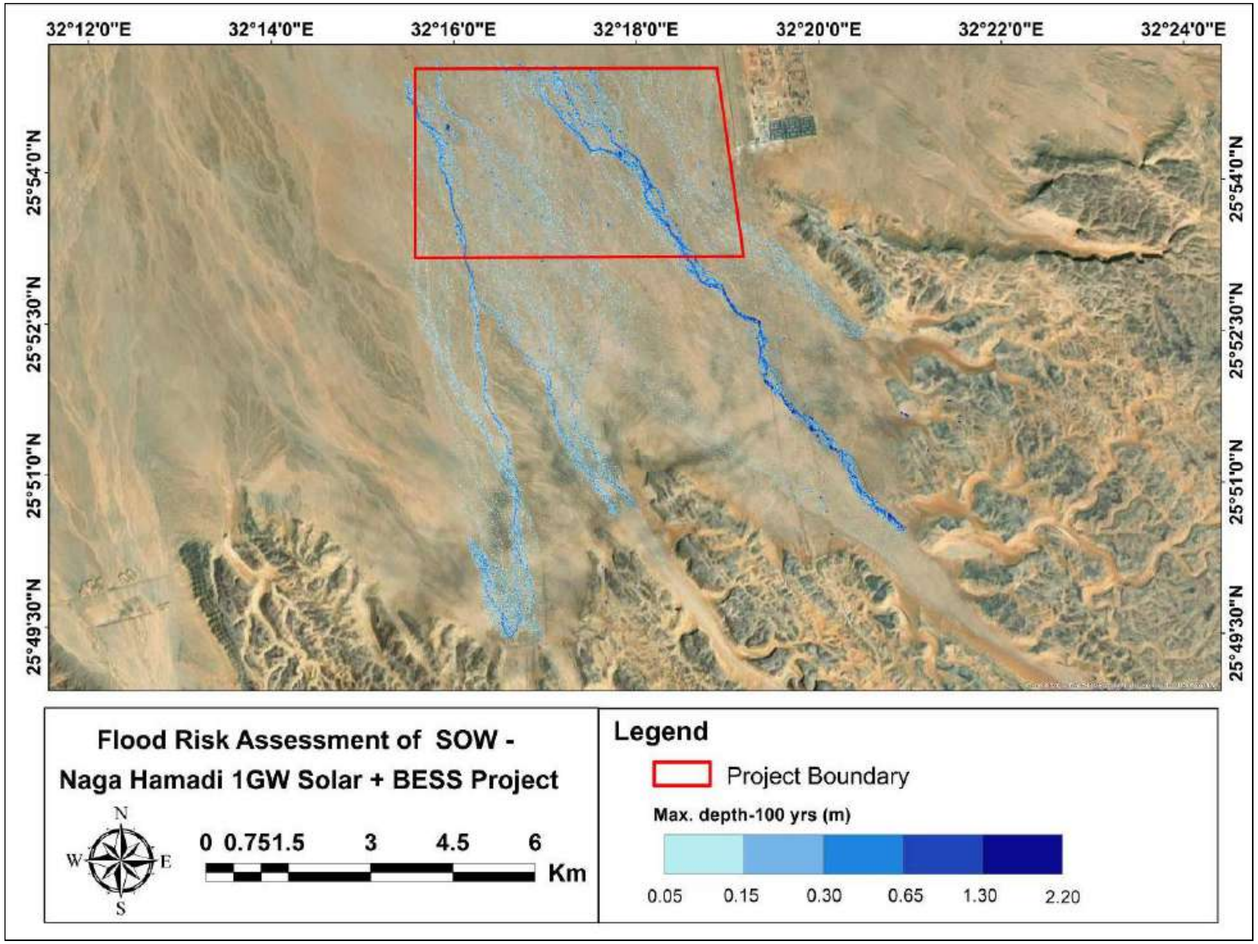
0 0.751.5 3 4.5 6
Km
Legend
Project Boundary
Max. depth-50 yrs (m)
0.05
0.20
0.35
0.55
0.95
1.90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25°49'30"N
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
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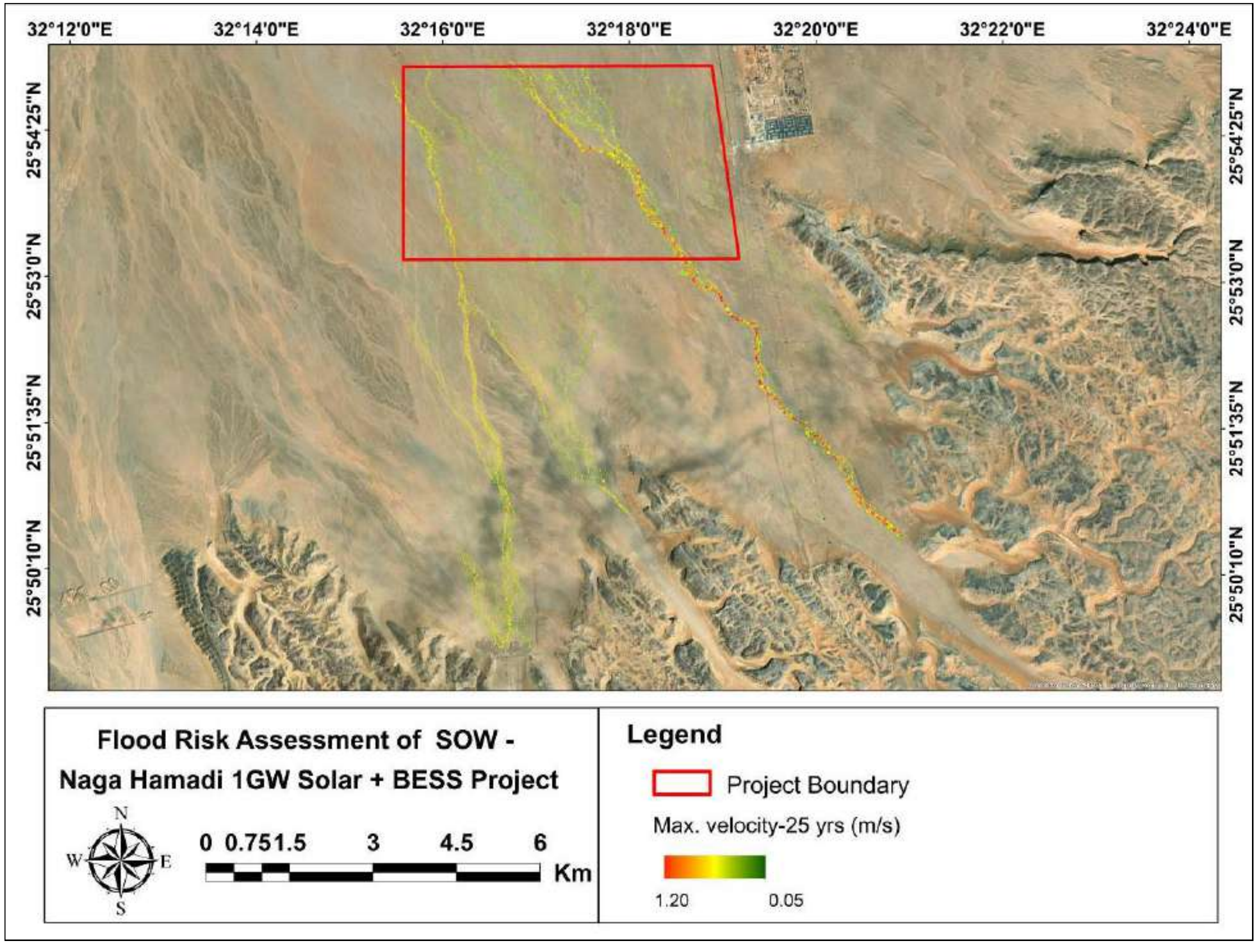
0 0.751.5 3 4.5 6
Km
Legend
Project Boundary
Max. depth-100 yrs (m)
0.05 0.15 0.30 0.65 1.30 2.20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25°51'35"N
25°50'10"N
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
N
W
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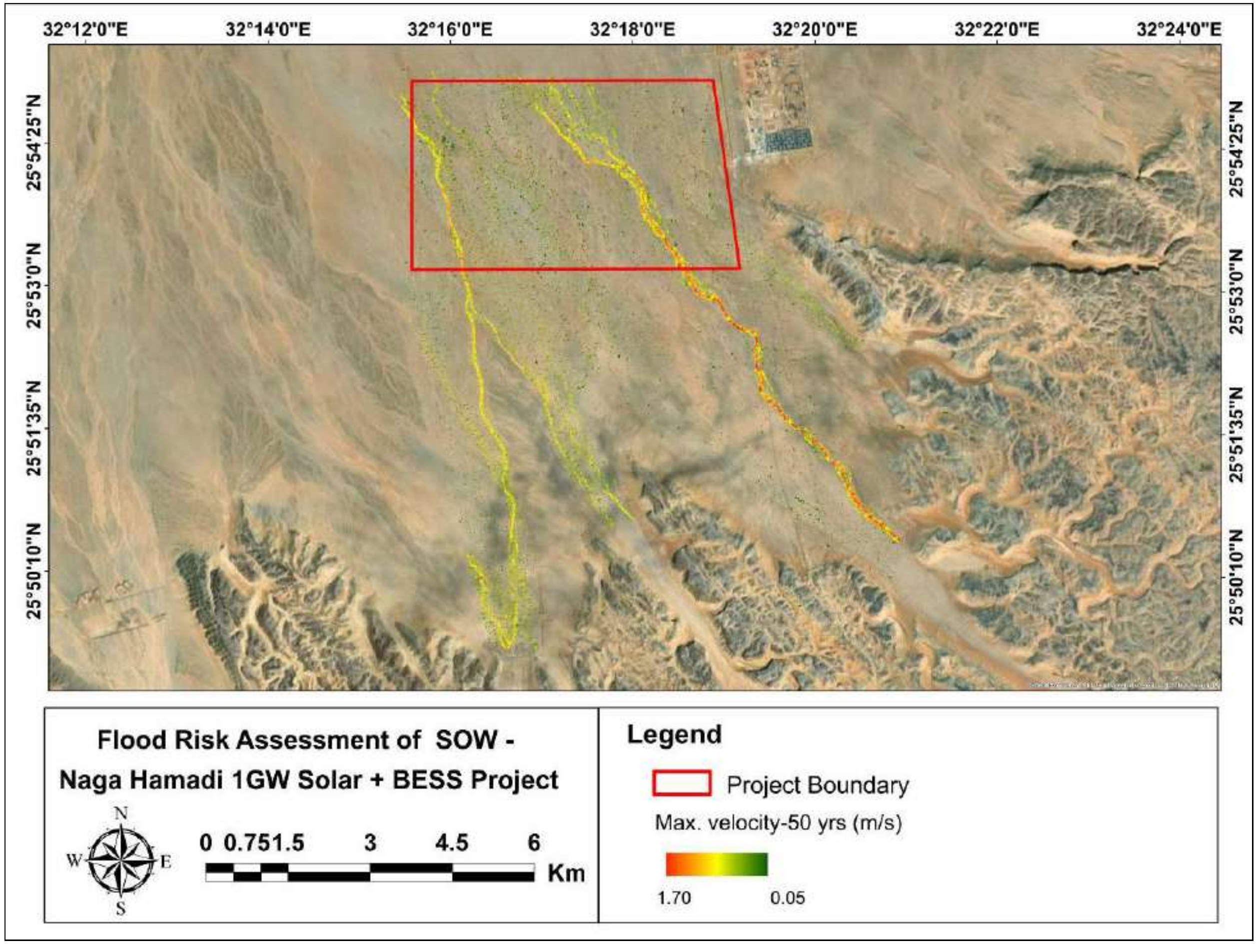
S
0 0.751.5 3 4.5 6
Km
Legend
Project Boundary
Max. velocity-25 yrs (m/s)
1.20
0.05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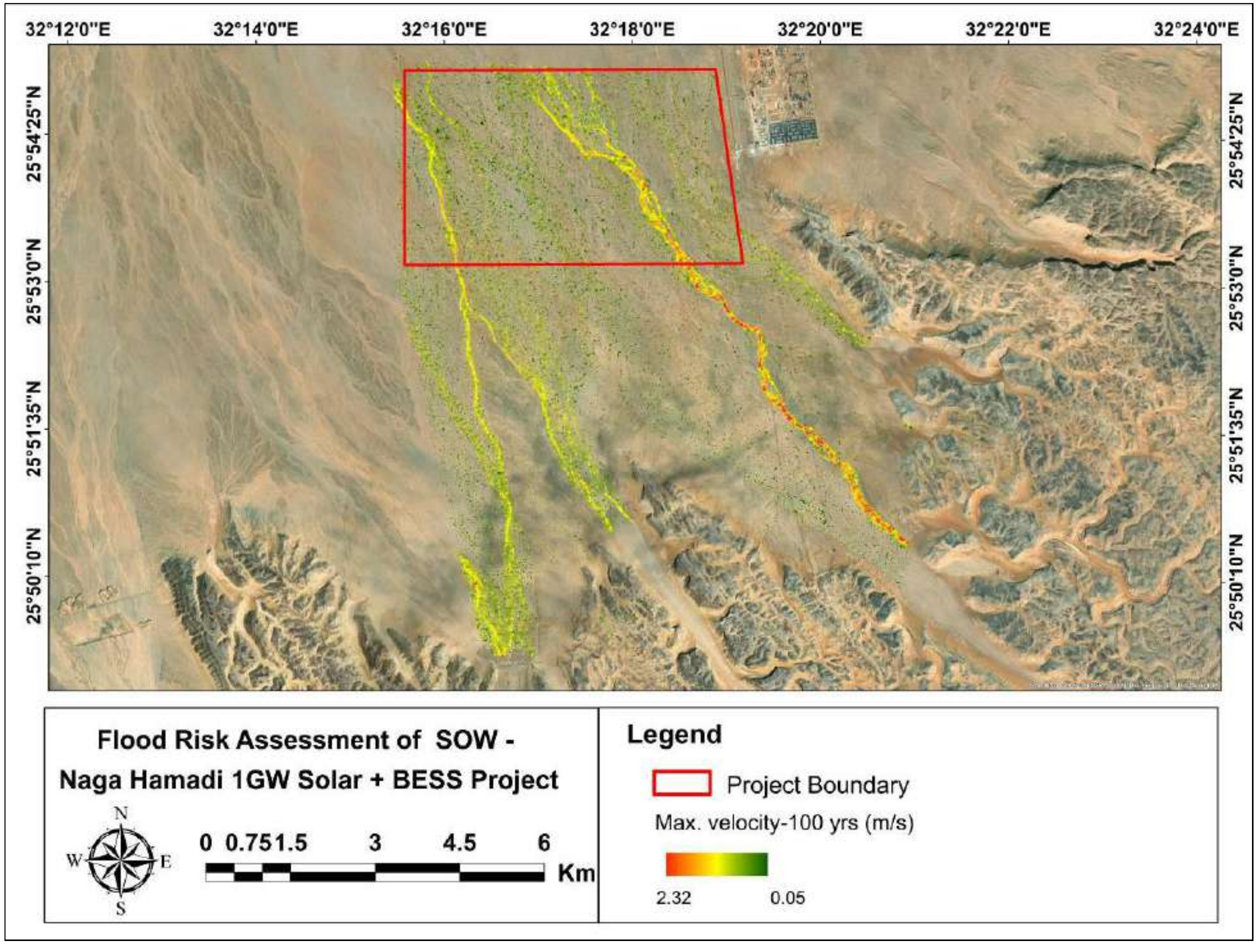
25°53'0"N
25°51'35"N
25°50'10"N
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
N
W
E
S
0 0.751.5 3 4.5 6
Km
Legend
Project Boundary
Max. velocity-50 yrs (m/s)
1.70
0.05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25°53'0"N
25°51'35"N
25°50'10"N
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
N
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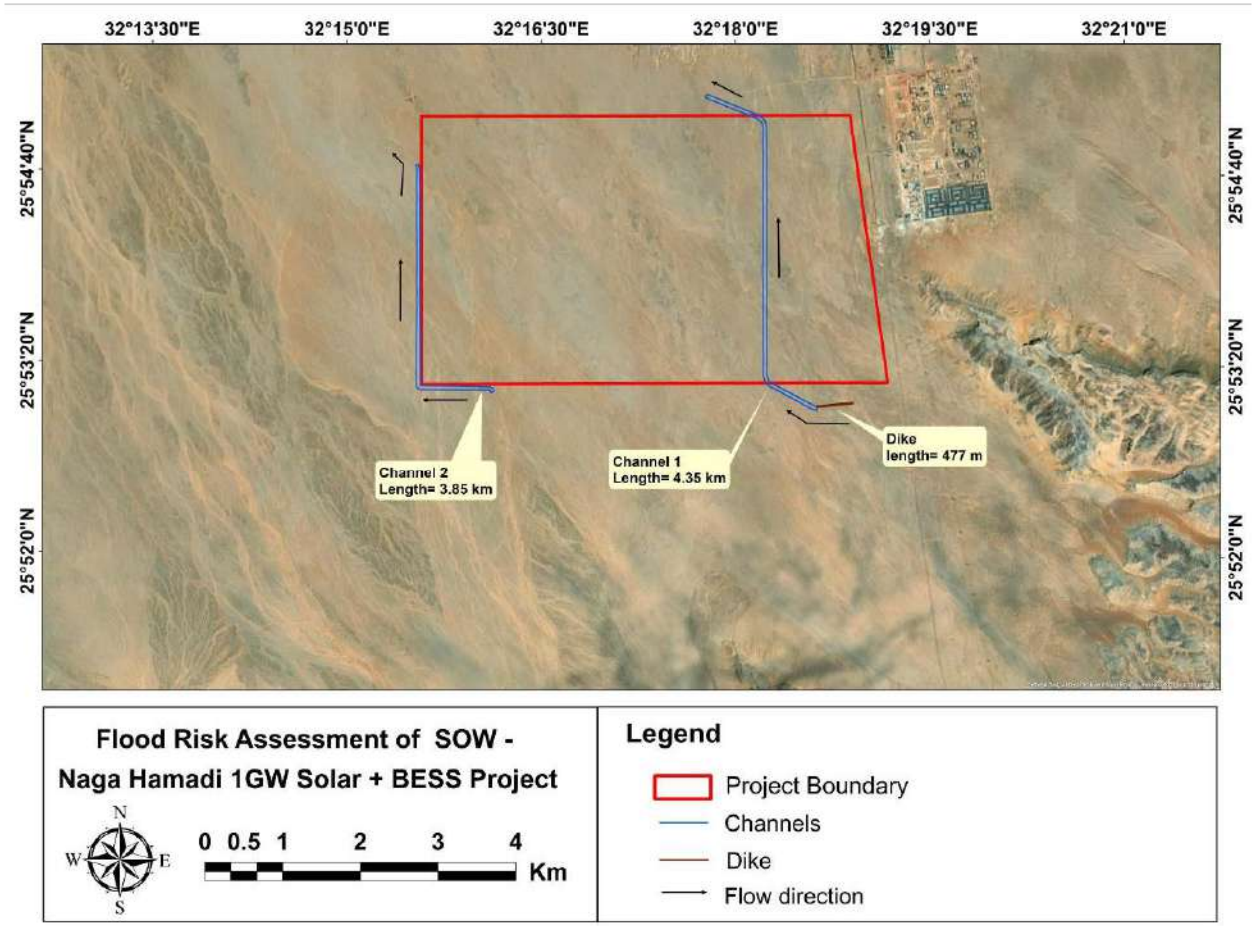
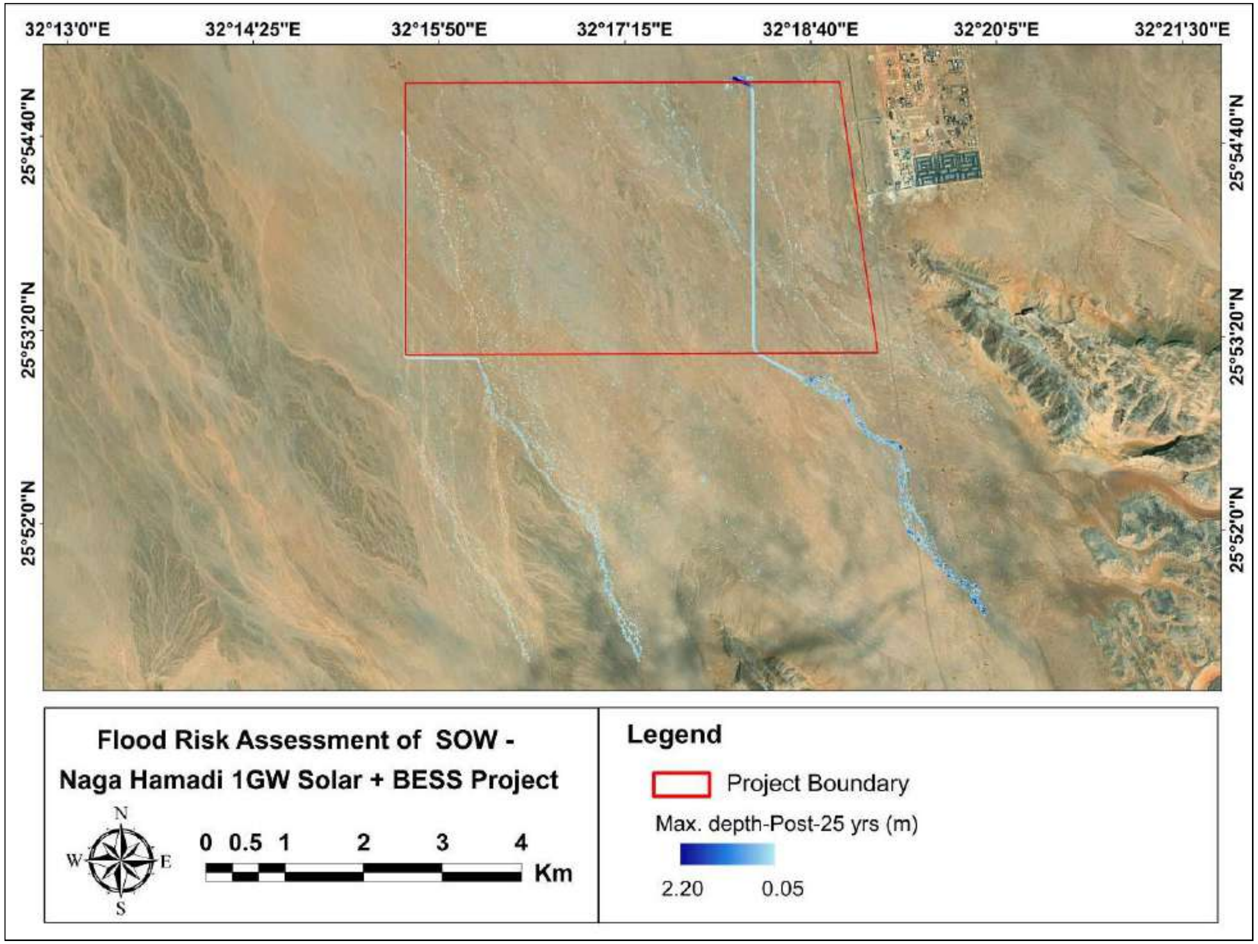
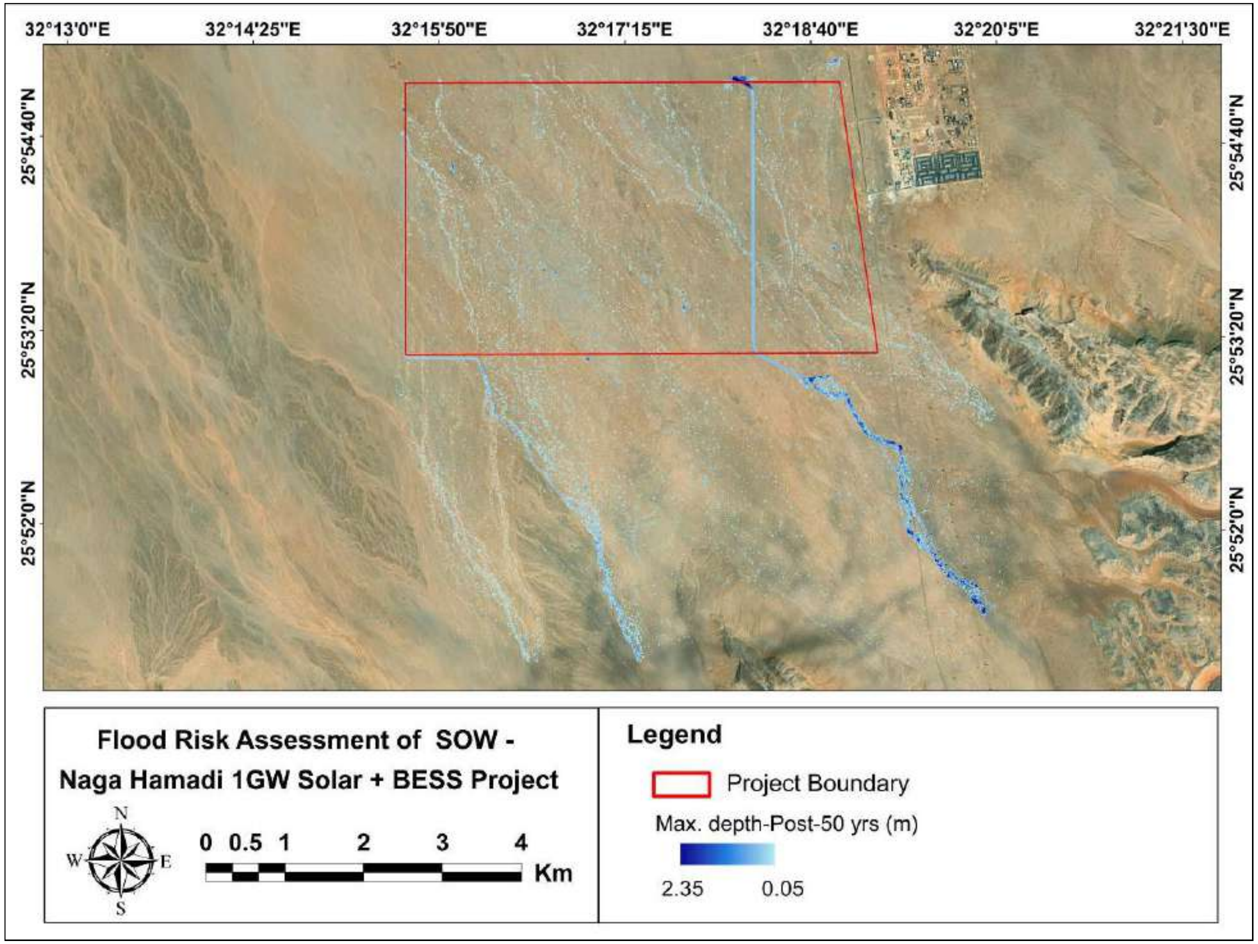
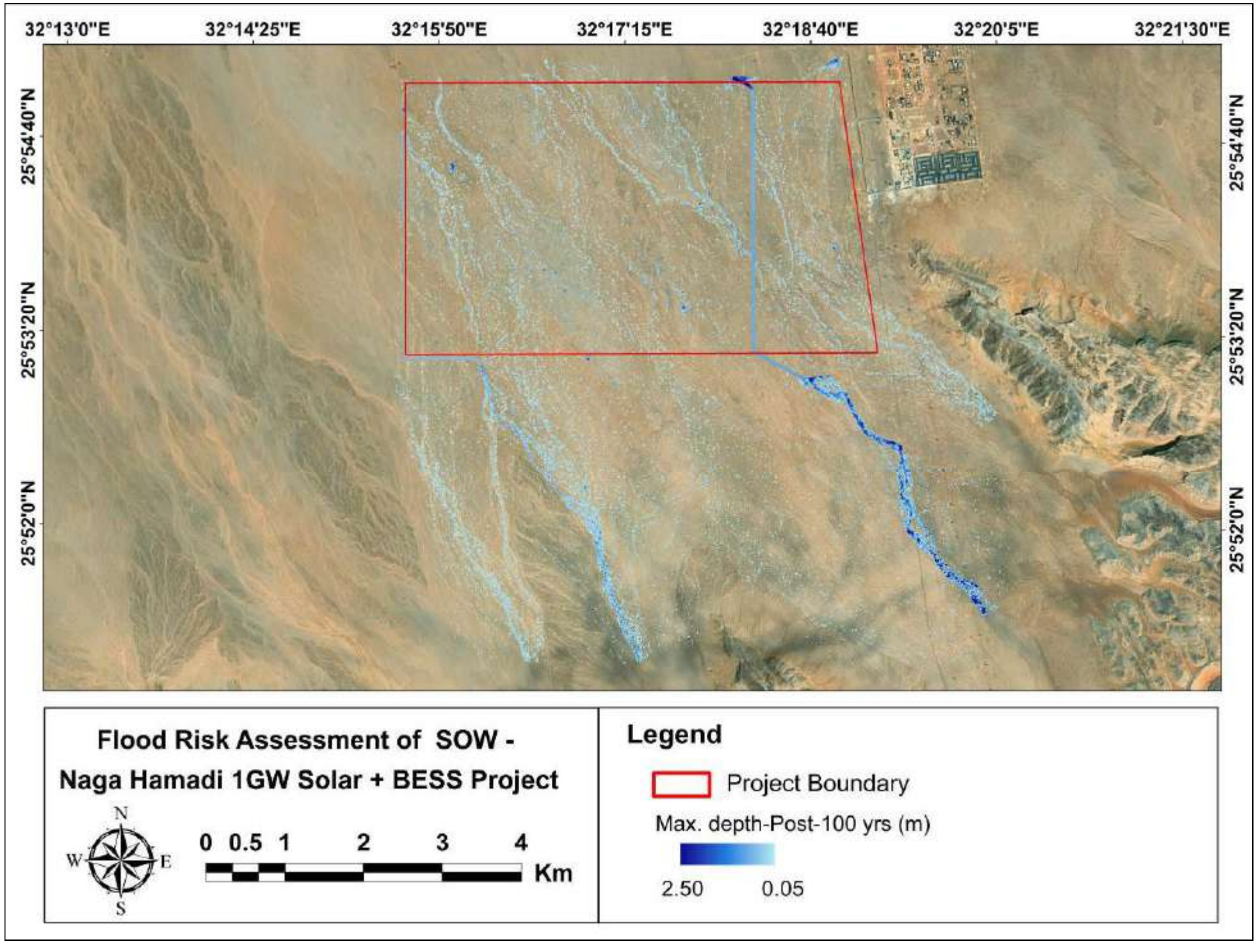
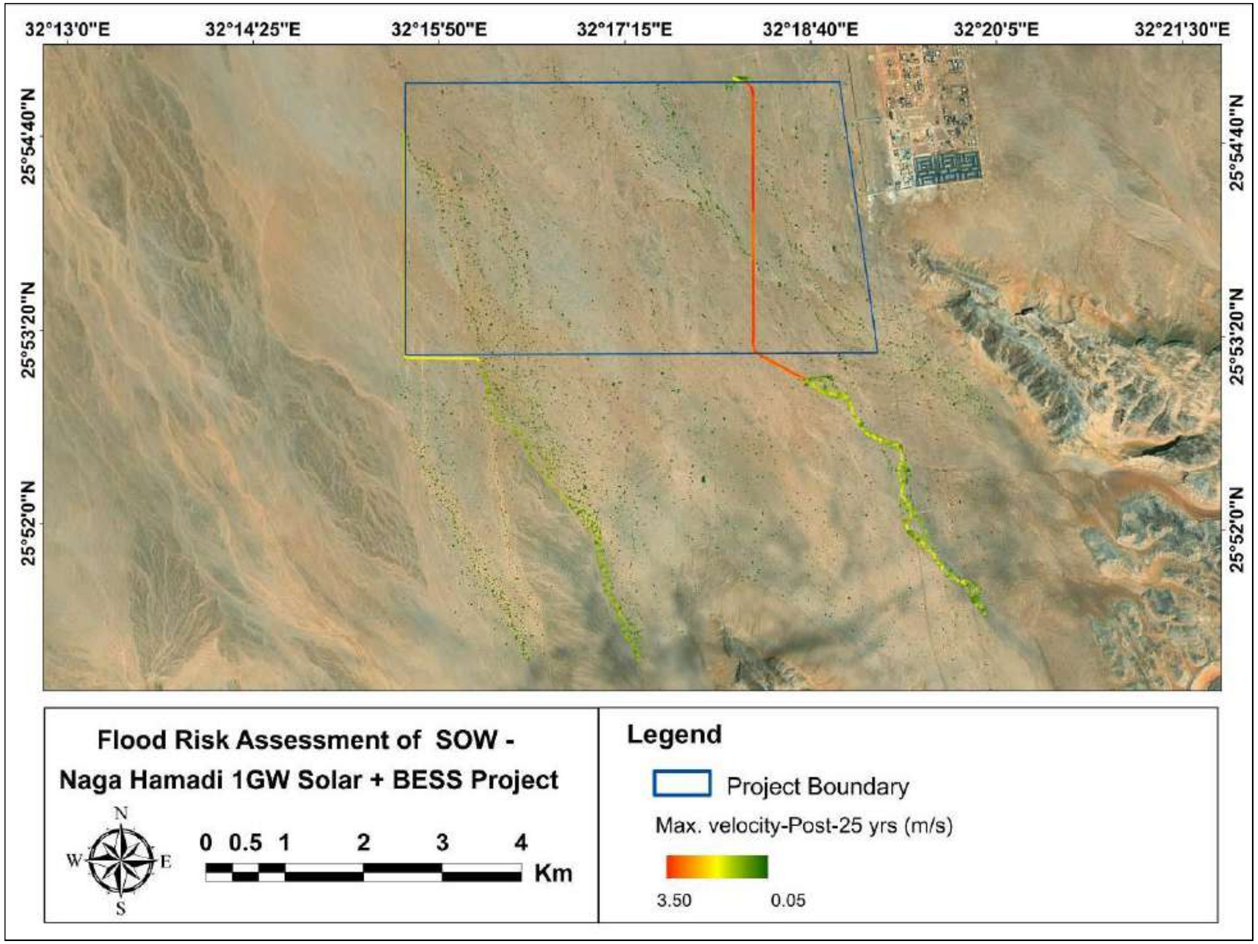
0 0.751.5 3 4.5 6
Km
Legend
Project Boundary
Max. velocity-100 yrs (m/s)
2.32
0.05

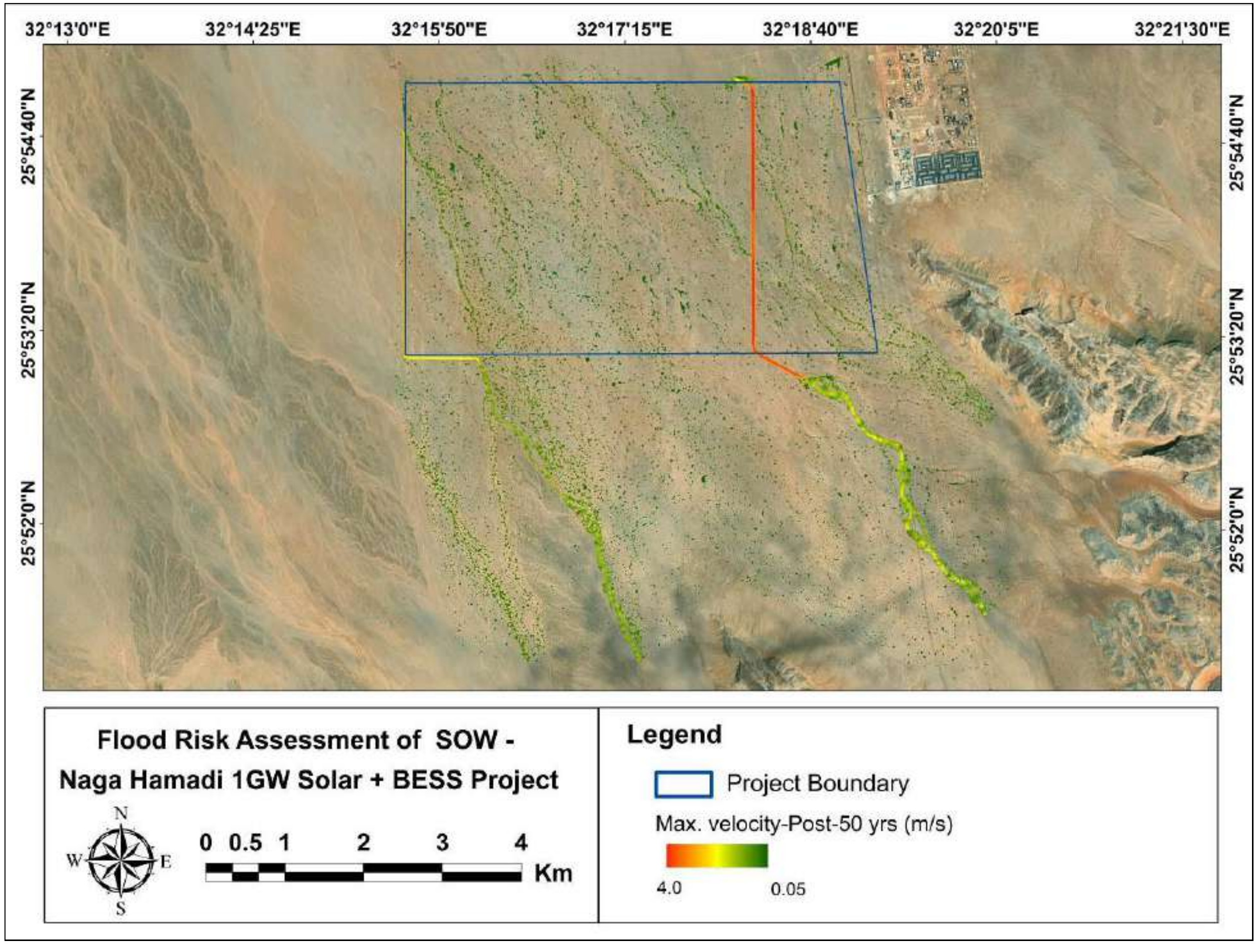

32°13'30"E
32°15'0"E
32°16'30"E
32°18'0"E
32°19'30"E
32°21'0"E
25°54'40"N
25°53'20"N
25°52'0"N
Channel 2
Length= 3.85 km
Channel 1
Length= 4.35 km
Dike
length= 477 m
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
N
W
E
S
0 0.5 1 2 3 4
Km
Legend
Project Boundary
Channels
Dike
Flow direction

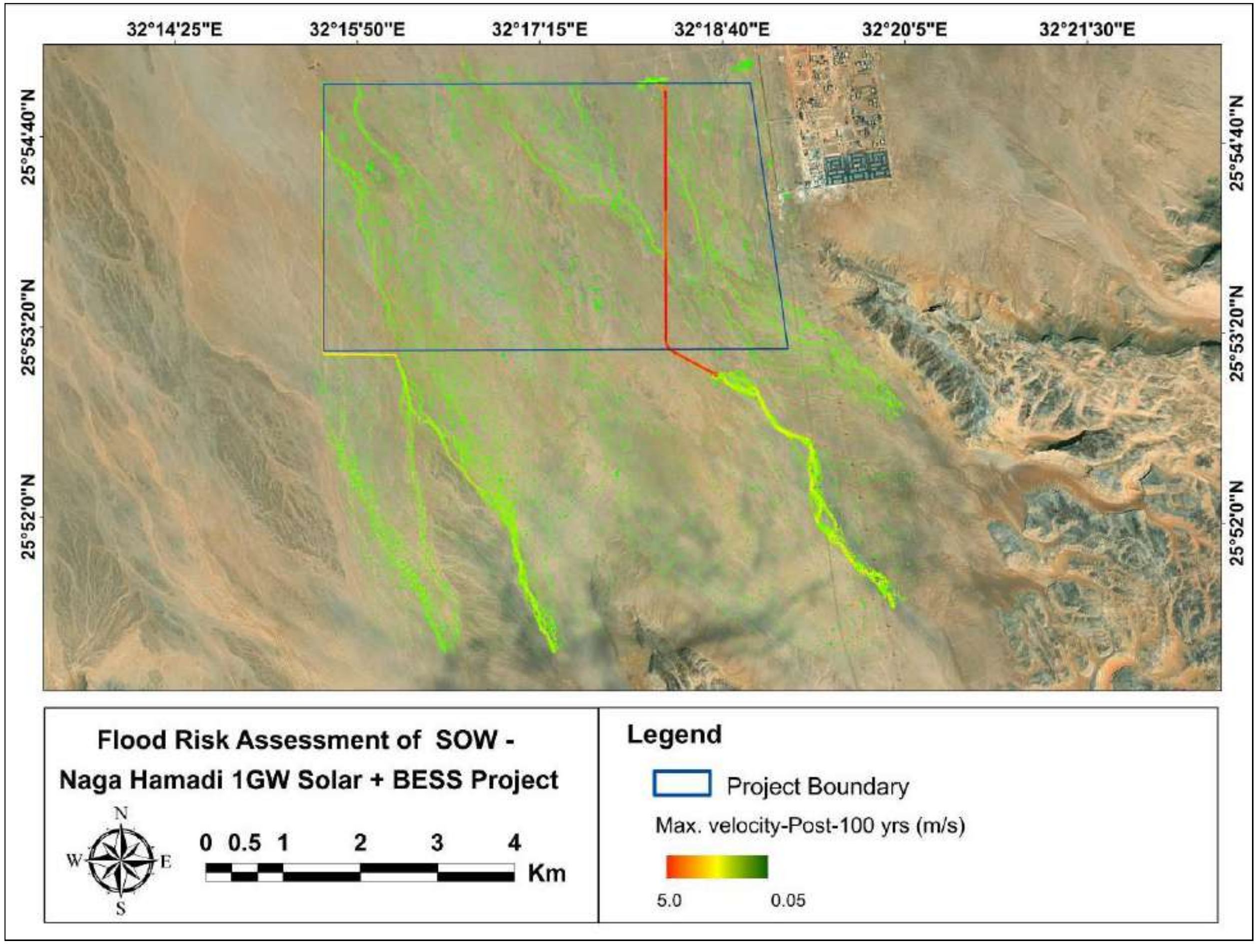

32°13'0"E
32°14'25"E
32°15'50"E
32°17'15"E
32°18'40"E
32°20'5"E
32°21'30"E
25°54'40"N
25°53'20"N
25°52'0"N
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
N
W
E
S
0 0.5 1 2 3 4
Km
Legend
Project Boundary
Max. depth-Post-25 yrs (m)
2.20
0.05

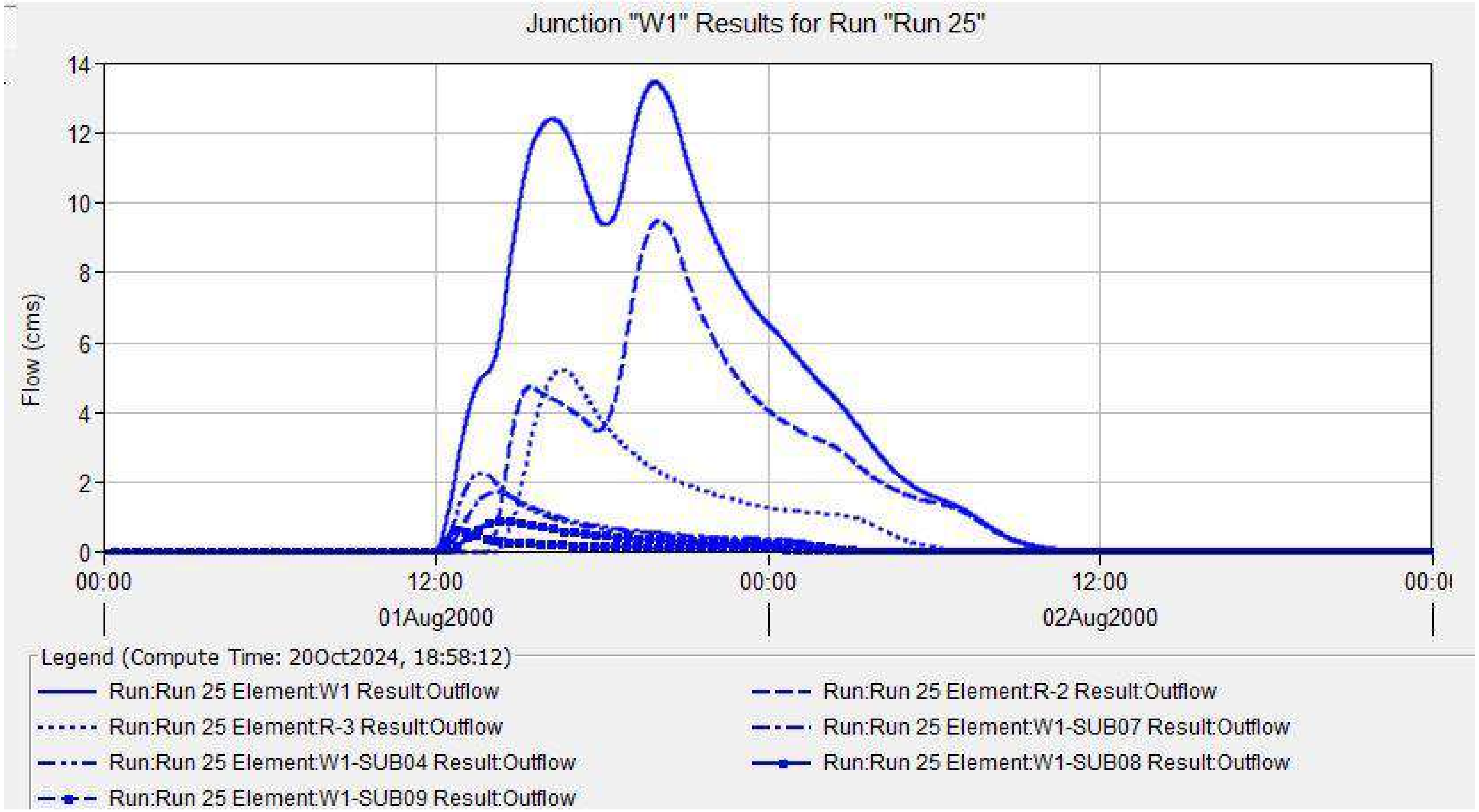

32°13'0"E
32°14'25"E
32°15'50"E
32°17'15"E
32°18'40"E
32°20'5"E
32°21'30"E
25°54'40"N
25°53'20"N
25°52'0"N
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
N
S
W
E
0 0.5 1 2 3 4
Km
Legend
Project Boundary
Max. depth-Post-50 yrs (m)
2.35
0.05

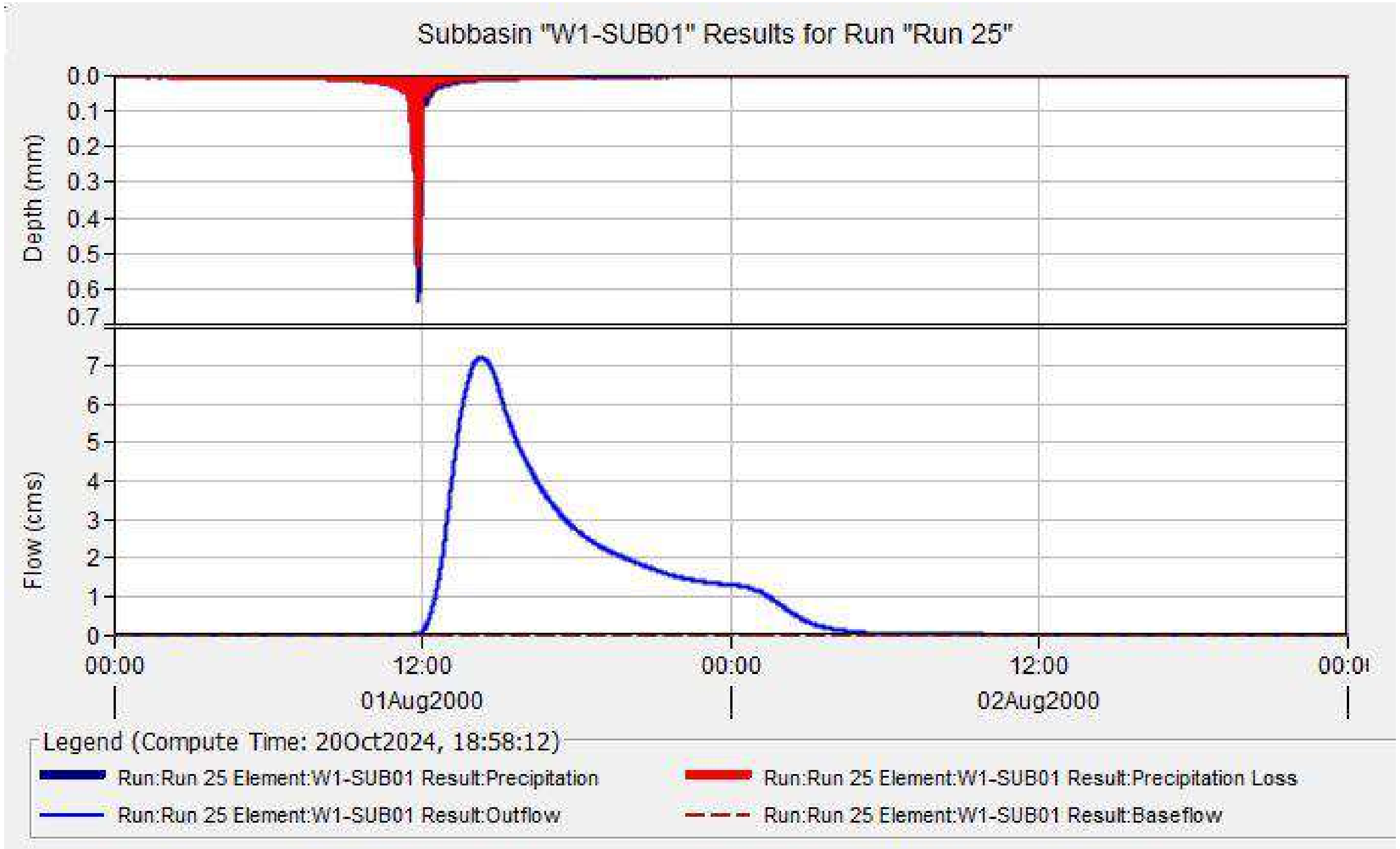

32°13'0"E
32°14'25"E
32°15'50"E
32°17'15"E
32°18'40"E
32°20'5"E
32°21'30"E
25°54'40"N
25°53'20"N
25°52'0"N
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
N
W
E
S
0 0.5 1 2 3 4
Km
Legend
Project Boundary
Max. depth-Post-100 yrs (m)
2.50
0.05

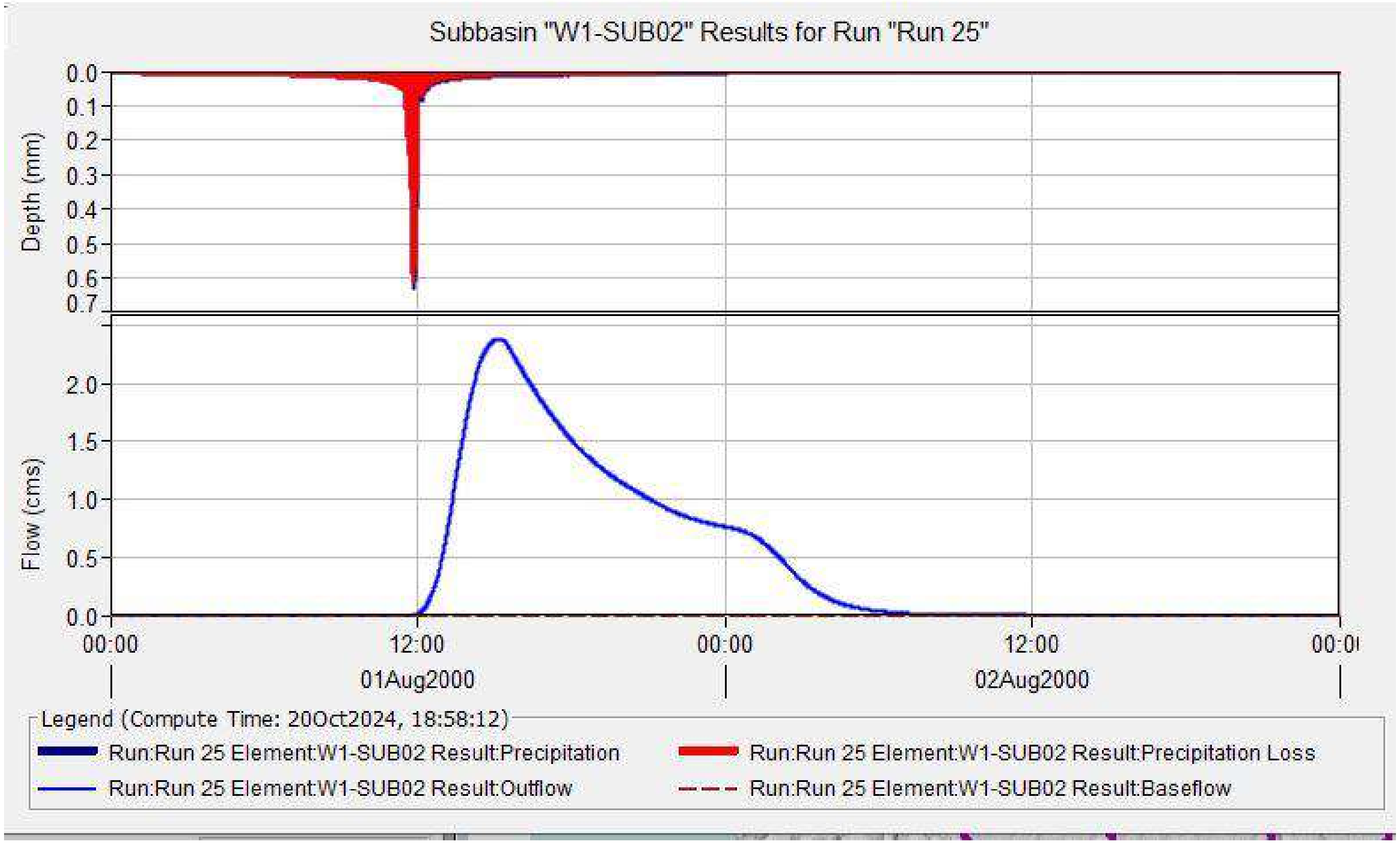

32°13'0"E
32°14'25"E
32°15'50"E
32°17'15"E
32°18'40"E
32°20'5"E
32°21'30"E
25°54'40"N
25°53'20"N
25°52'0"N
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
N
S
W
E
0 0.5 1 2 3 4
Km
Legend
Project Boundary
Max. velocity-Post-25 yrs (m/s)
3.50
0.05

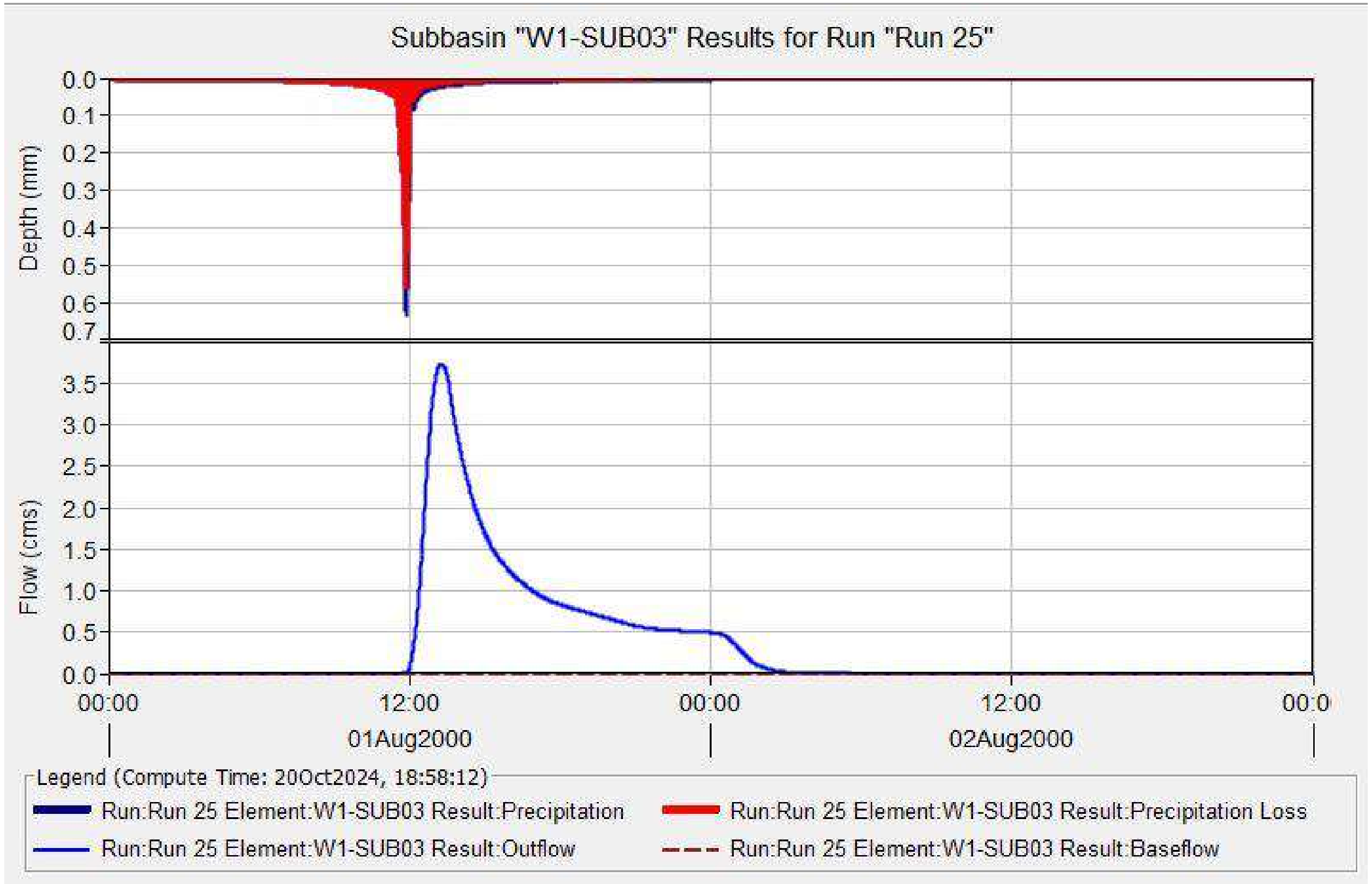

32°13'0"E
32°14'25"E
32°15'50"E
32°17'15"E
32°18'40"E
32°20'5"E
32°21'30"E
25°54'40"N
25°53'20"N
25°52'0"N
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
N
W
E
S
0 0.5 1 2 3 4
Km
Legend
Project Boundary
Max. velocity-Post-50 yrs (m/s)
4.0
0.05

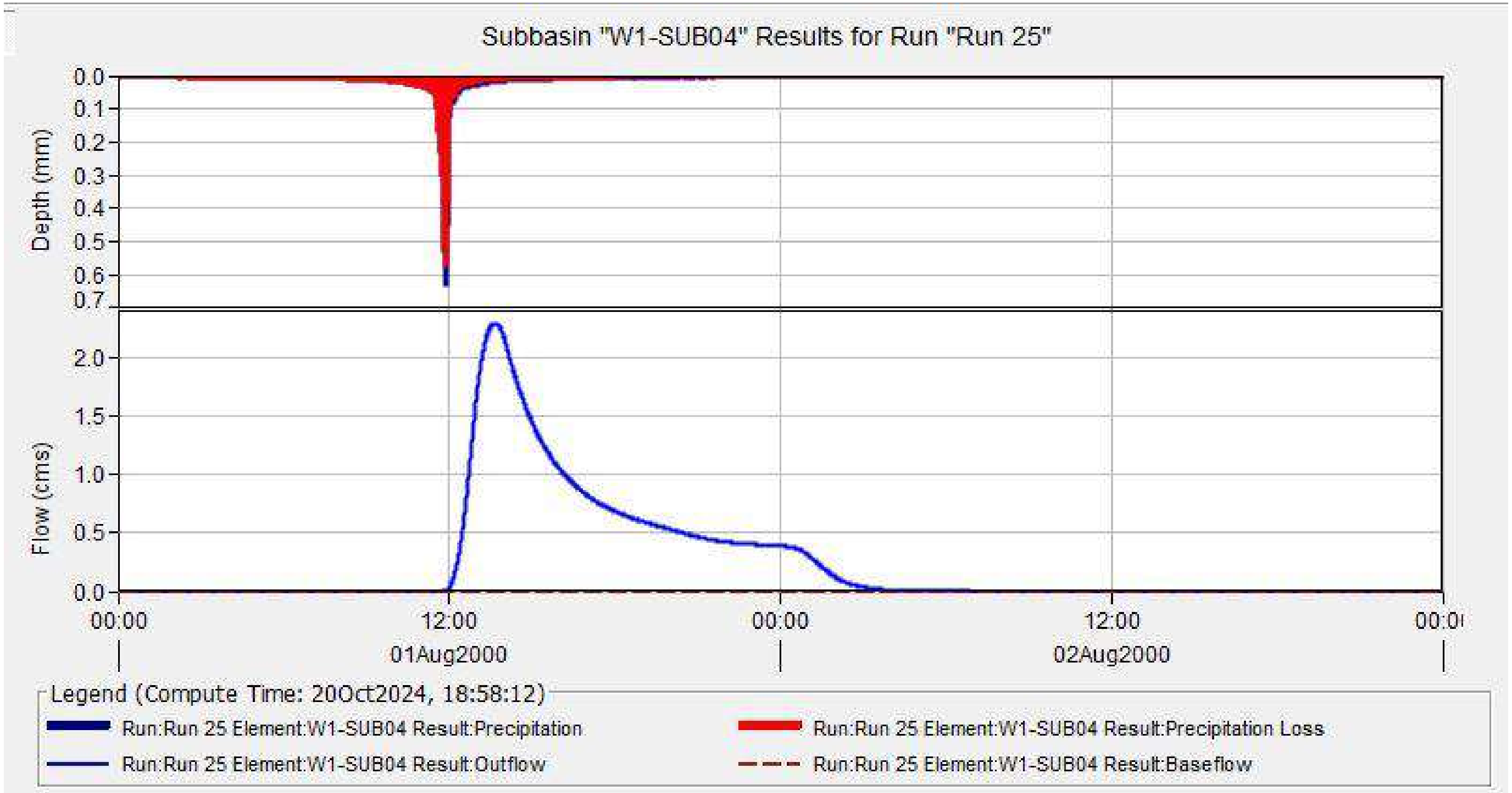

32°14'25"E
32°15'50"E
32°17'15"E
32°18'40"E
32°20'5"E
32°21'30"E
25°54'40"N
25°53'20"N
25°52'0"N
Flood Risk Assessment of SOW -
Naga Hamadi 1GW Solar + BESS Project
N
W
E
S
0 0.5 1 2 3 4
Km
Legend
Project Boundary
Max. velocity-Post-100 yrs (m/s)
5.0
0.05

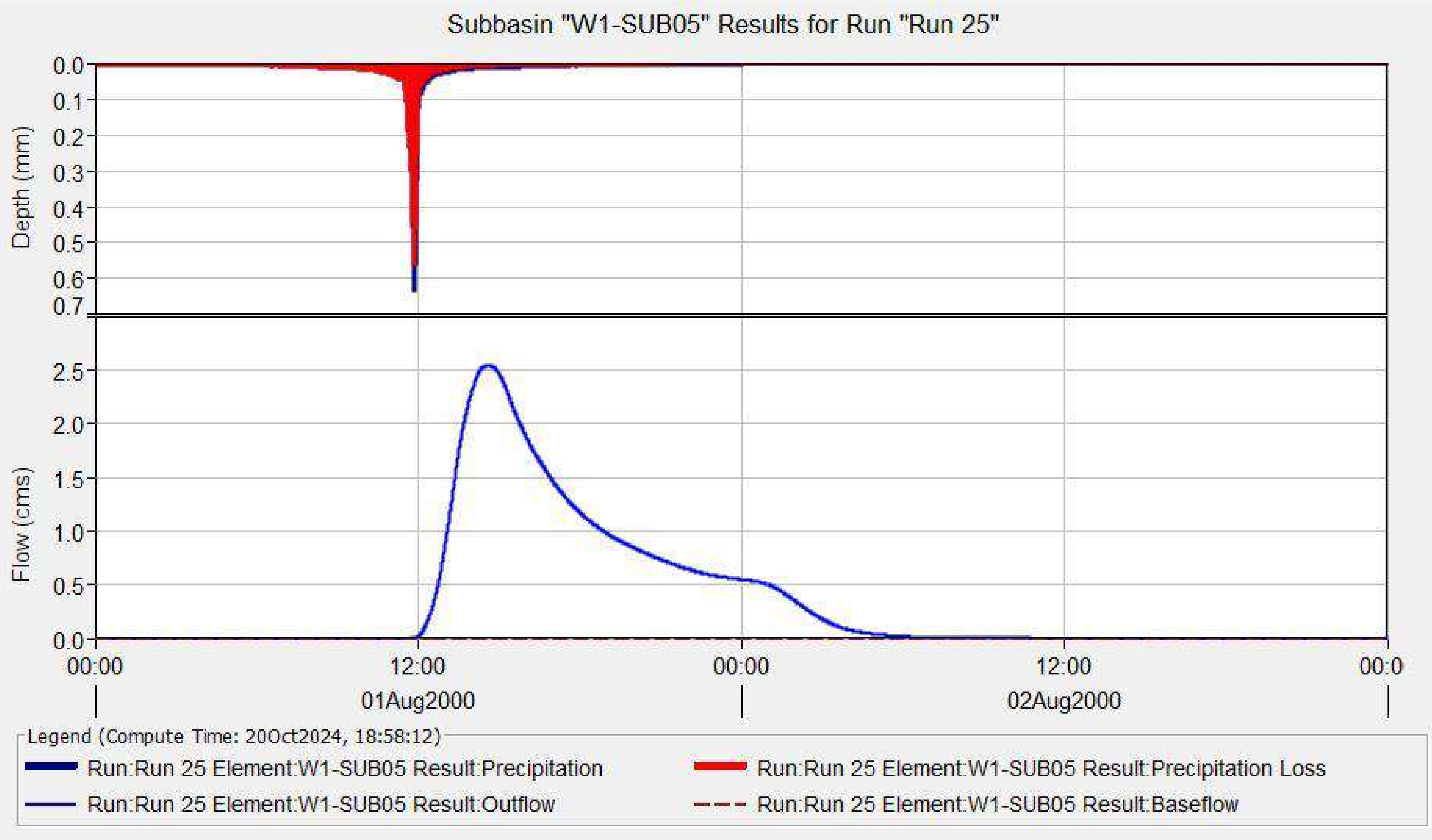

Junction "W1" Results for Run "Run 25"
Flow (cms)
14
12
10
8
6
4
2
0
00:00
12:00
00:00
12:00
00:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:58:12)
Run:Run 25 Element:W1 Result:Outflow
Run:Run 25 Element:R-2 Result:Outflow
Run:Run 25 Element:R-3 Result:Outflow
Run:Run 25 Element:W1-SUB07 Result:Outflow
Run:Run 25 Element:W1-SUB04 Result:Outflow
Run:Run 25 Element:W1-SUB08 Result:Outflow
Run:Run 25 Element:W1-SUB09 Result:Outflow

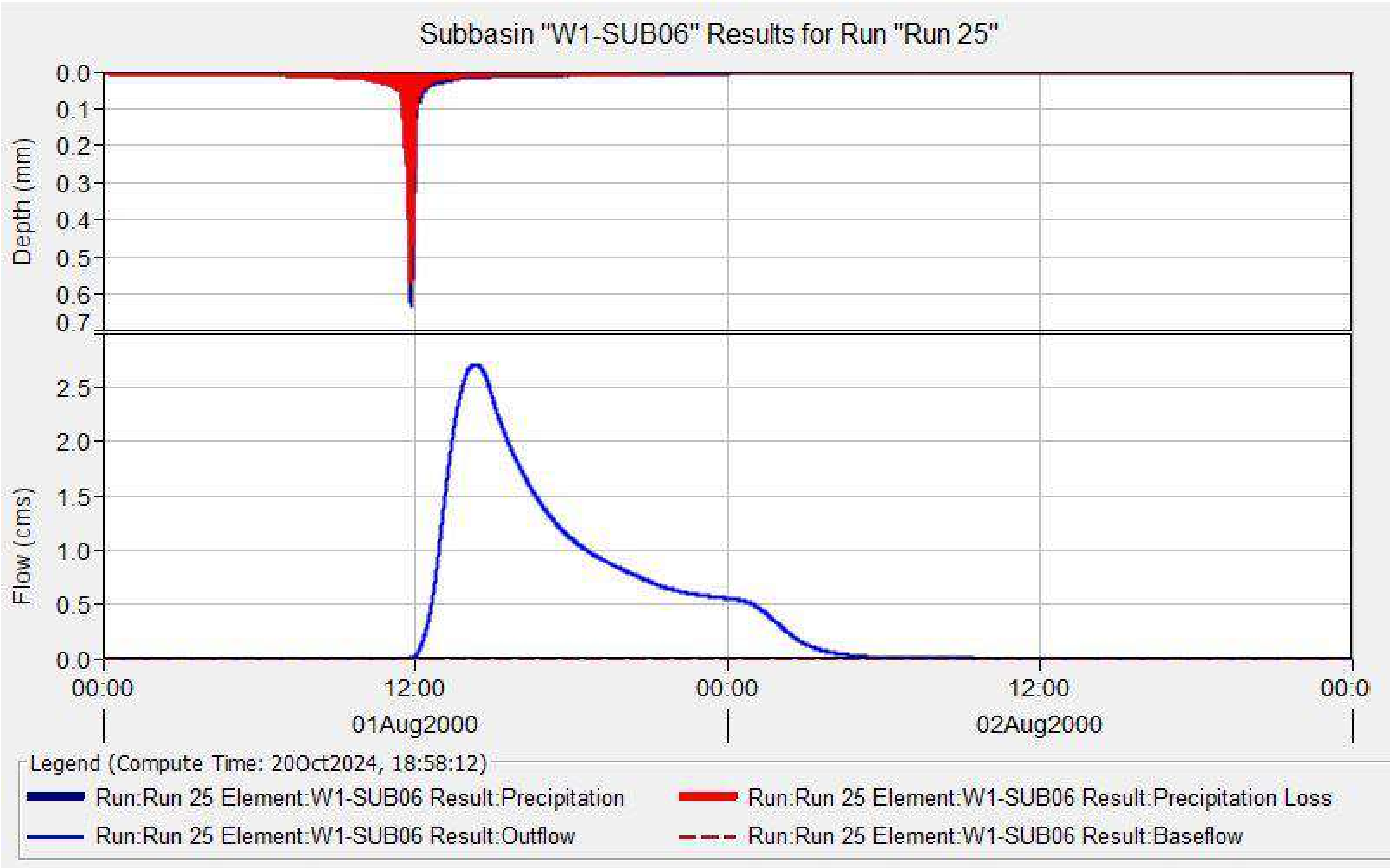

Subbasin "W1-SUB01" Results for Run "Run 25"
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
7
6
5
4
3
2
1
0
00:00
12:00
00:00
12:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:58:12)
Run:Run 25 Element:W1-SUB01 Result:Precipitation
Run:Run 25 Element:W1-SUB01 Result:Precipitation Loss
Run:Run 25 Element:W1-SUB01 Result:Outflow
Run:Run 25 Element:W1-SUB01 Result:Baseflow

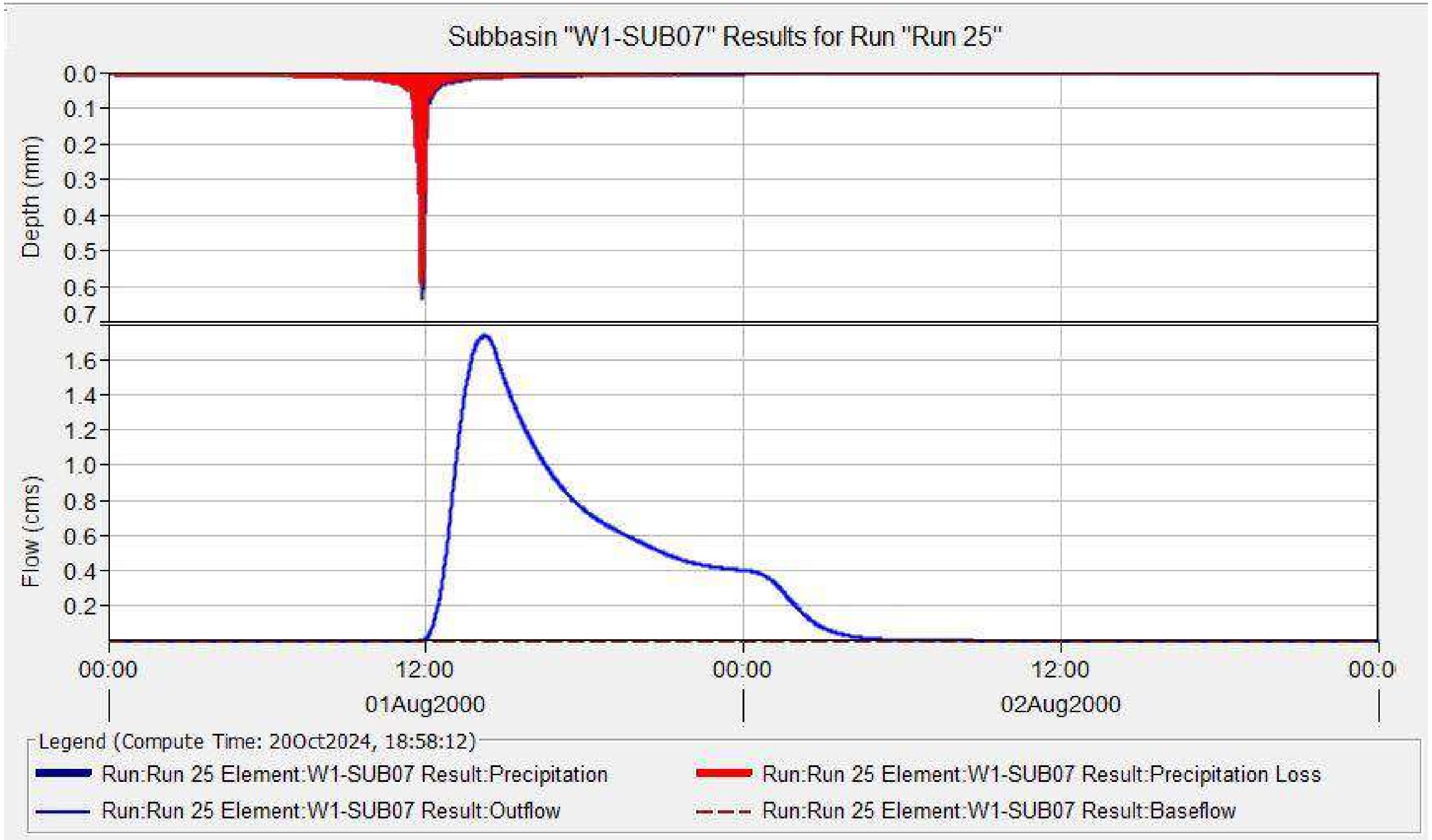

Subbasin "W1-SUB02" Results for Run "Run 25"
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:58:12)
Run:Run 25 Element:W1-SUB02 Result:Precipitation
Run:Run 25 Element:W1-SUB02 Result:Precipitation Loss
Run:Run 25 Element:W1-SUB02 Result:Outflow
Run:Run 25 Element:W1-SUB02 Result:Baseflow

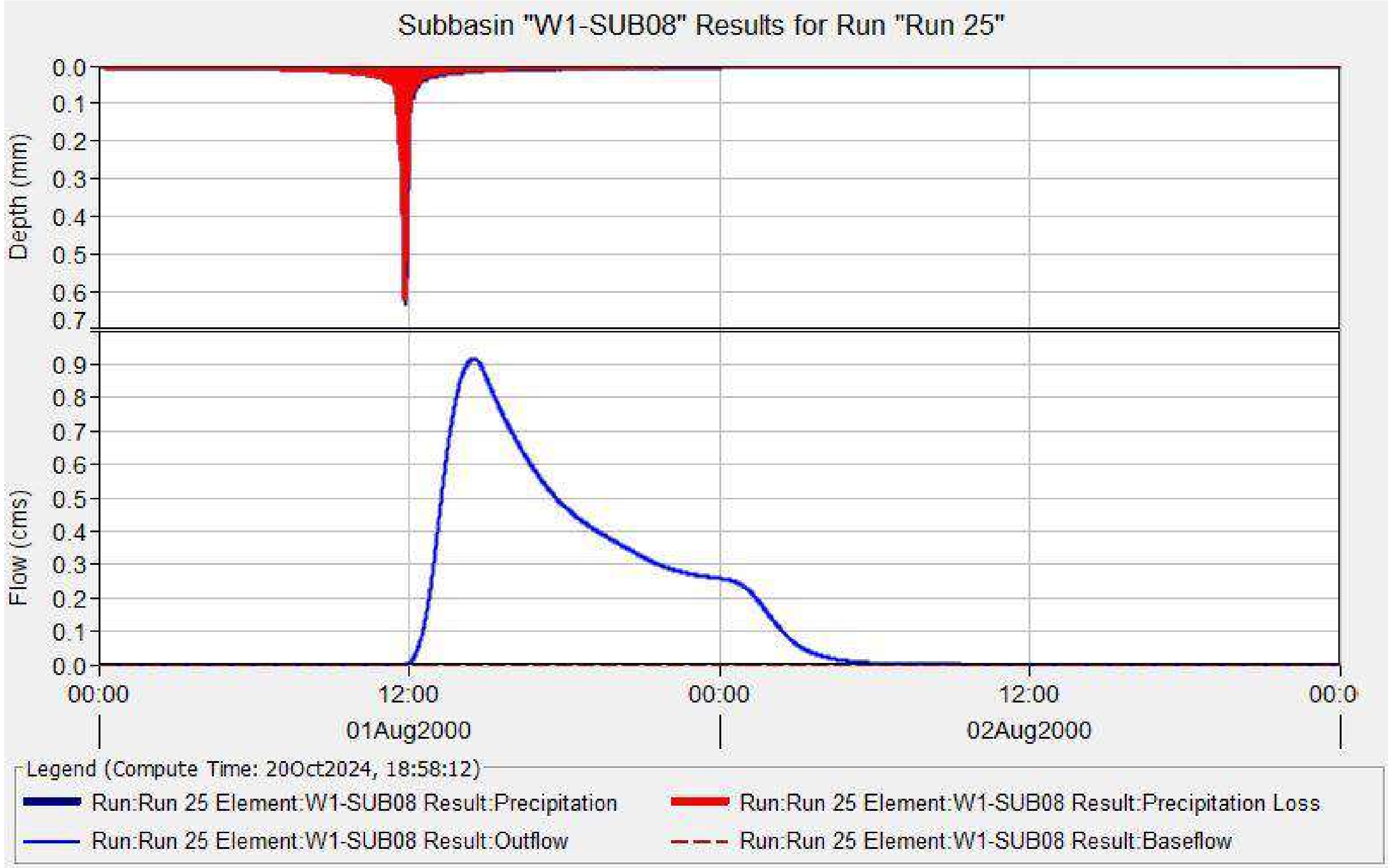

Subbasin "W1-SUB03" Results for Run "Run 25"
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:58:12)
Run:Run 25 Element:W1-SUB03 Result:Precipitation
Run:Run 25 Element:W1-SUB03 Result:Precipitation Loss
Run:Run 25 Element:W1-SUB03 Result:Outflow
Run:Run 25 Element:W1-SUB03 Result:Baseflow

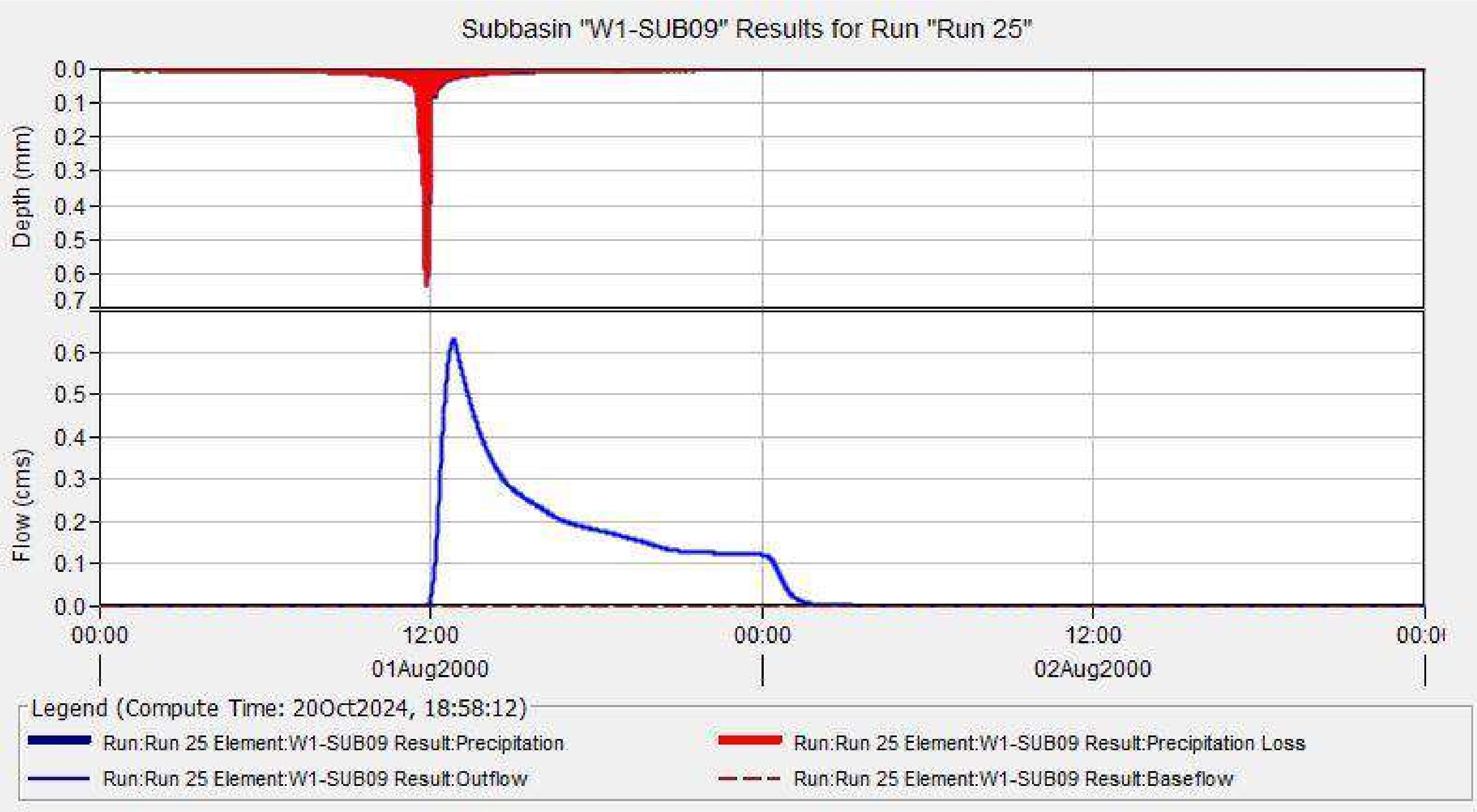

Subbasin "W1-SUB04" Results for Run "Run 25"
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
2.0
1.5
1.0
0.5
0.0
00:00
12:00
01Aug2000
00:00
12:00
02Aug2000
Legend (Compute Time: 20Oct2024, 18:58:12)
Run:Run 25 Element:W1-SUB04 Result:Precipitation
Run:Run 25 Element:W1-SUB04 Result:Precipitation Loss
Run:Run 25 Element:W1-SUB04 Result:Outflow
Run:Run 25 Element:W1-SUB04 Result:Baseflow

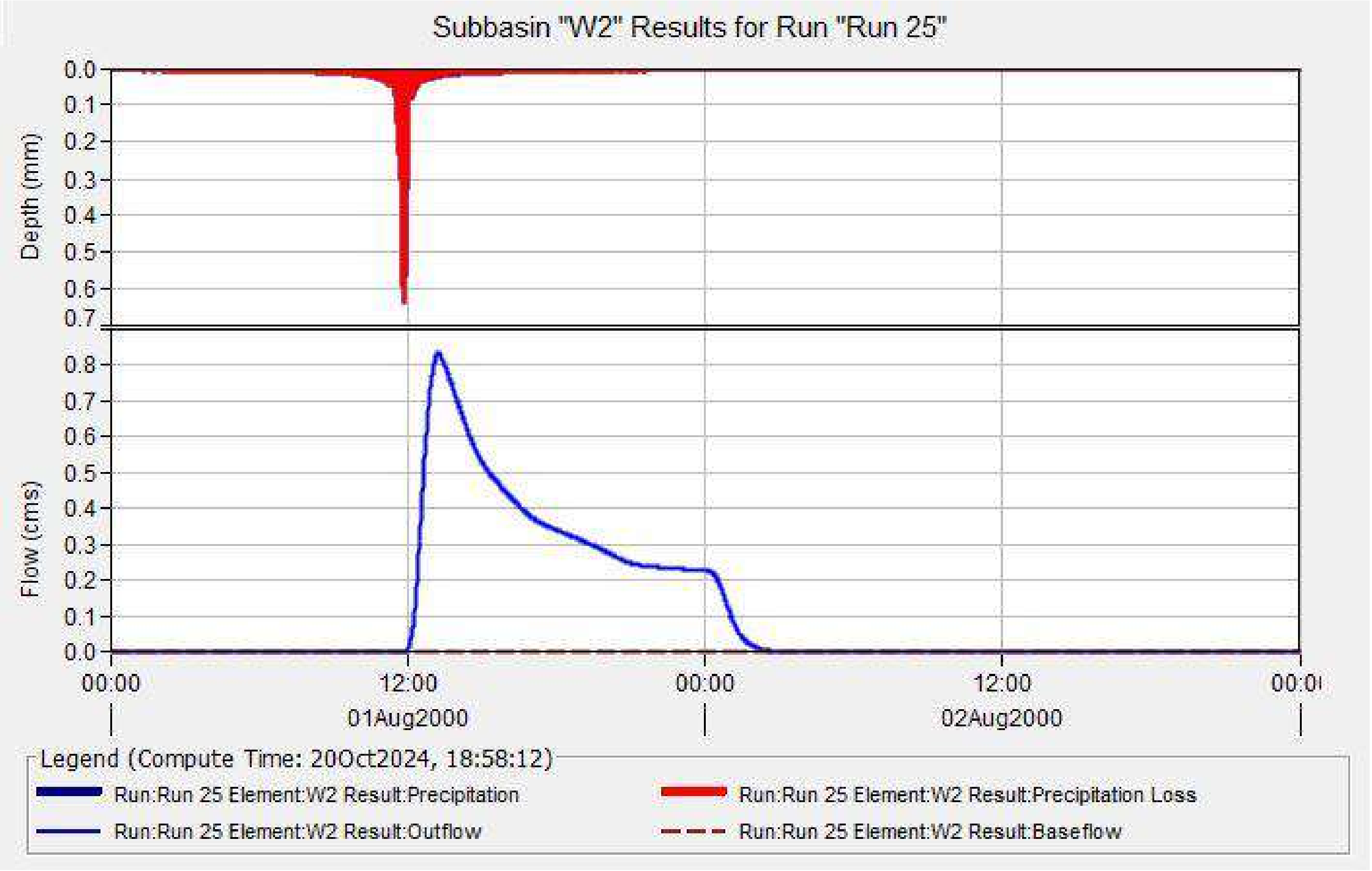

Subbasin "W1-SUB05" Results for Run "Run 25"
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
2.5
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:58:12)
Run:Run 25 Element:W1-SUB05 Result:Precipitation
Run:Run 25 Element:W1-SUB05 Result:Precipitation Loss
Run:Run 25 Element:W1-SUB05 Result:Outflow
Run:Run 25 Element:W1-SUB05 Result:Baseflow

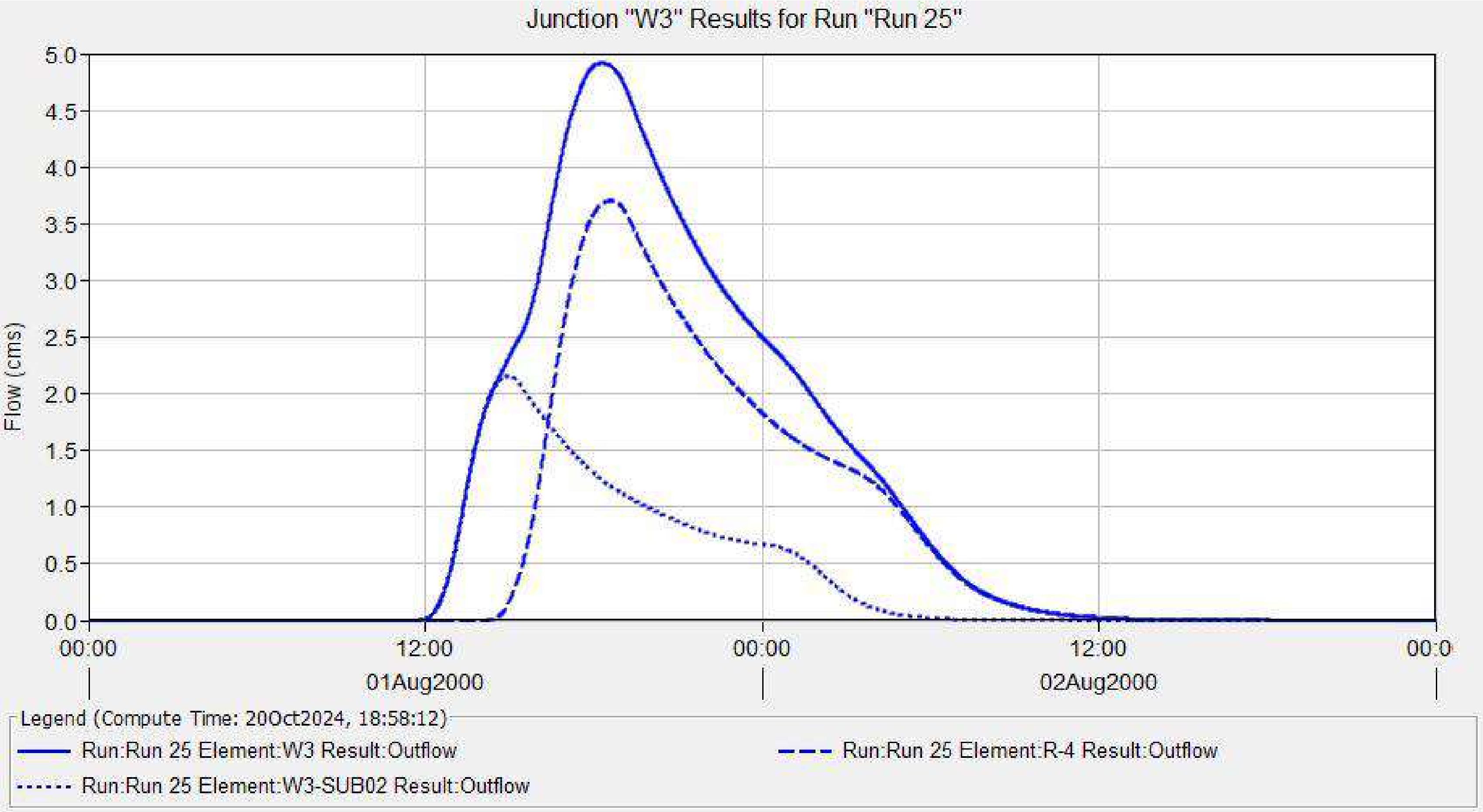

Subbasin "W1-SUB06" Results for Run "Run 25"
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
2.5
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:58:12)
Run:Run 25 Element:W1-SUB06 Result:Precipitation
Run:Run 25 Element:W1-SUB06 Result:Precipitation Loss
Run:Run 25 Element:W1-SUB06 Result:Outflow
Run:Run 25 Element:W1-SUB06 Result:Baseflow

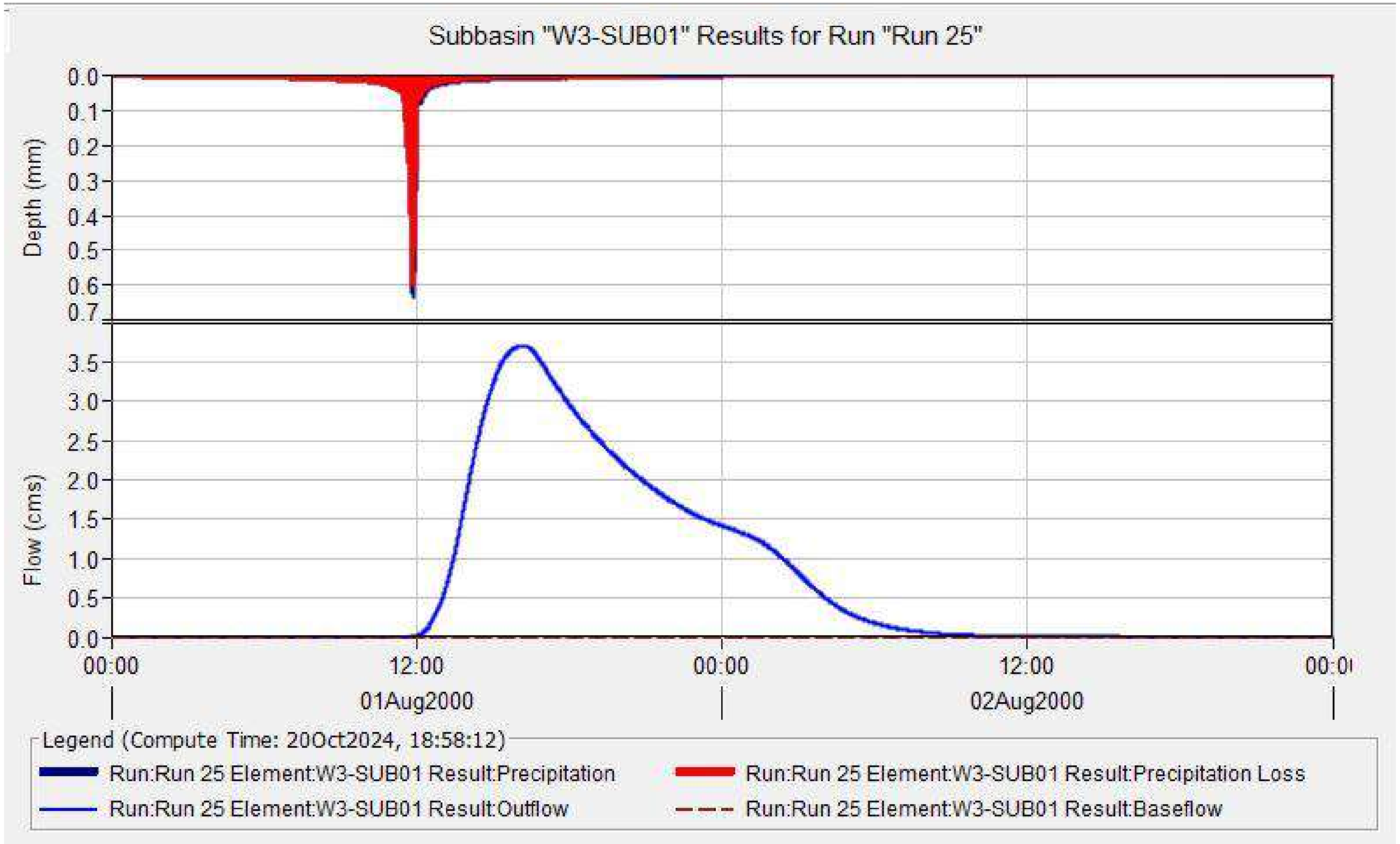

Subbasin "W1-SUB07" Results for Run "Run 25"
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:58:12)
Run:Run 25 Element:W1-SUB07 Result:Precipitation
Run:Run 25 Element:W1-SUB07 Result:Precipitation Loss
Run:Run 25 Element:W1-SUB07 Result:Outflow
Run:Run 25 Element:W1-SUB07 Result:Baseflow

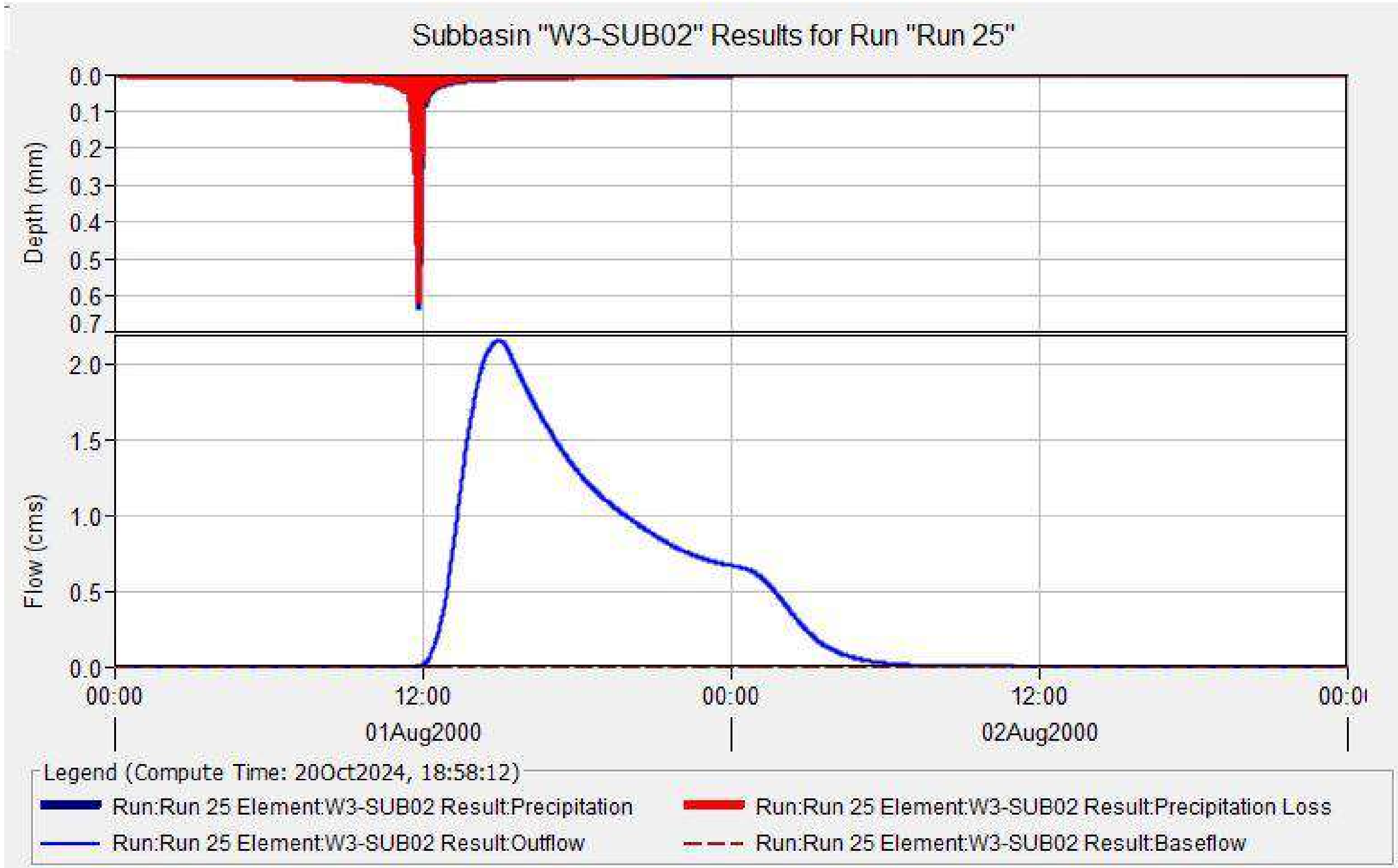

Subbasin "W1-SUB08" Results for Run "Run 25"
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:58:12)
Run:Run 25 Element:W1-SUB08 Result:Precipitation
Run:Run 25 Element:W1-SUB08 Result:Precipitation Loss
Run:Run 25 Element:W1-SUB08 Result:Outflow
Run:Run 25 Element:W1-SUB08 Result:Baseflow

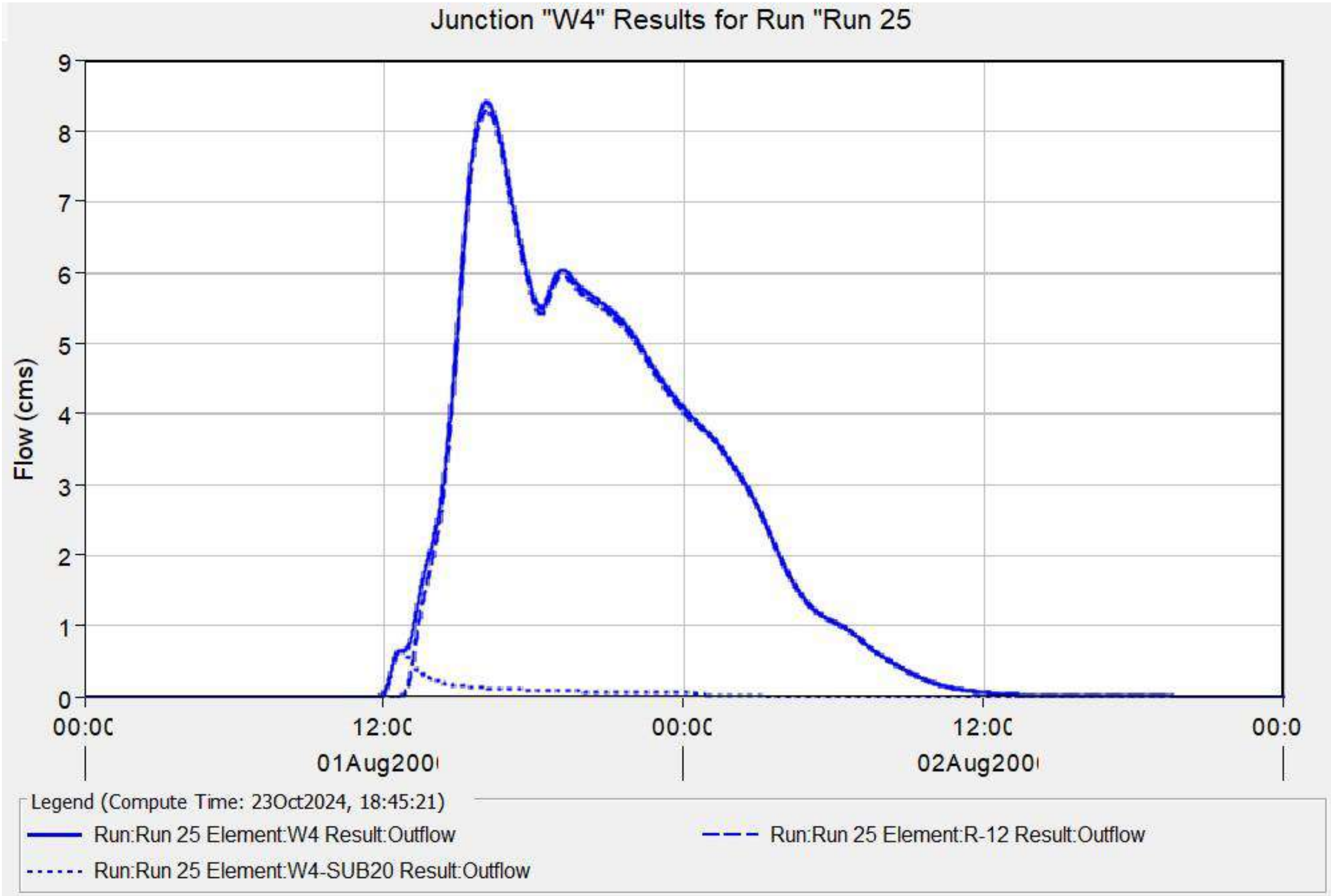

Subbasin "W1-SUB09" Results for Run "Run 25"
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
00:00
12:00
00:00
12:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:58:12)
Run:Run 25 Element:W1-SUB09 Result:Precipitation
Run:Run 25 Element:W1-SUB09 Result:Precipitation Loss
Run:Run 25 Element:W1-SUB09 Result:Outflow
Run:Run 25 Element:W1-SUB09 Result:Baseflow

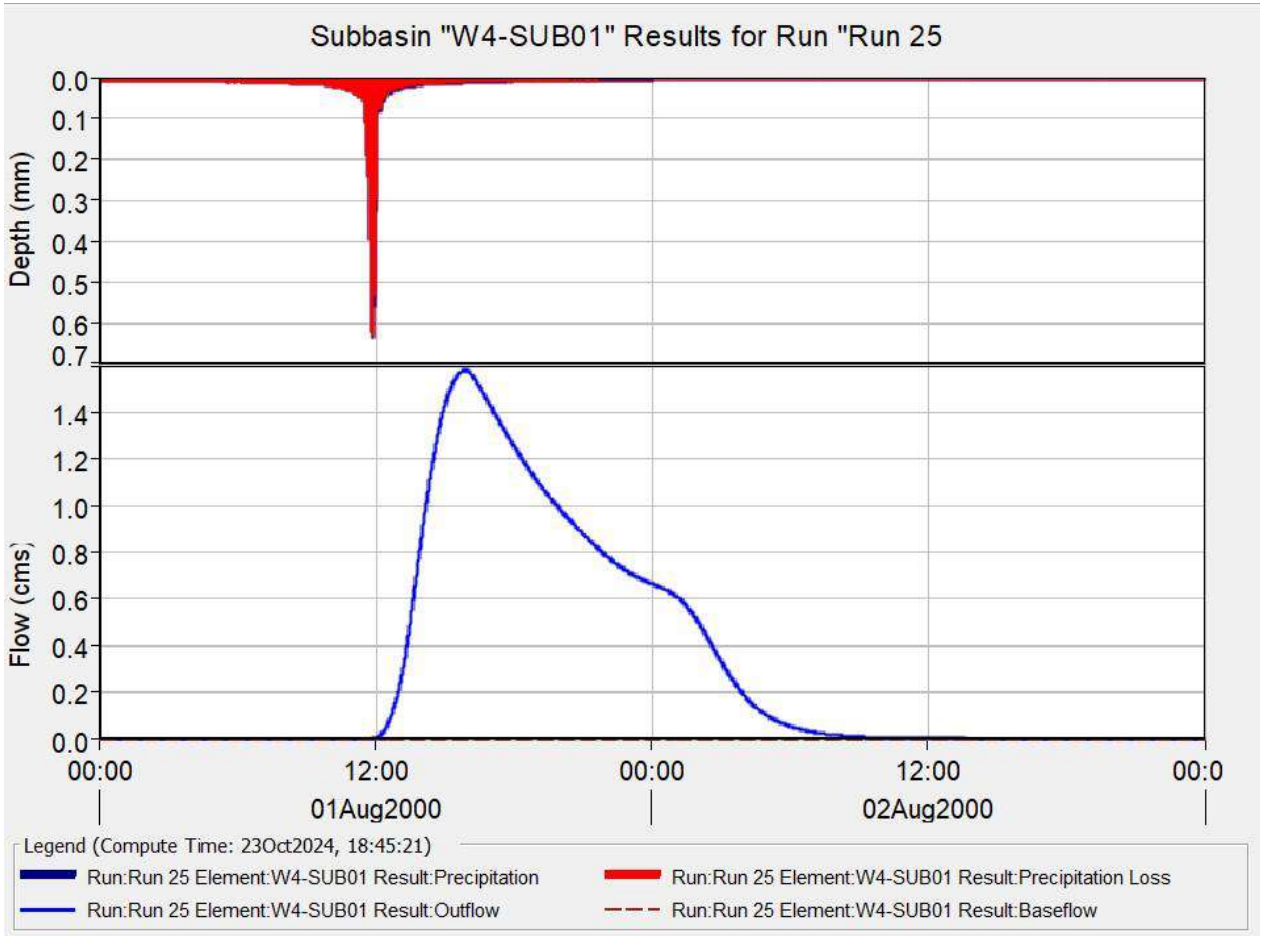

Subbasin "W2" Results for Run "Run 25"
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:58:12)
Run:Run 25 Element:W2 Result:Precipitation
Run:Run 25 Element:W2 Result:Precipitation Loss
Run:Run 25 Element:W2 Result:Outflow
Run:Run 25 Element:W2 Result:Baseflow

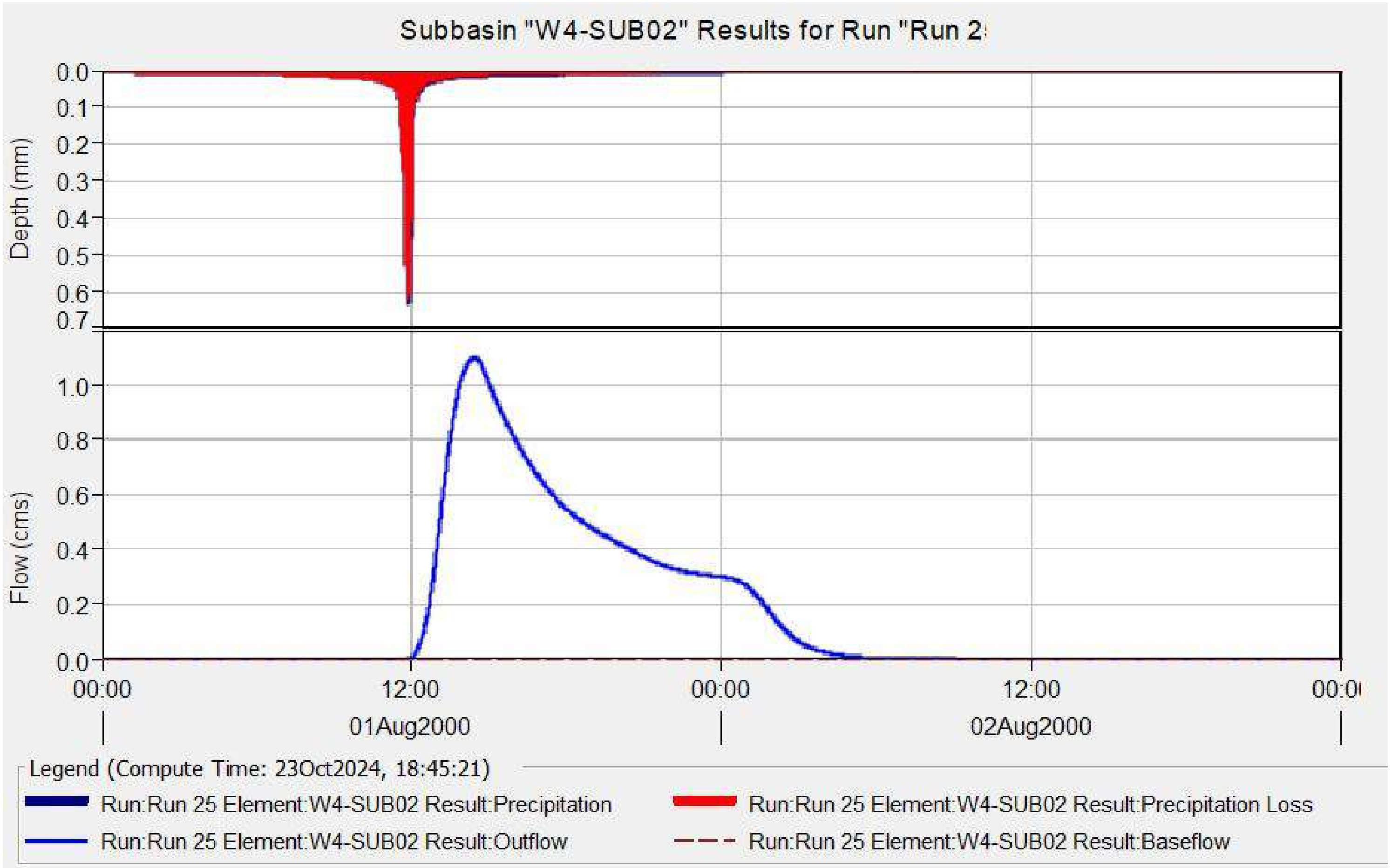

Junction "W3" Results for Run "Run 25"
Flow (cms)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:58:12)
Run:Run 25 Element:W3 Result:Outflow
Run:Run 25 Element:R-4 Result:Outflow
Run:Run 25 Element:W3-SUB02 Result:Outflow

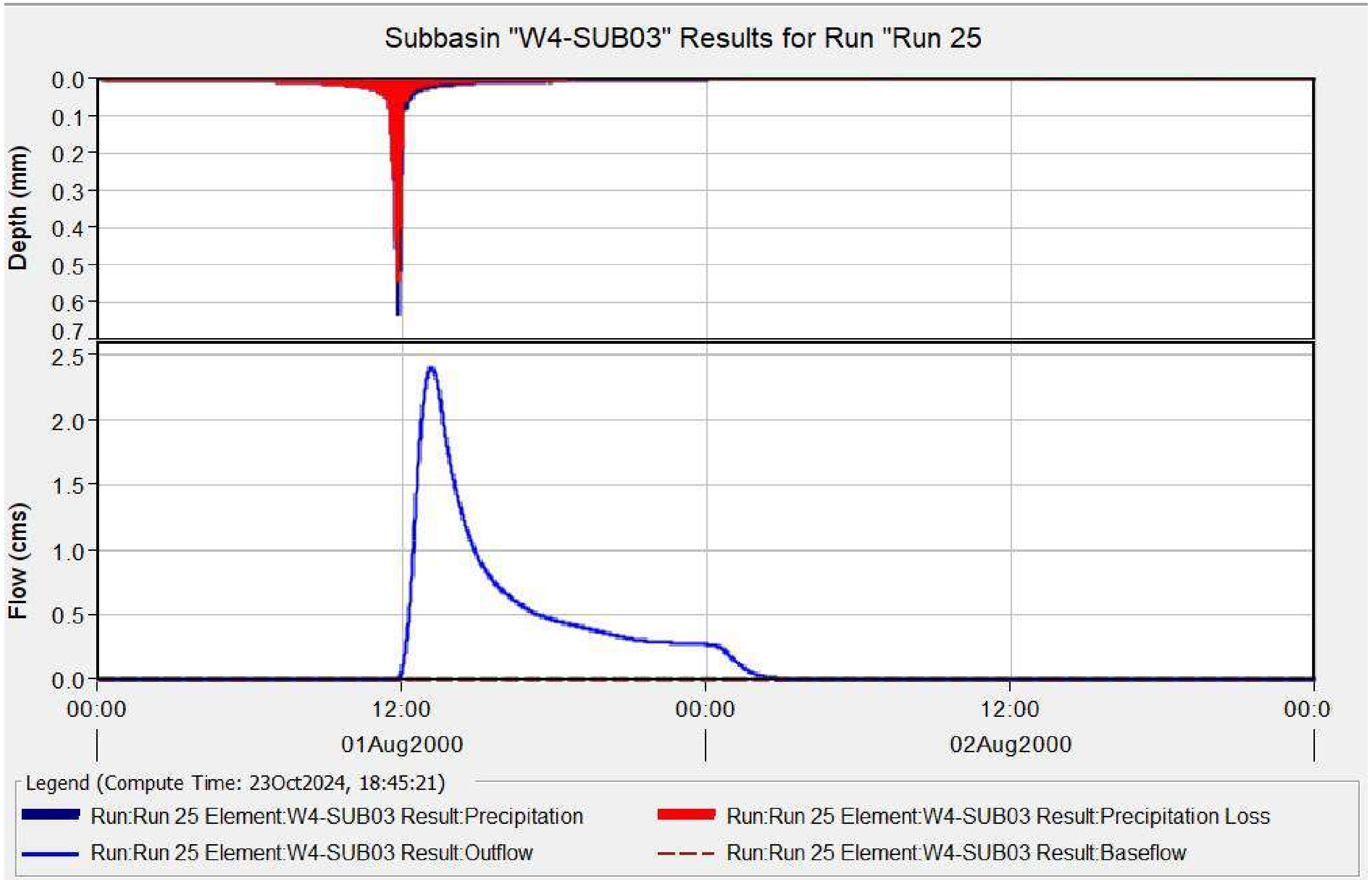

Subbasin "W3-SUB01" Results for Run "Run 25"
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:58:12)
Run:Run 25 Element:W3-SUB01 Result:Precipitation
Run:Run 25 Element:W3-SUB01 Result:Precipitation Loss
Run:Run 25 Element:W3-SUB01 Result:Outflow
Run:Run 25 Element:W3-SUB01 Result:Baseflow

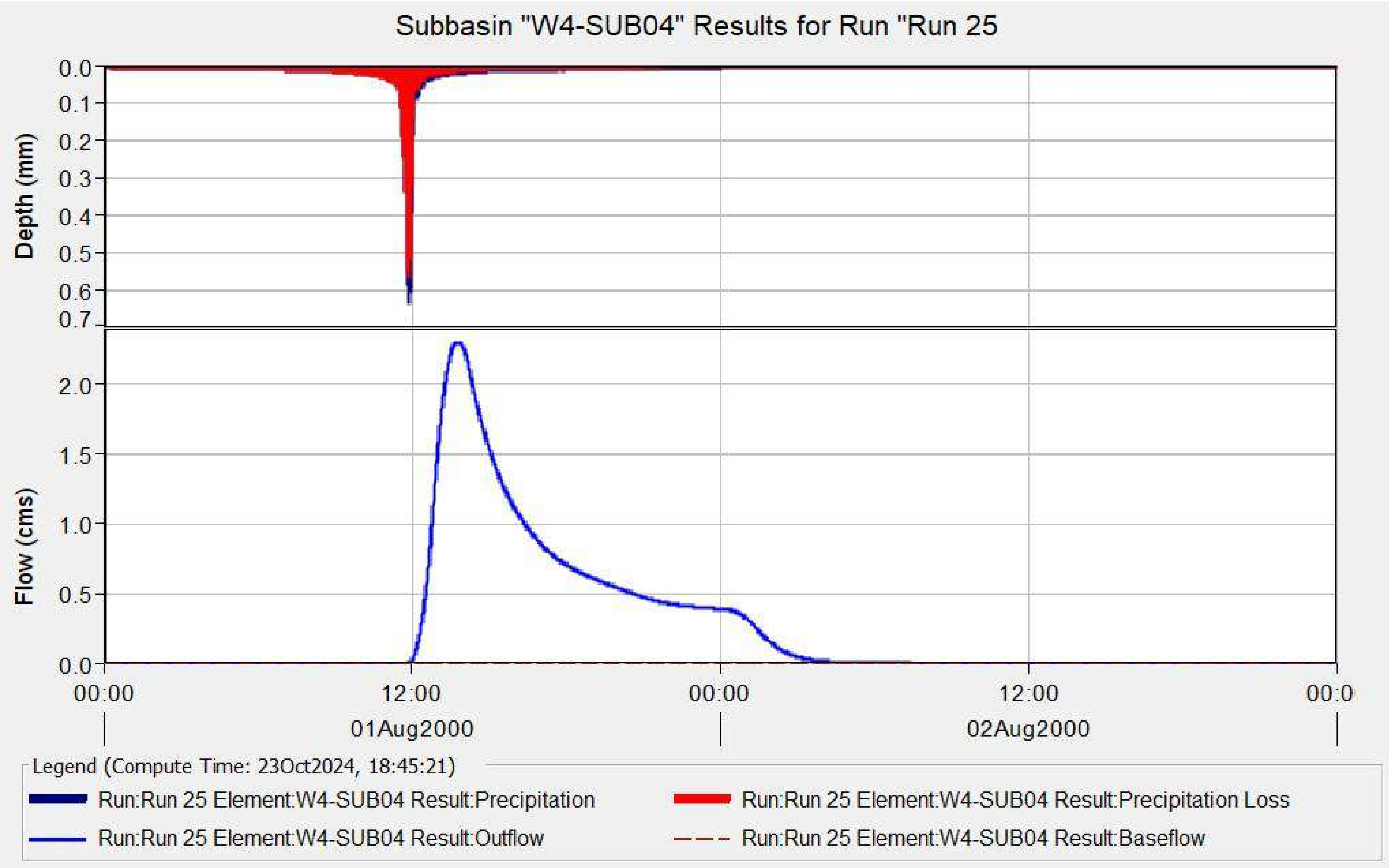

Subbasin "W3-SUB02" Results for Run "Run 25"
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:58:12)
Run:Run 25 Element:W3-SUB02 Result:Precipitation
Run:Run 25 Element:W3-SUB02 Result:Precipitation Loss
Run:Run 25 Element:W3-SUB02 Result:Outflow
Run:Run 25 Element:W3-SUB02 Result:Baseflow

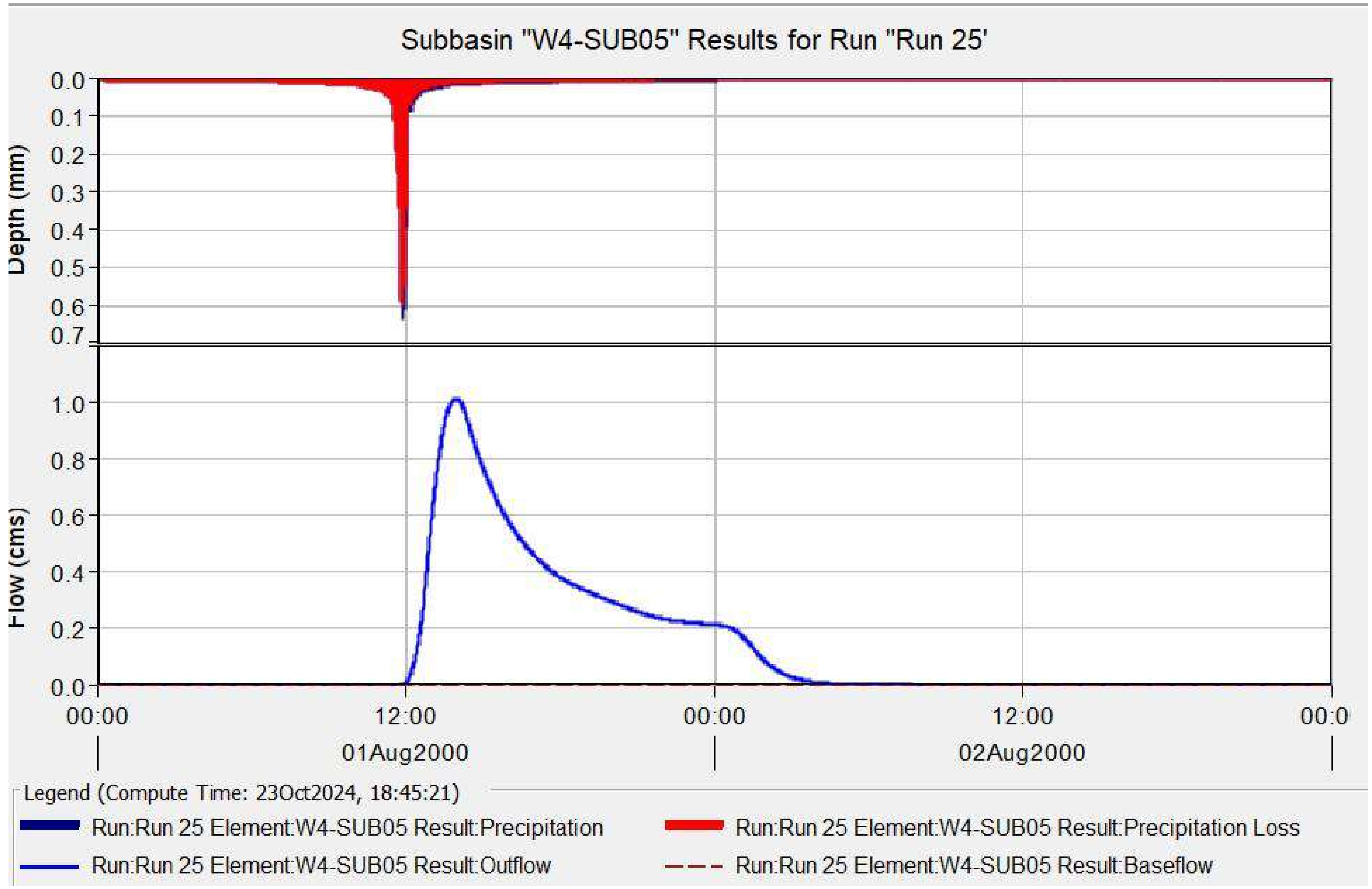

Junction "W4" Results for Run "Run 25
Flow (cms)
9
8
7
6
5
4
3
2
1
0
00:00
12:00
00:00
12:00
00:0
01Aug200
02Aug200
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4 Result:Outflow
Run:Run 25 Element:R-12 Result:Outflow
Run:Run 25 Element:W4-SUB20 Result:Outflow

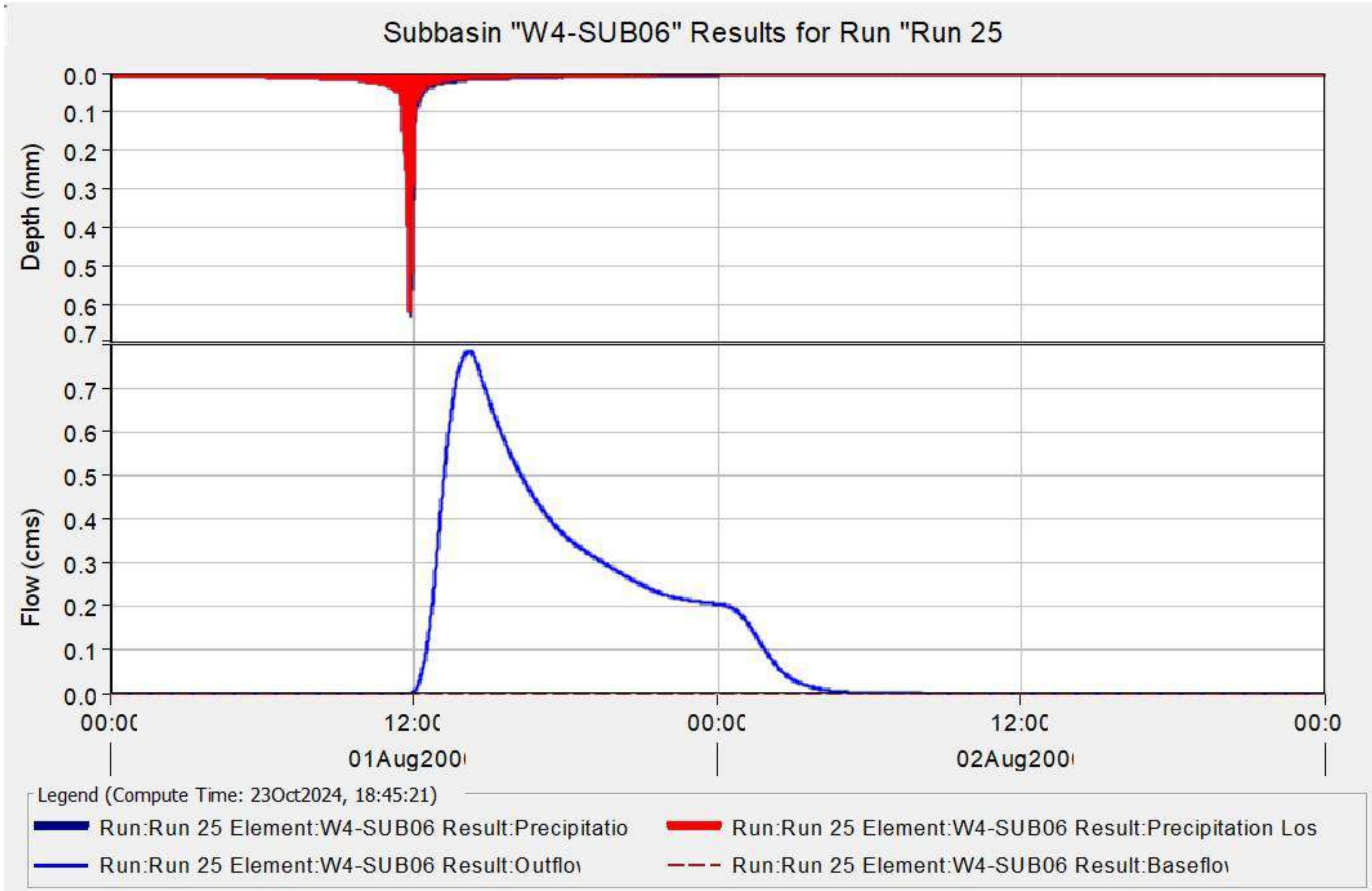

Subbasin "W4-SUB01" Results for Run "Run 25
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4-SUB01 Result:Precipitation
Run:Run 25 Element:W4-SUB01 Result:Precipitation Loss
Run:Run 25 Element:W4-SUB01 Result:Outflow
Run:Run 25 Element:W4-SUB01 Result:Baseflow

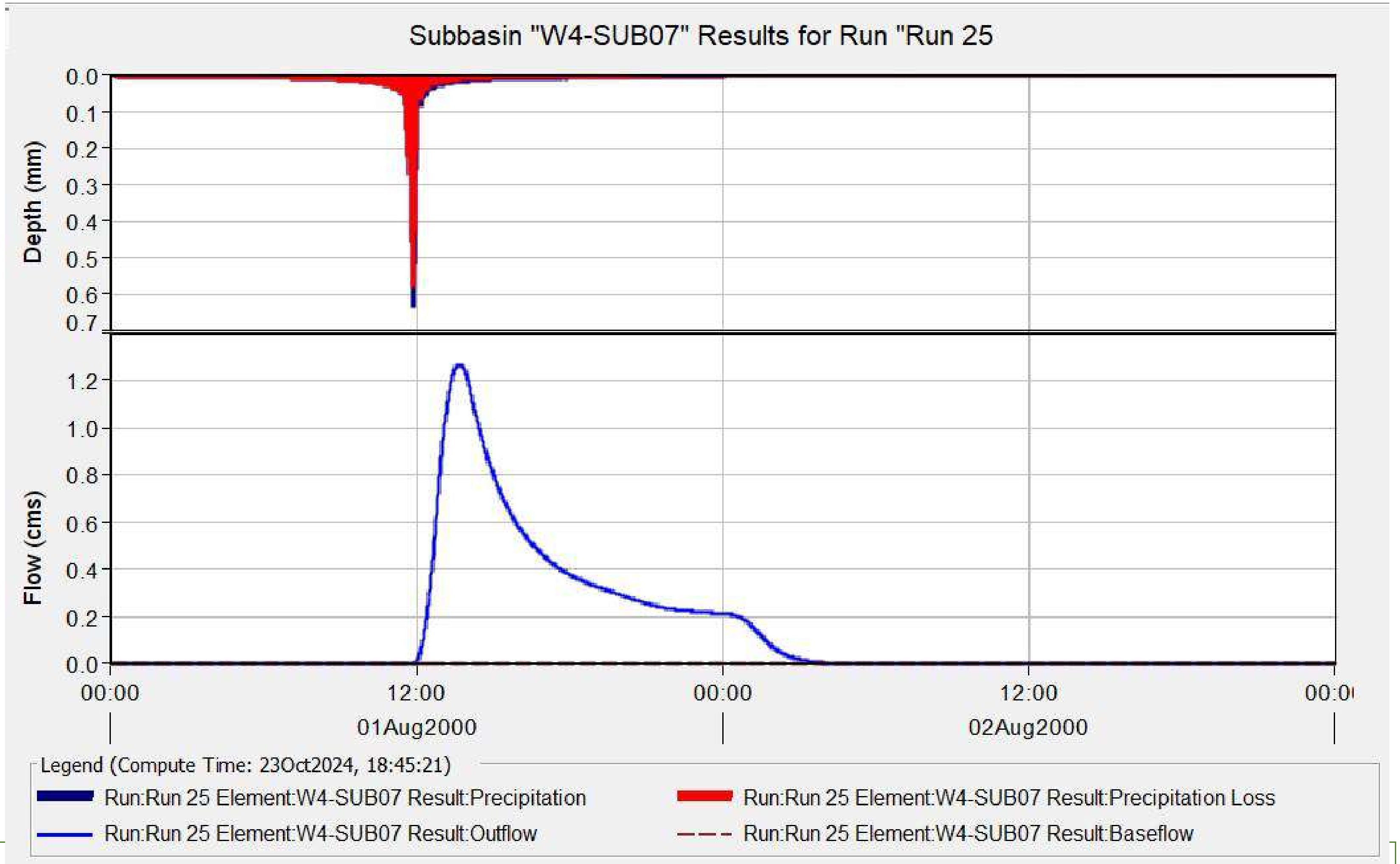

Subbasin "W4-SUB02" Results for Run "Run 2
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
1.0
0.8
0.6
0.4
0.2
0.0
00:00
12:00
00:00
12:00
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4-SUB02 Result:Precipitation
Run:Run 25 Element:W4-SUB02 Result:Precipitation Loss
Run:Run 25 Element:W4-SUB02 Result:Outflow
Run:Run 25 Element:W4-SUB02 Result:Baseflow

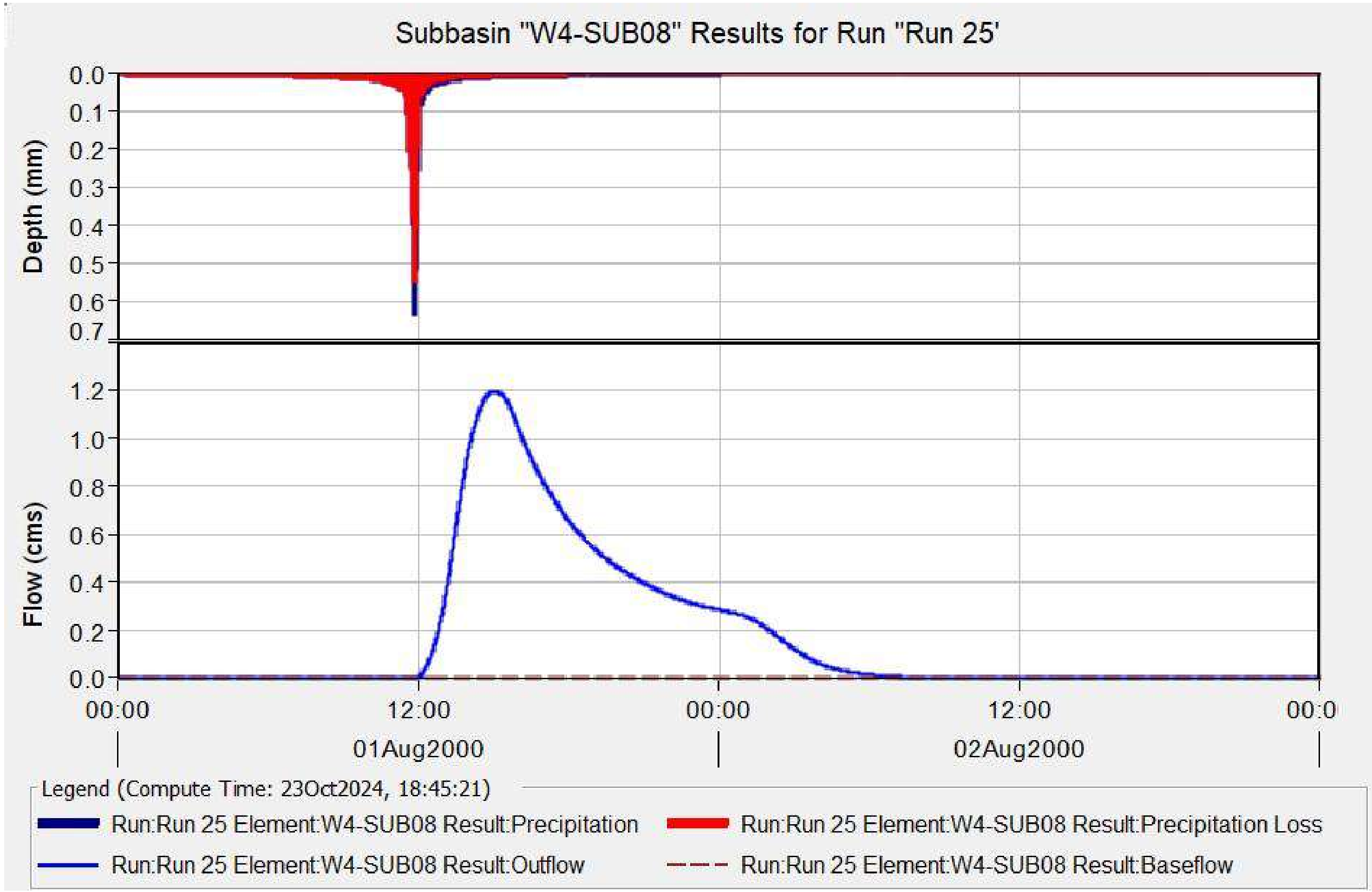

Subbasin "W4-SUB03" Results for Run "Run 25
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
2.5
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4-SUB03 Result:Precipitation
Run:Run 25 Element:W4-SUB03 Result:Precipitation Loss
Run:Run 25 Element:W4-SUB03 Result:Outflow
Run:Run 25 Element:W4-SUB03 Result:Baseflow

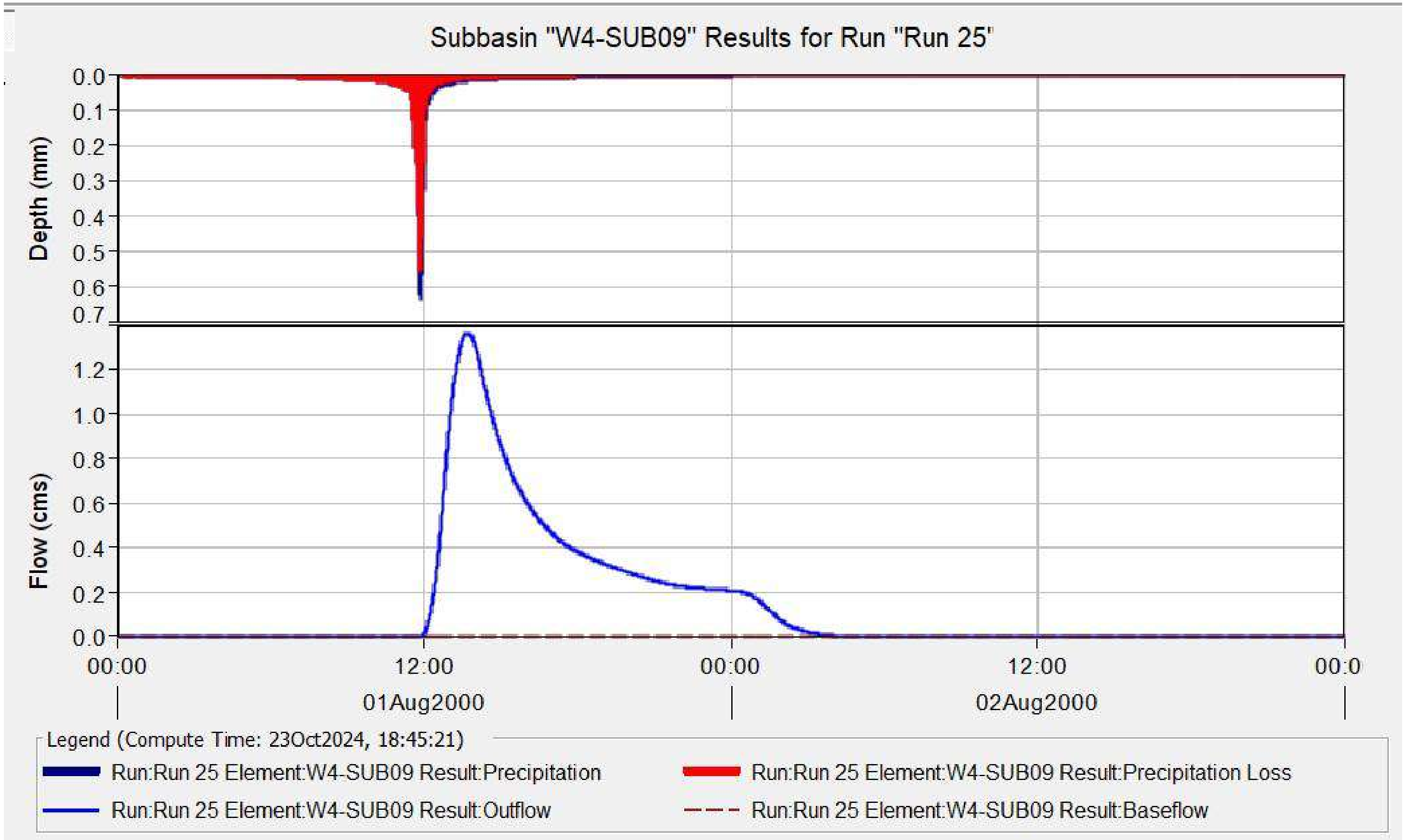

Subbasin "W4-SUB04" Results for Run "Run 25
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4-SUB04 Result:Precipitation
Run:Run 25 Element:W4-SUB04 Result:Precipitation Loss
Run:Run 25 Element:W4-SUB04 Result:Outflow
Run:Run 25 Element:W4-SUB04 Result:Baseflow

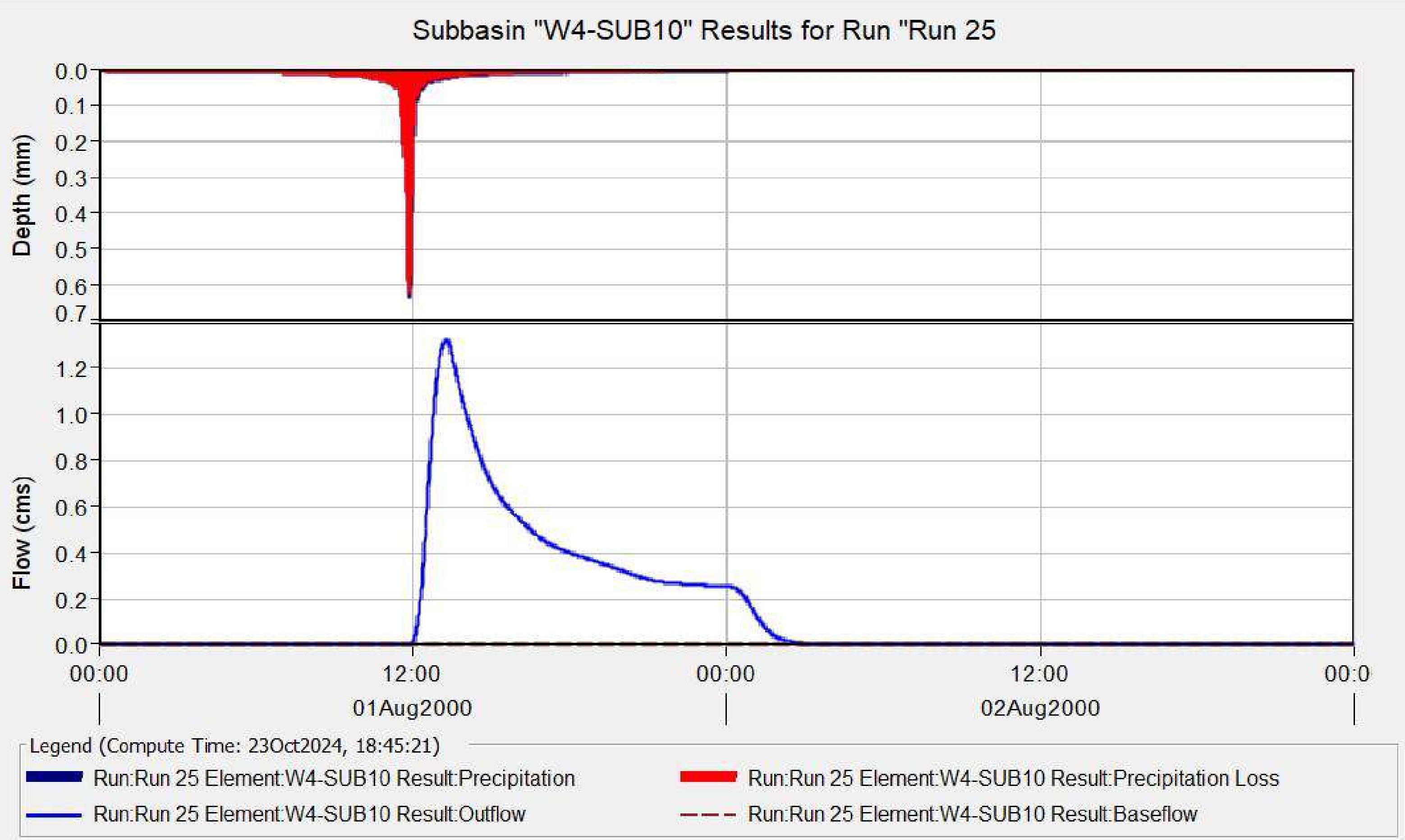

Subbasin "W4-SUB05" Results for Run "Run 25'
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
1.0
0.8
0.6
0.4
0.2
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4-SUB05 Result:Precipitation
Run:Run 25 Element:W4-SUB05 Result:Precipitation Loss
Run:Run 25 Element:W4-SUB05 Result:Outflow
Run:Run 25 Element:W4-SUB05 Result:Baseflow

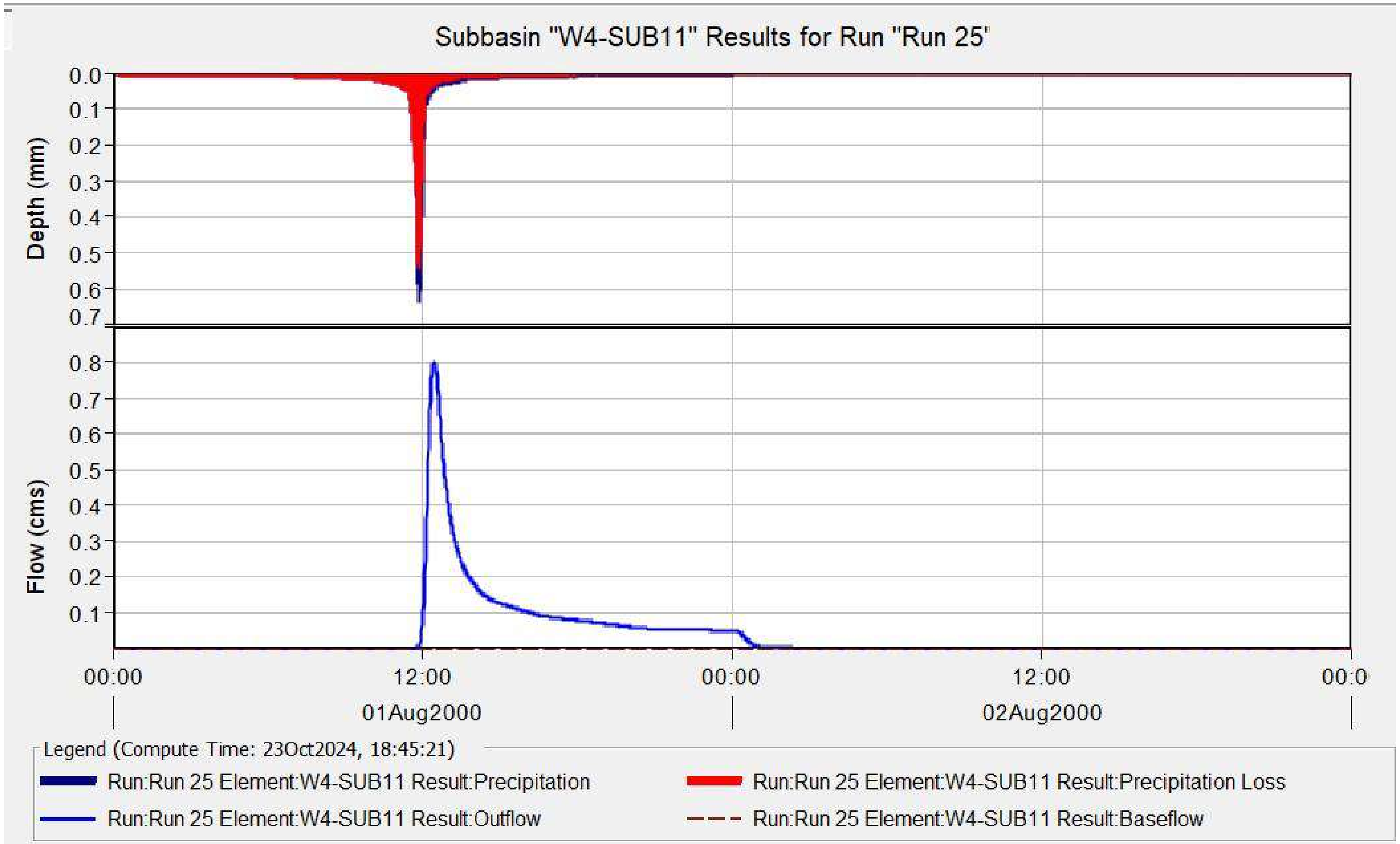

Subbasin "W4-SUB06" Results for Run "Run 25
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
00:0(
12:0(
00:0(
12:0(
00:0
01Aug200
02Aug200
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4-SUB06 Result:Precipitatio
Run:Run 25 Element:W4-SUB06 Result:Precipitation Los
Run:Run 25 Element:W4-SUB06 Result:Outflo
Run:Run 25 Element:W4-SUB06 Result:Baseflo

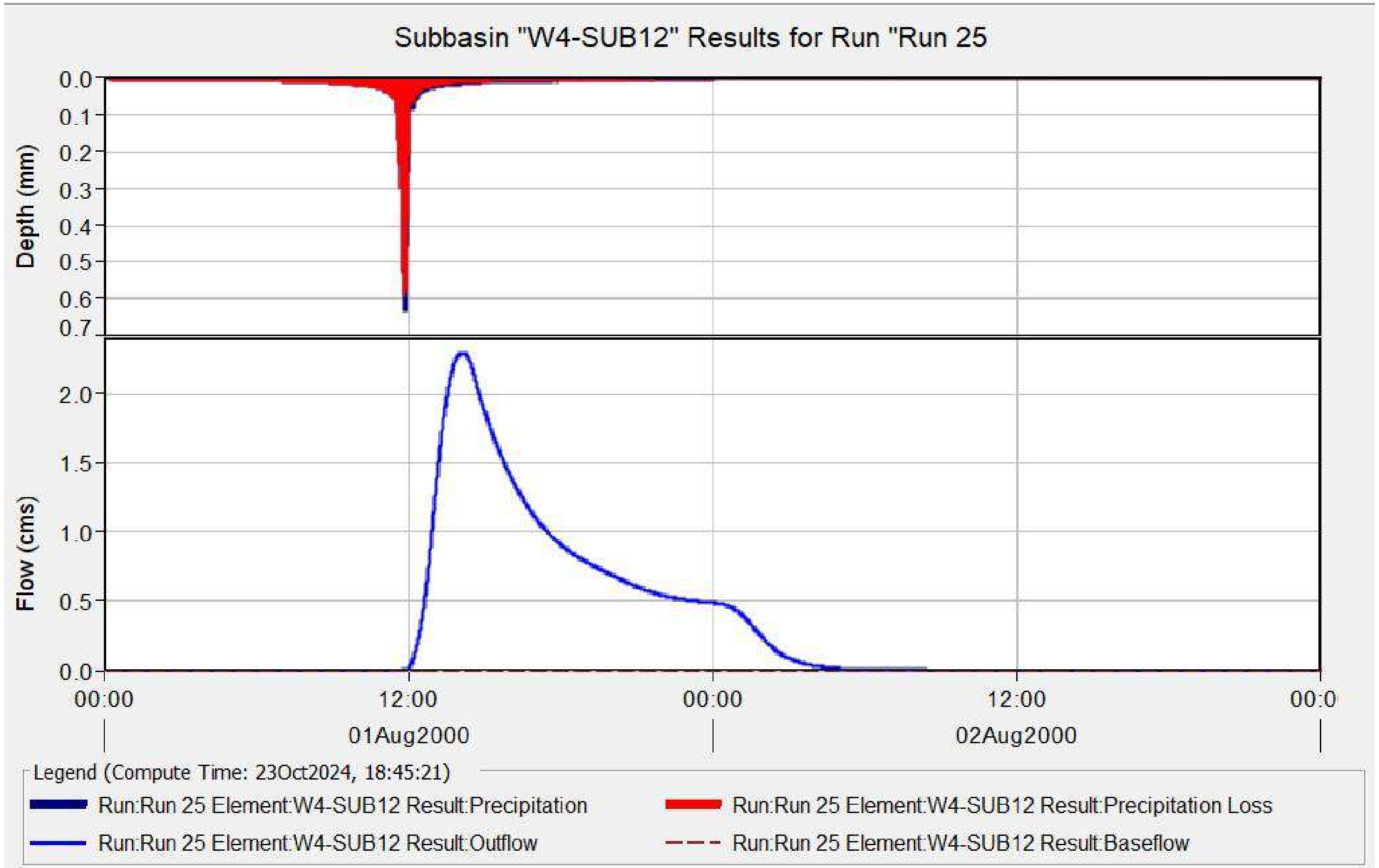

Subbasin "W4-SUB07" Results for Run "Run 25
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
00:00
12:00
00:00
12:00
00:00
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4-SUB07 Result:Precipitation
Run:Run 25 Element:W4-SUB07 Result:Precipitation Loss
Run:Run 25 Element:W4-SUB07 Result:Outflow
Run:Run 25 Element:W4-SUB07 Result:Baseflow

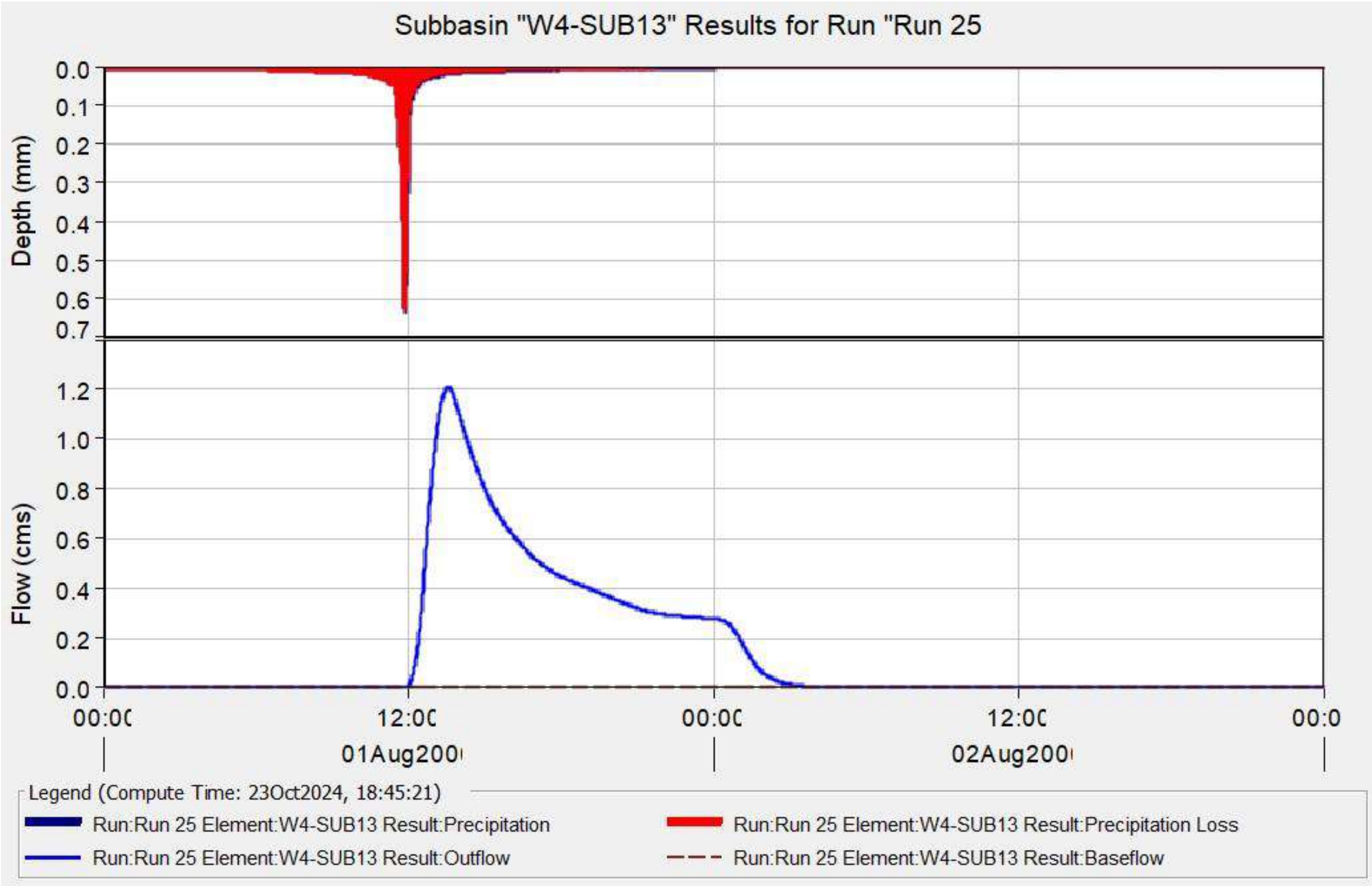

Subbasin "W4-SUB08" Results for Run "Run 25'
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4-SUB08 Result:Precipitation
Run:Run 25 Element:W4-SUB08 Result:Precipitation Loss
Run:Run 25 Element:W4-SUB08 Result:Outflow
Run:Run 25 Element:W4-SUB08 Result:Baseflow

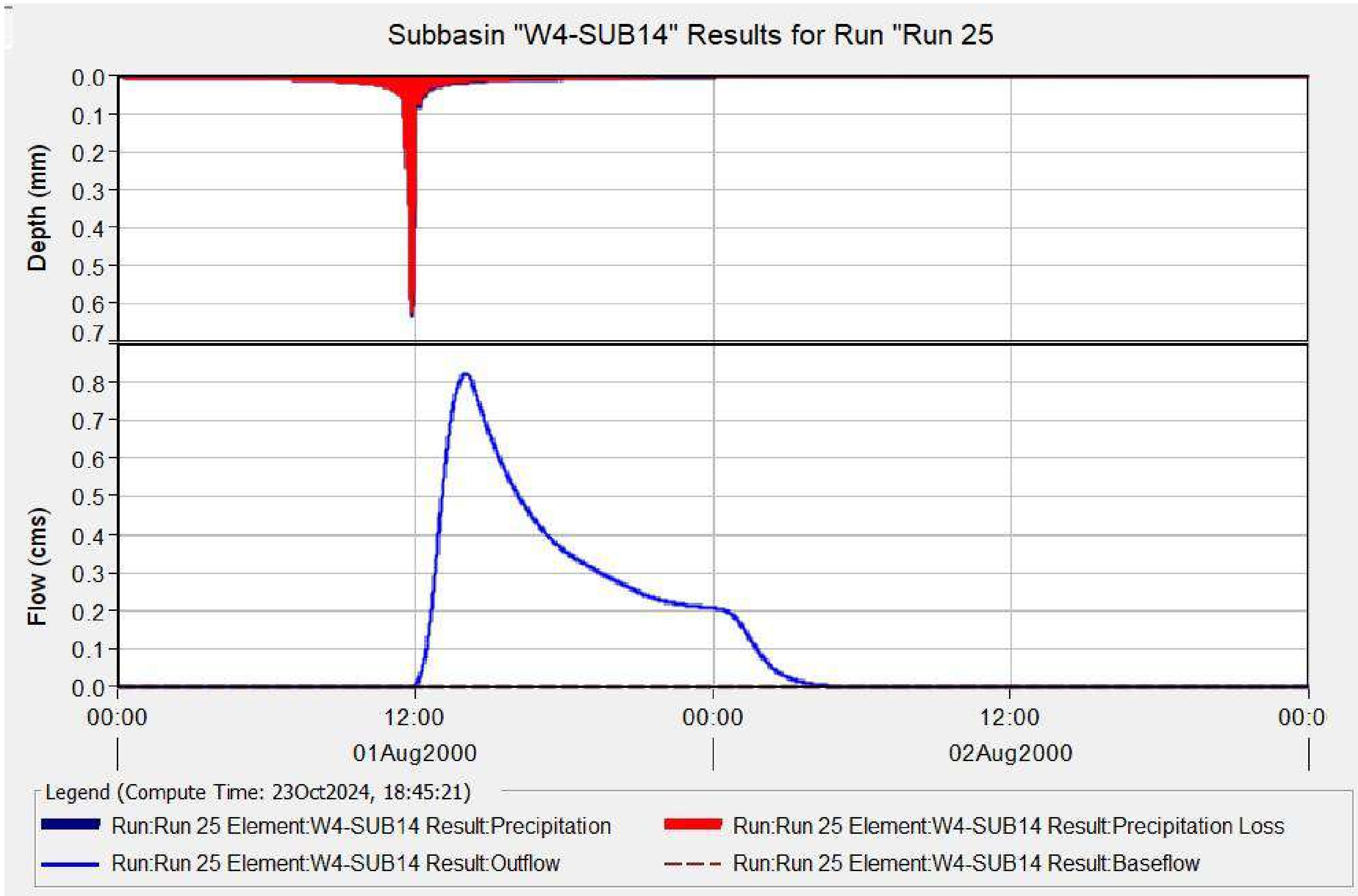

Subbasin "W4-SUB09" Results for Run "Run 25"
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4-SUB09 Result:Precipitation
Run:Run 25 Element:W4-SUB09 Result:Precipitation Loss
Run:Run 25 Element:W4-SUB09 Result:Outflow
Run:Run 25 Element:W4-SUB09 Result:Baseflow

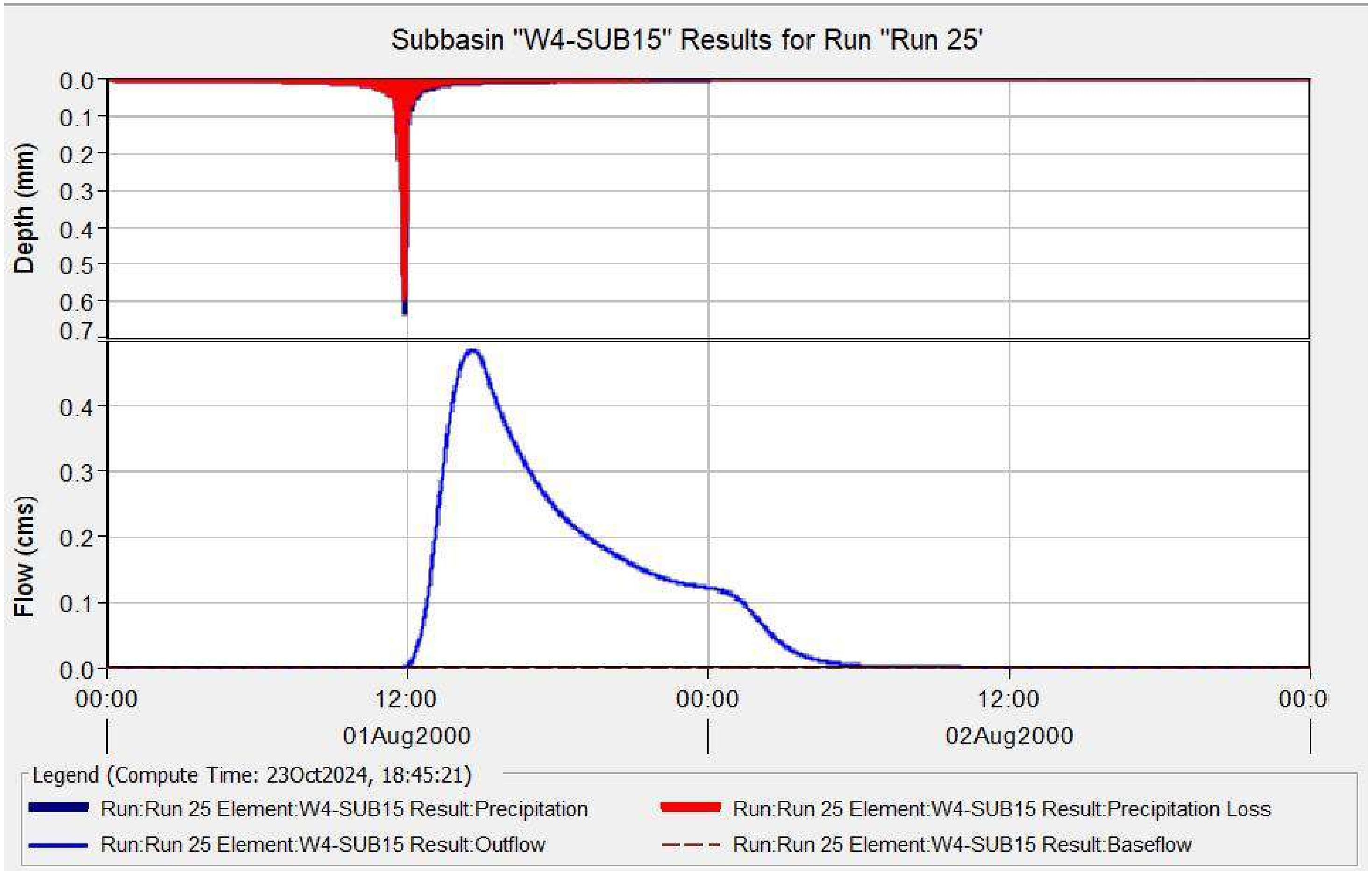

Subbasin "W4-SUB10" Results for Run "Run 25
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4-SUB10 Result:Precipitation
Run:Run 25 Element:W4-SUB10 Result:Precipitation Loss
Run:Run 25 Element:W4-SUB10 Result:Outflow
Run:Run 25 Element:W4-SUB10 Result:Baseflow

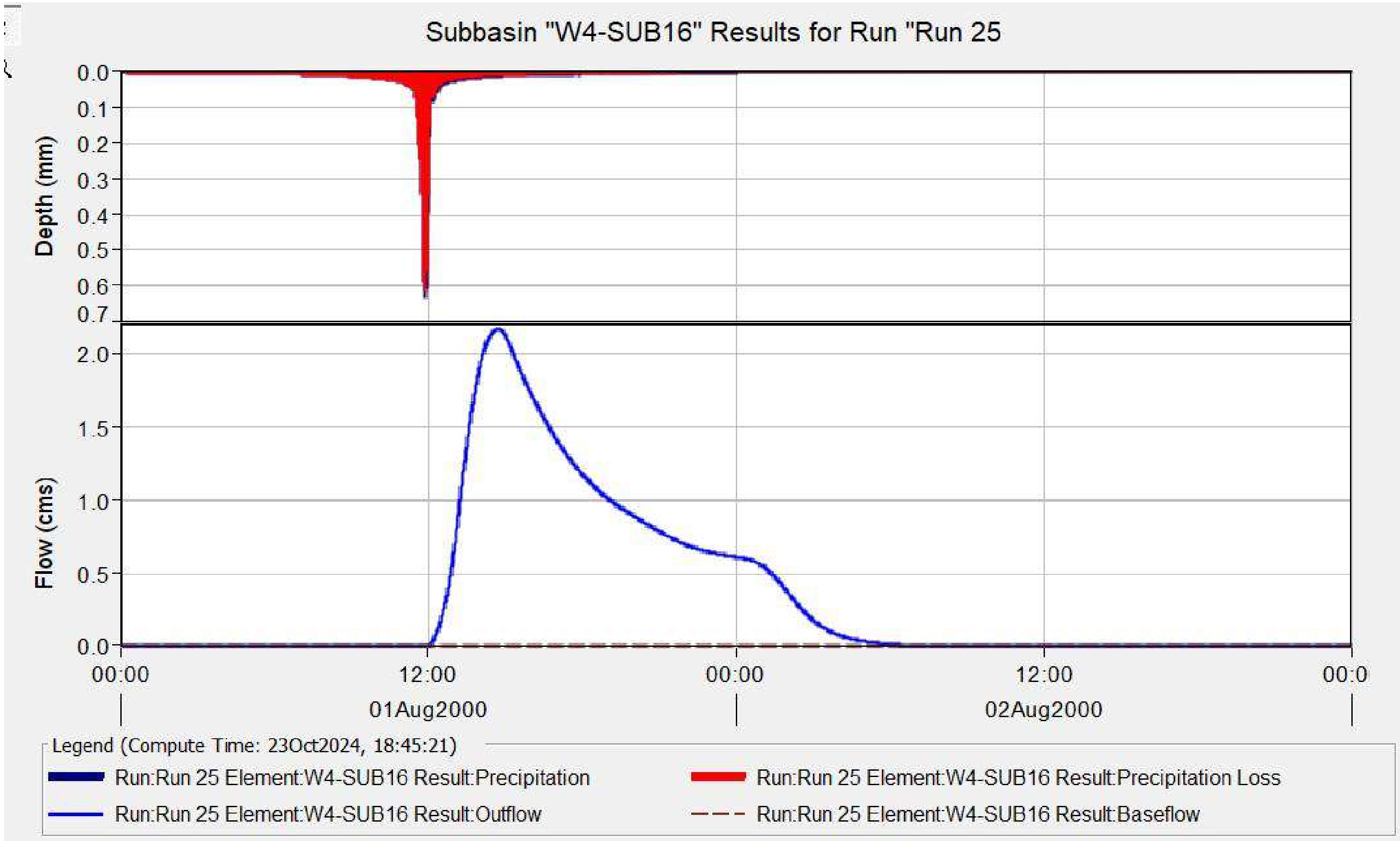

Subbasin "W4-SUB11" Results for Run "Run 25"
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4-SUB11 Result:Precipitation
Run:Run 25 Element:W4-SUB11 Result:Precipitation Loss
Run:Run 25 Element:W4-SUB11 Result:Outflow
Run:Run 25 Element:W4-SUB11 Result:Baseflow

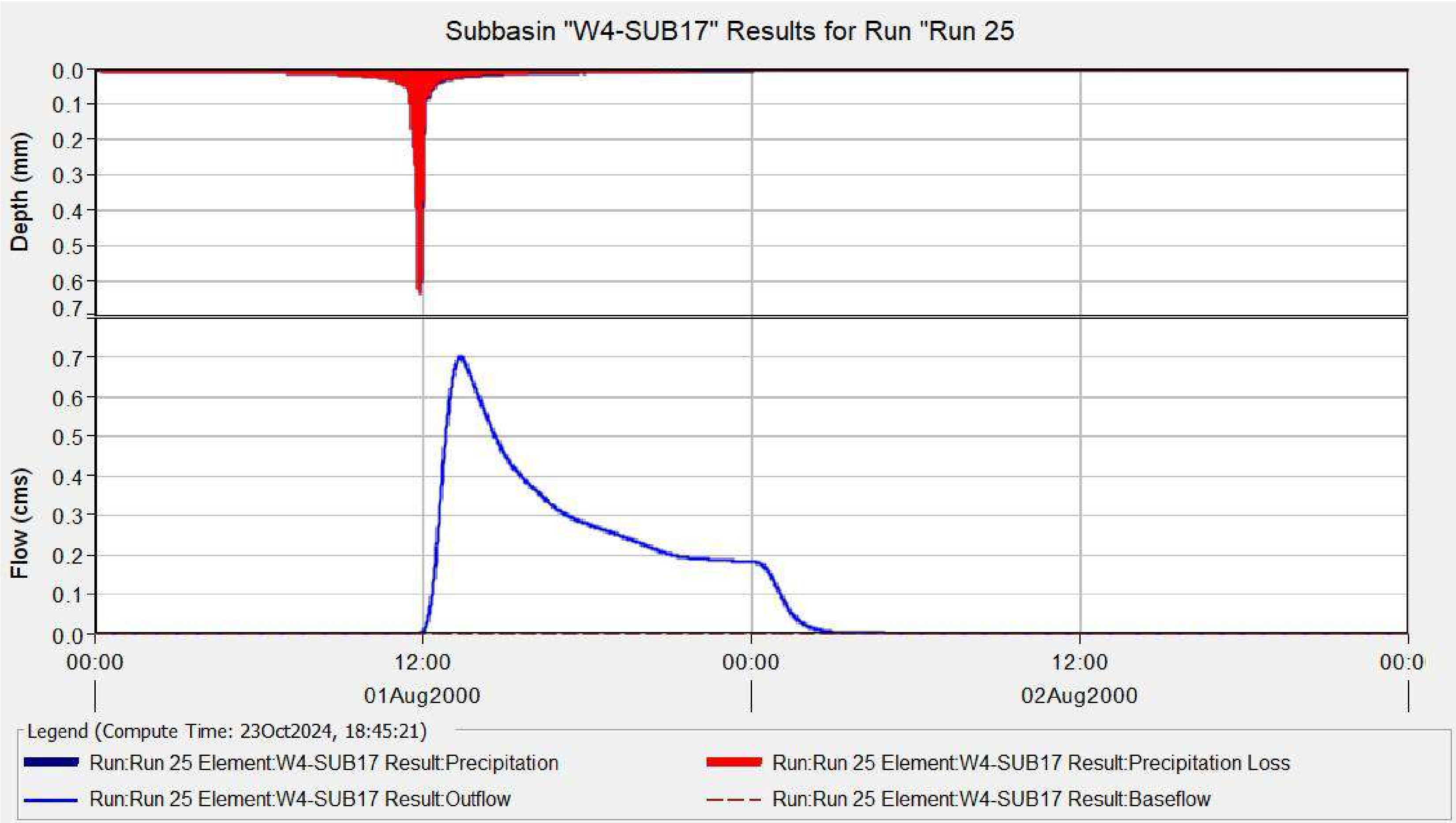

Subbasin "W4-SUB12" Results for Run "Run 25
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4-SUB12 Result:Precipitation
Run:Run 25 Element:W4-SUB12 Result:Precipitation Loss
Run:Run 25 Element:W4-SUB12 Result:Outflow
Run:Run 25 Element:W4-SUB12 Result:Baseflow

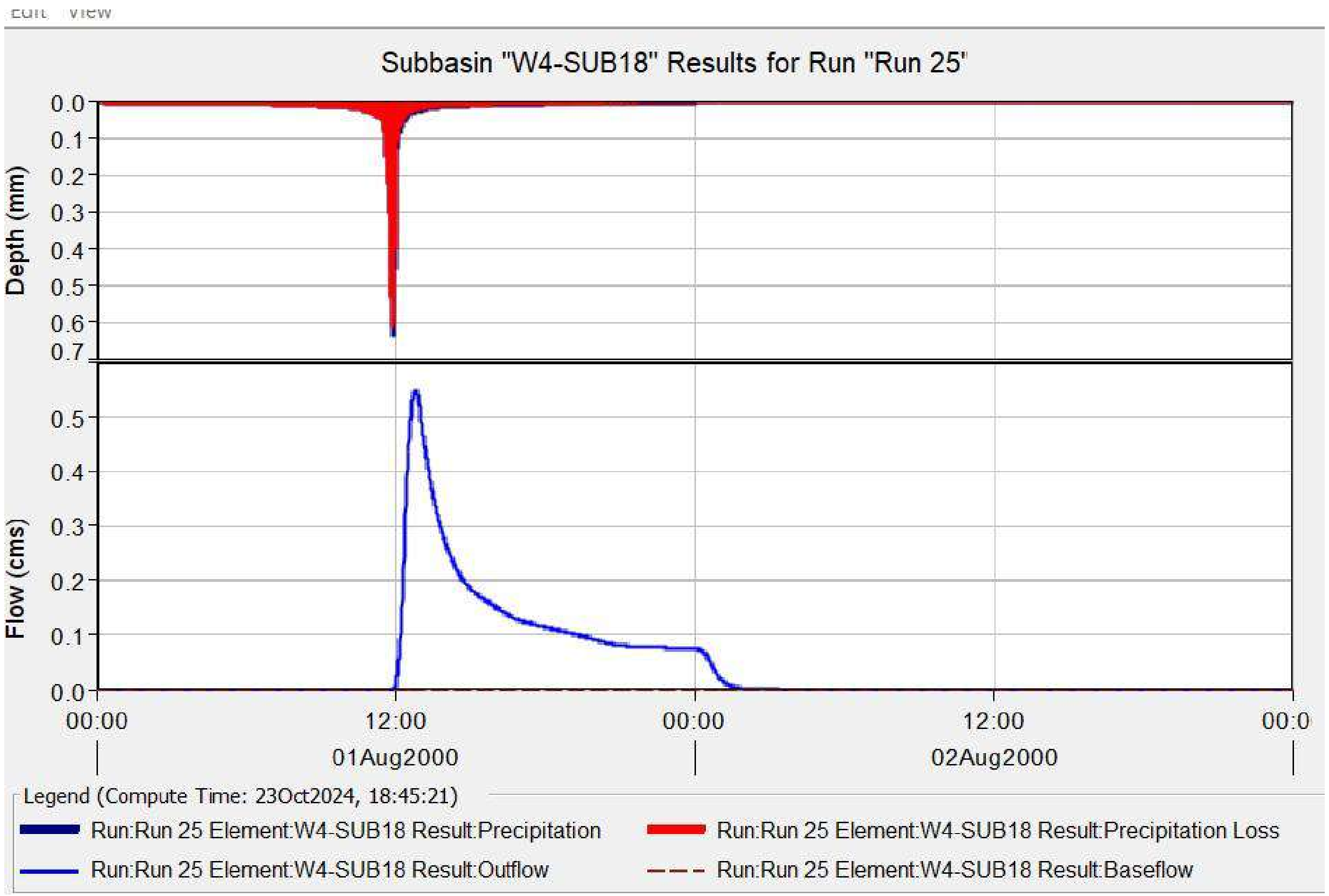

Subbasin "W4-SUB13" Results for Run "Run 25
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
00:0C
12:0C
00:0C
12:0C
00:0
01Aug200
02Aug200
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4-SUB13 Result:Precipitation
Run:Run 25 Element:W4-SUB13 Result:Precipitation Loss
Run:Run 25 Element:W4-SUB13 Result:Outflow
Run:Run 25 Element:W4-SUB13 Result:Baseflow

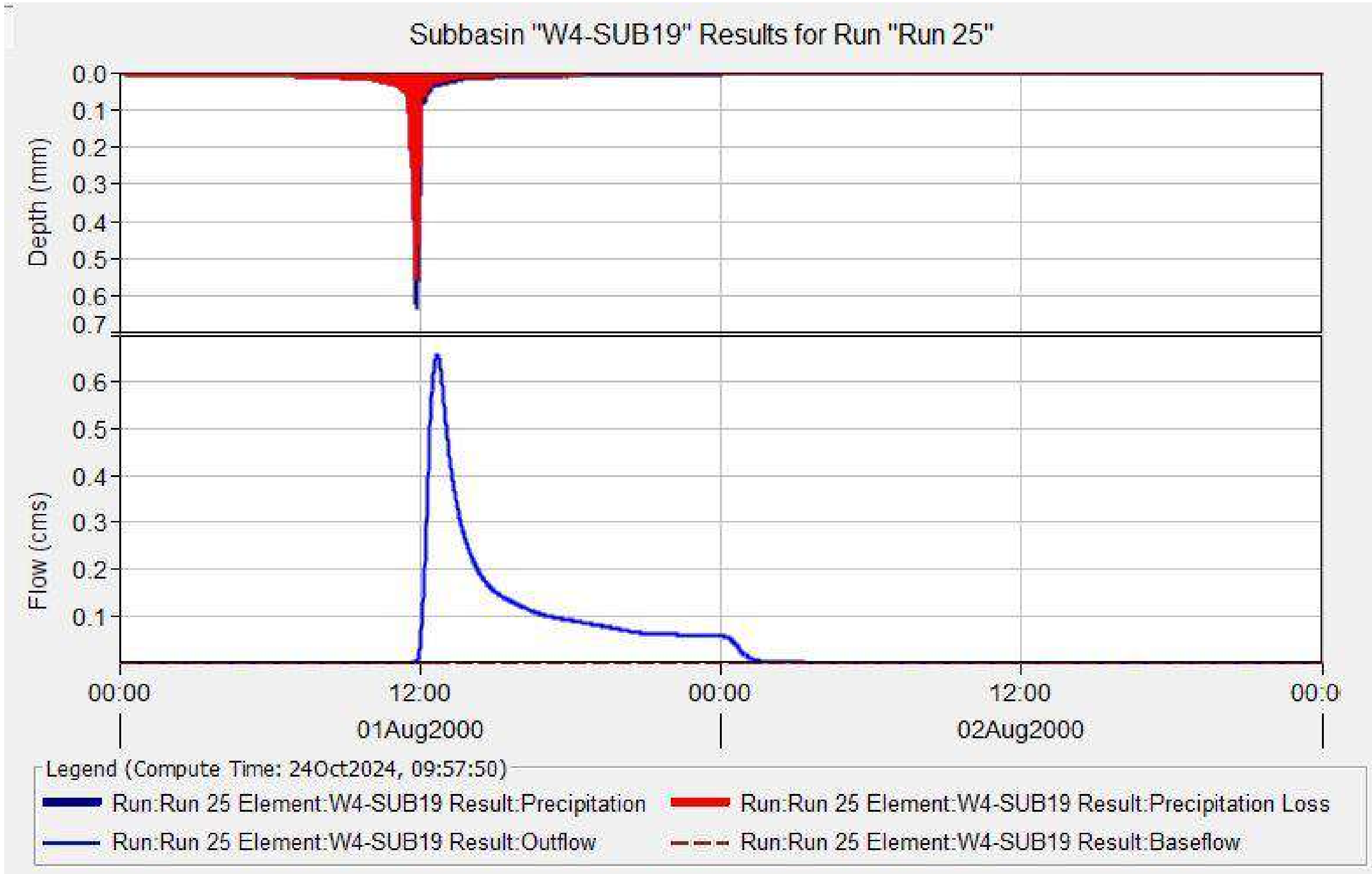

Subbasin "W4-SUB14" Results for Run "Run 25
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4-SUB14 Result:Precipitation
Run:Run 25 Element:W4-SUB14 Result:Precipitation Loss
Run:Run 25 Element:W4-SUB14 Result:Outflow
Run:Run 25 Element:W4-SUB14 Result:Baseflow

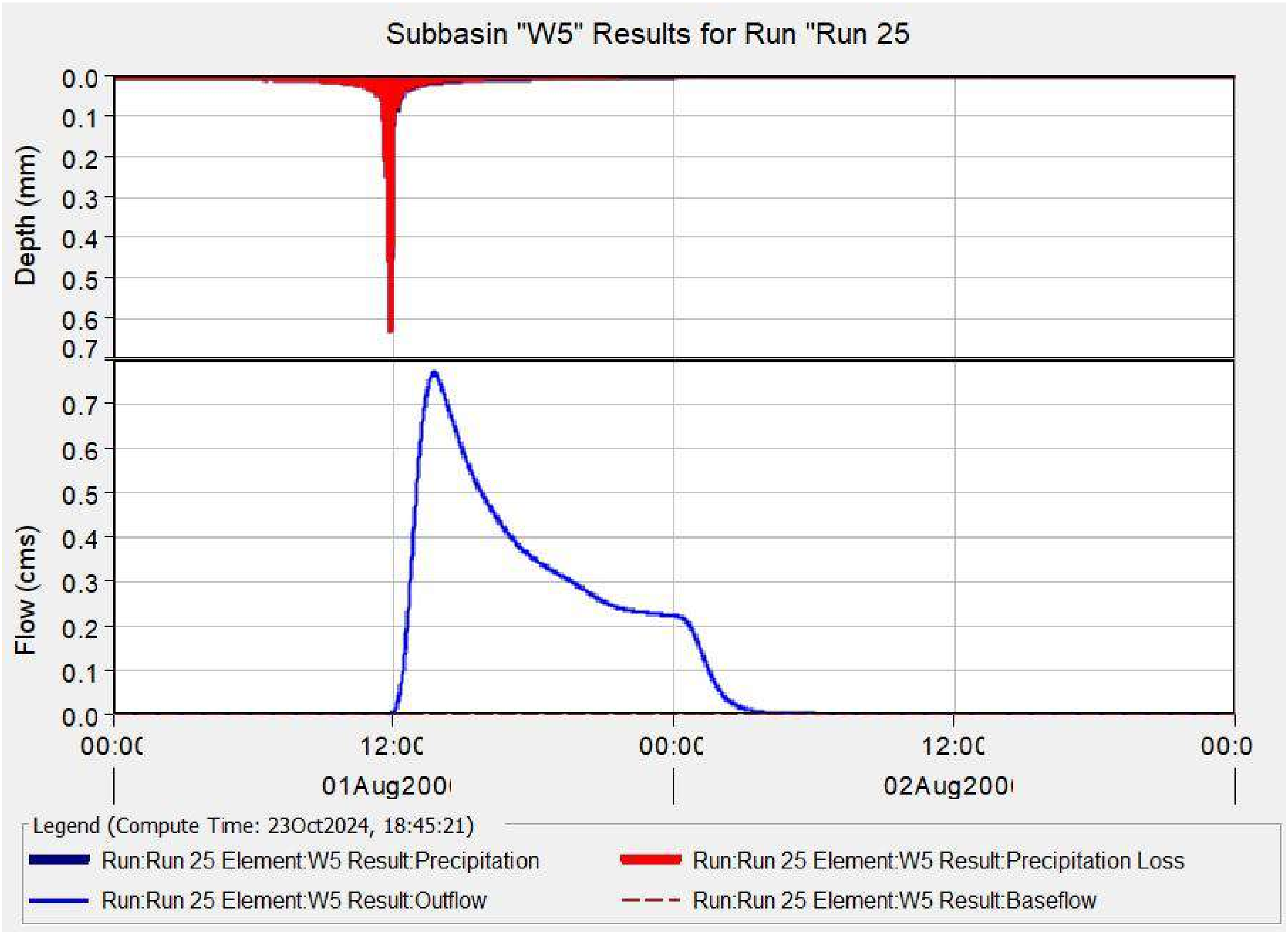

Subbasin "W4-SUB15" Results for Run "Run 25'
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
0.0
0.1
0.2
0.3
0.4
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4-SUB15 Result:Precipitation
Run:Run 25 Element:W4-SUB15 Result:Precipitation Loss
Run:Run 25 Element:W4-SUB15 Result:Outflow
Run:Run 25 Element:W4-SUB15 Result:Baseflow

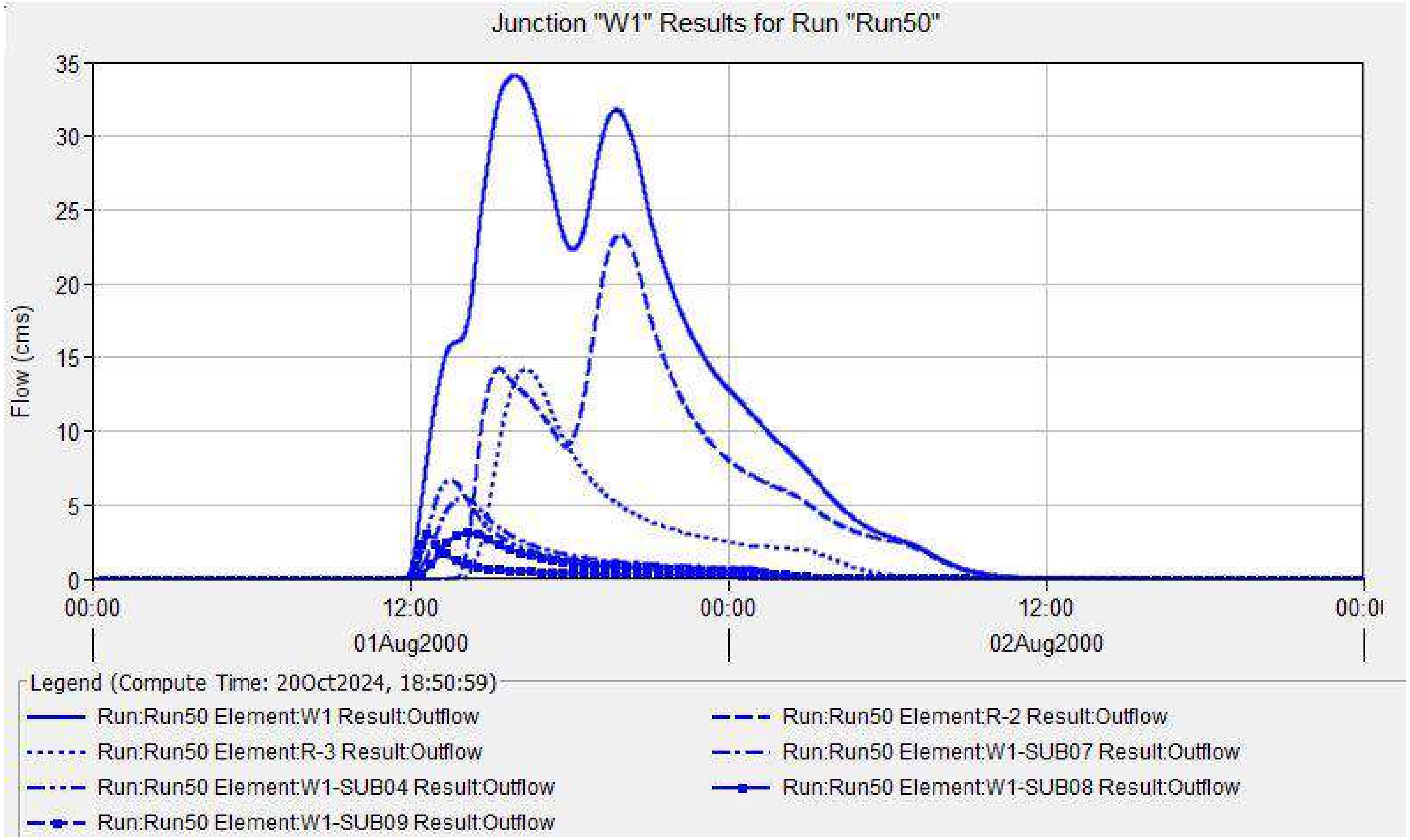

Subbasin "W4-SUB16" Results for Run "Run 25
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4-SUB16 Result:Precipitation
Run:Run 25 Element:W4-SUB16 Result:Precipitation Loss
Run:Run 25 Element:W4-SUB16 Result:Outflow
Run:Run 25 Element:W4-SUB16 Result:Baseflow


Subbasin "W4-SUB17" Results for Run "Run 25
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4-SUB17 Result:Precipitation
Run:Run 25 Element:W4-SUB17 Result:Precipitation Loss
Run:Run 25 Element:W4-SUB17 Result:Outflow
Run:Run 25 Element:W4-SUB17 Result:Baseflow

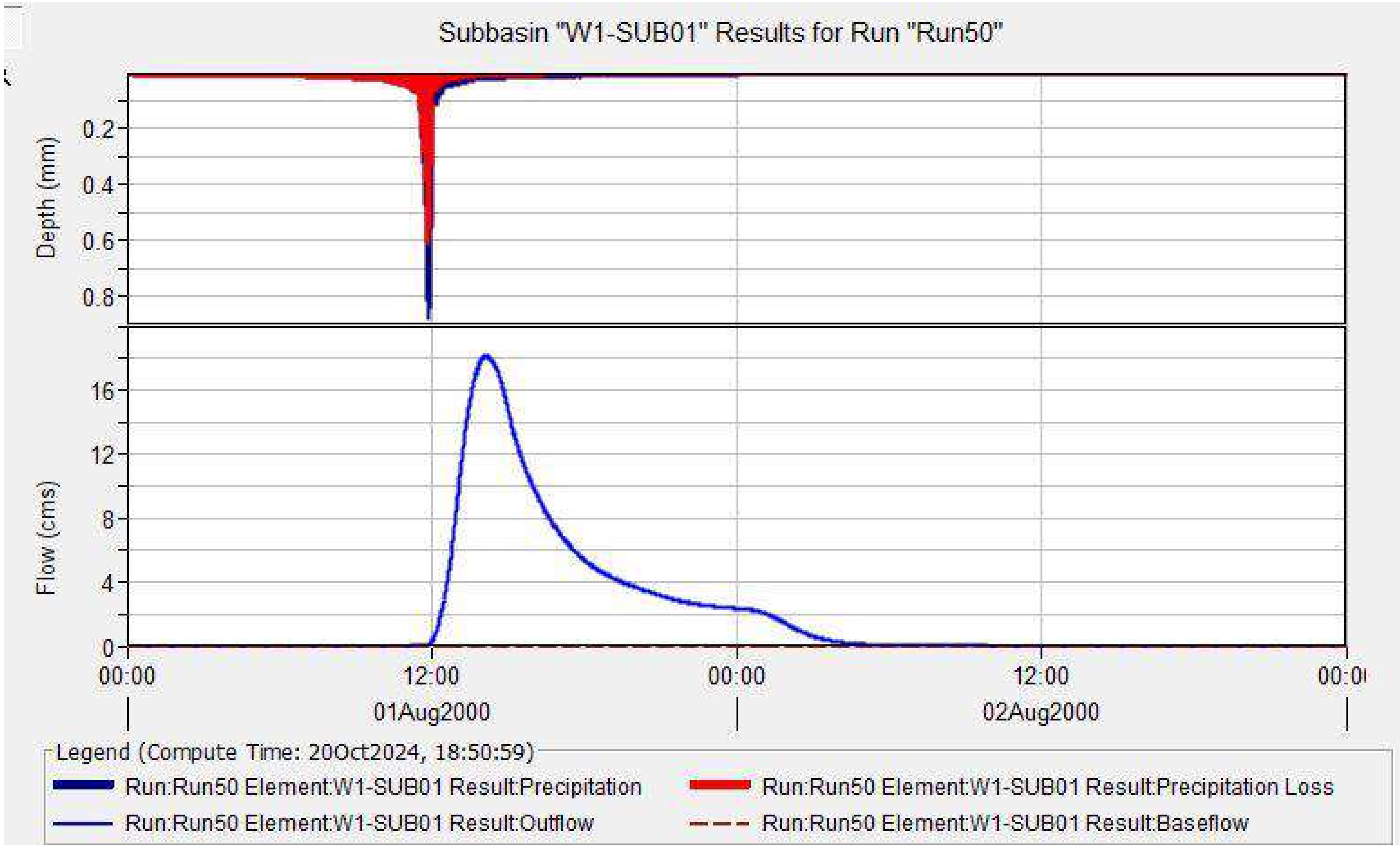

Edit View
Subbasin "W4-SUB18" Results for Run "Run 25"
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
0.5
0.4
0.3
0.2
0.1
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W4-SUB18 Result:Precipitation
Run:Run 25 Element:W4-SUB18 Result:Precipitation Loss
Run:Run 25 Element:W4-SUB18 Result:Outflow
Run:Run 25 Element:W4-SUB18 Result:Baseflow

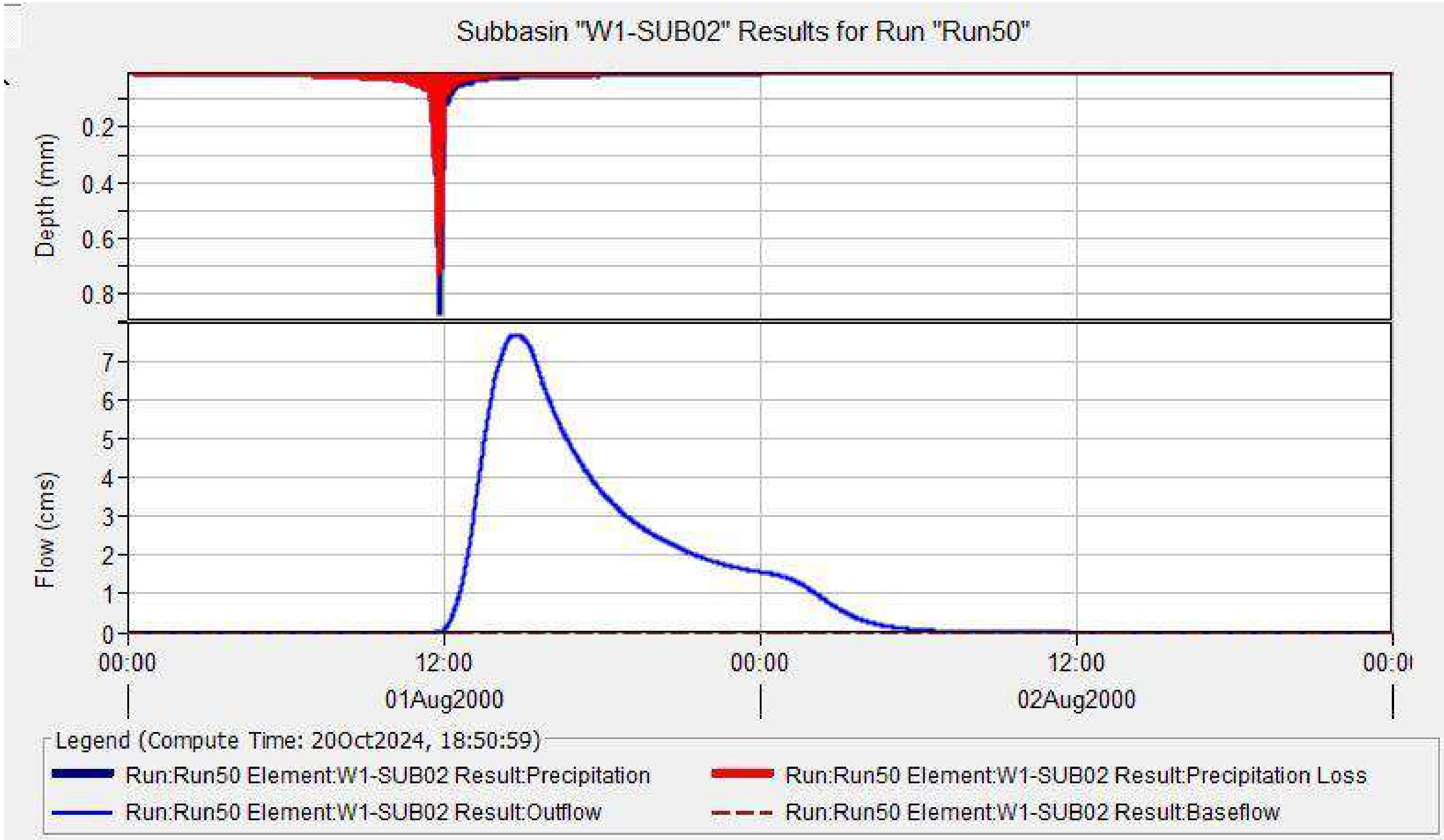

Subbasin "W4-SUB19" Results for Run "Run 25"
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
0.6
0.5
0.4
0.3
0.2
0.1
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 24Oct2024, 09:57:50)
Run:Run 25 Element:W4-SUB19 Result:Precipitation
Run:Run 25 Element:W4-SUB19 Result:Precipitation Loss
Run:Run 25 Element:W4-SUB19 Result:Outflow
Run:Run 25 Element:W4-SUB19 Result:Baseflow

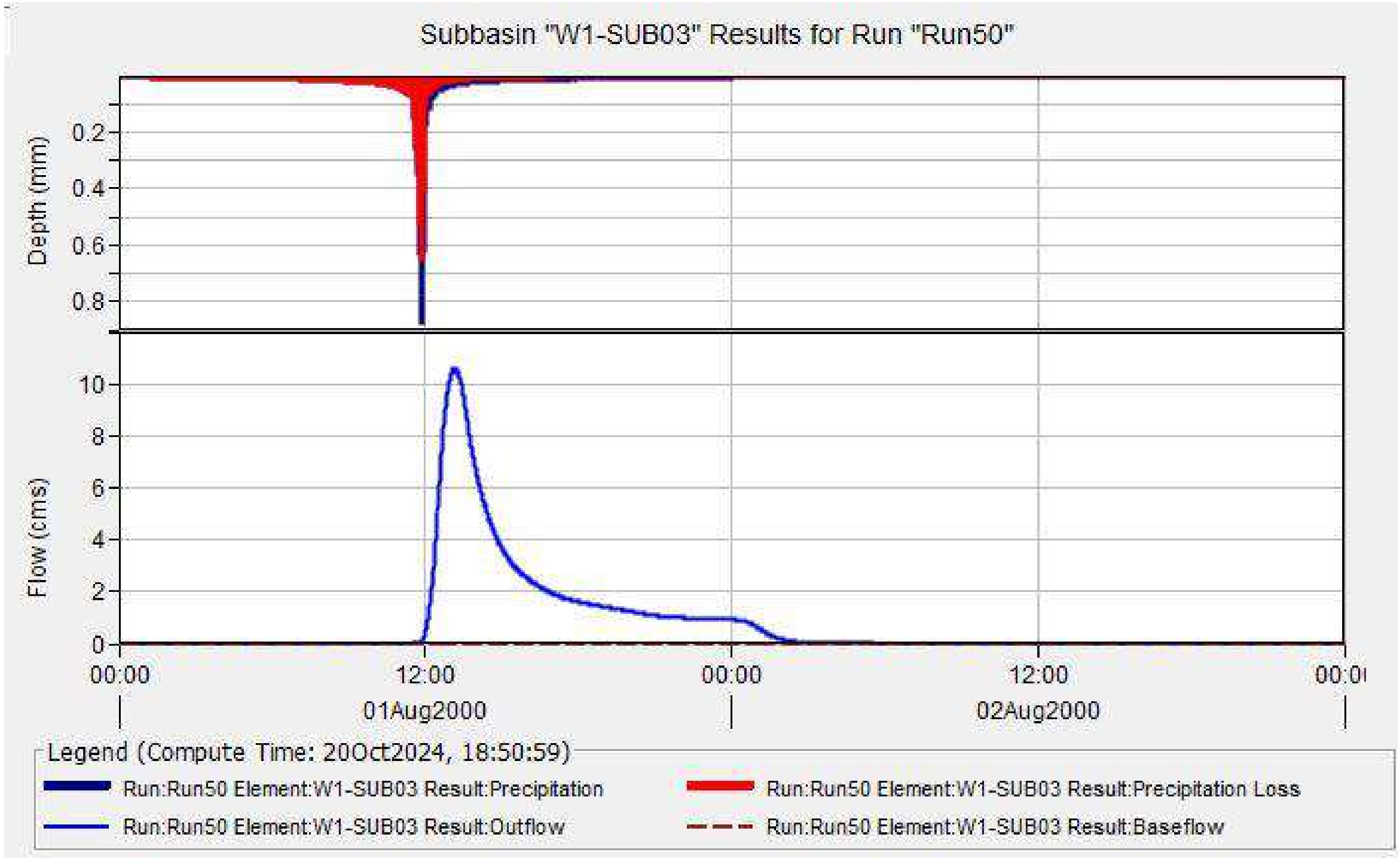

Subbasin "W5" Results for Run "Run 25
Depth (mm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Flow (cms)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
00:0(
12:0(
00:0(
12:0(
00:0
01Aug200
02Aug200
Legend (Compute Time: 23Oct2024, 18:45:21)
Run:Run 25 Element:W5 Result:Precipitation
Run:Run 25 Element:W5 Result:Precipitation Loss
Run:Run 25 Element:W5 Result:Outflow
Run:Run 25 Element:W5 Result:Baseflow

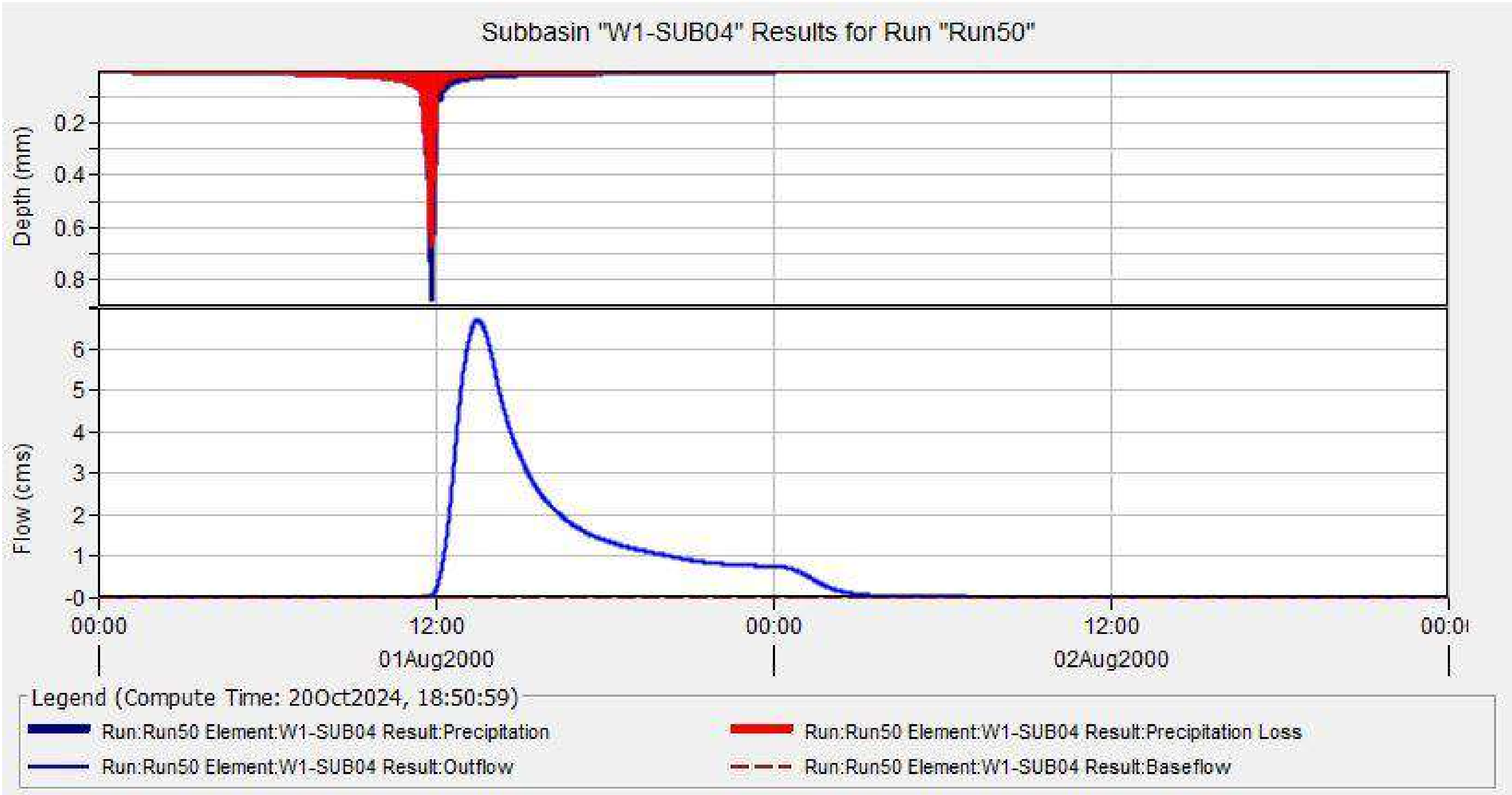


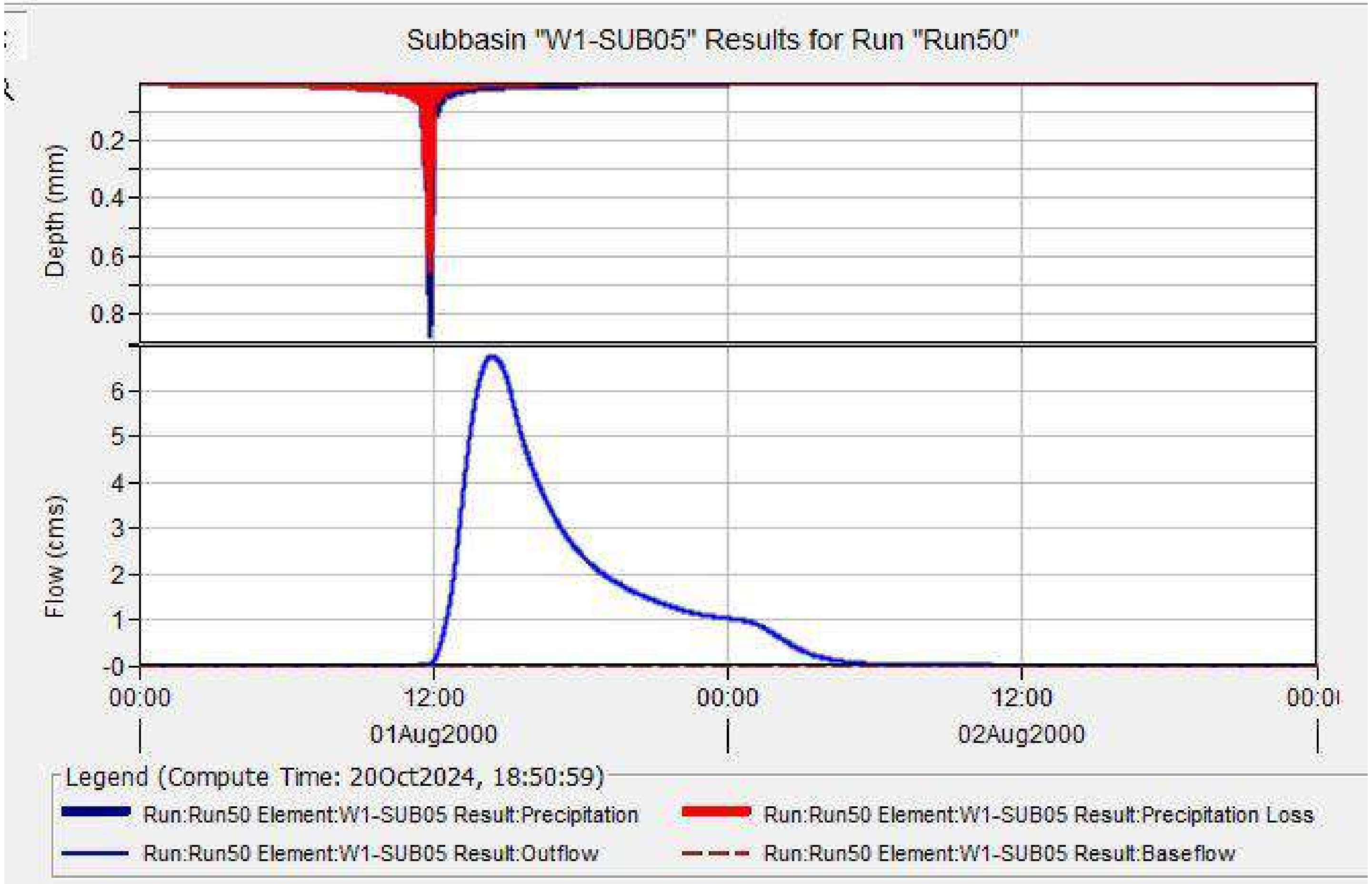
Junction "W1" Results for Run "Run50"
Flow (cms)
35
30
25
20
15
10
5
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:50:59)
Run:Run50 Element:W1 Result:Outflow
Run:Run50 Element:R-2 Result:Outflow
Run:Run50 Element:R-3 Result:Outflow
Run:Run50 Element:W1-SUB07 Result:Outflow
Run:Run50 Element:W1-SUB04 Result:Outflow
Run:Run50 Element:W1-SUB08 Result:Outflow
Run:Run50 Element:W1-SUB09 Result:Outflow

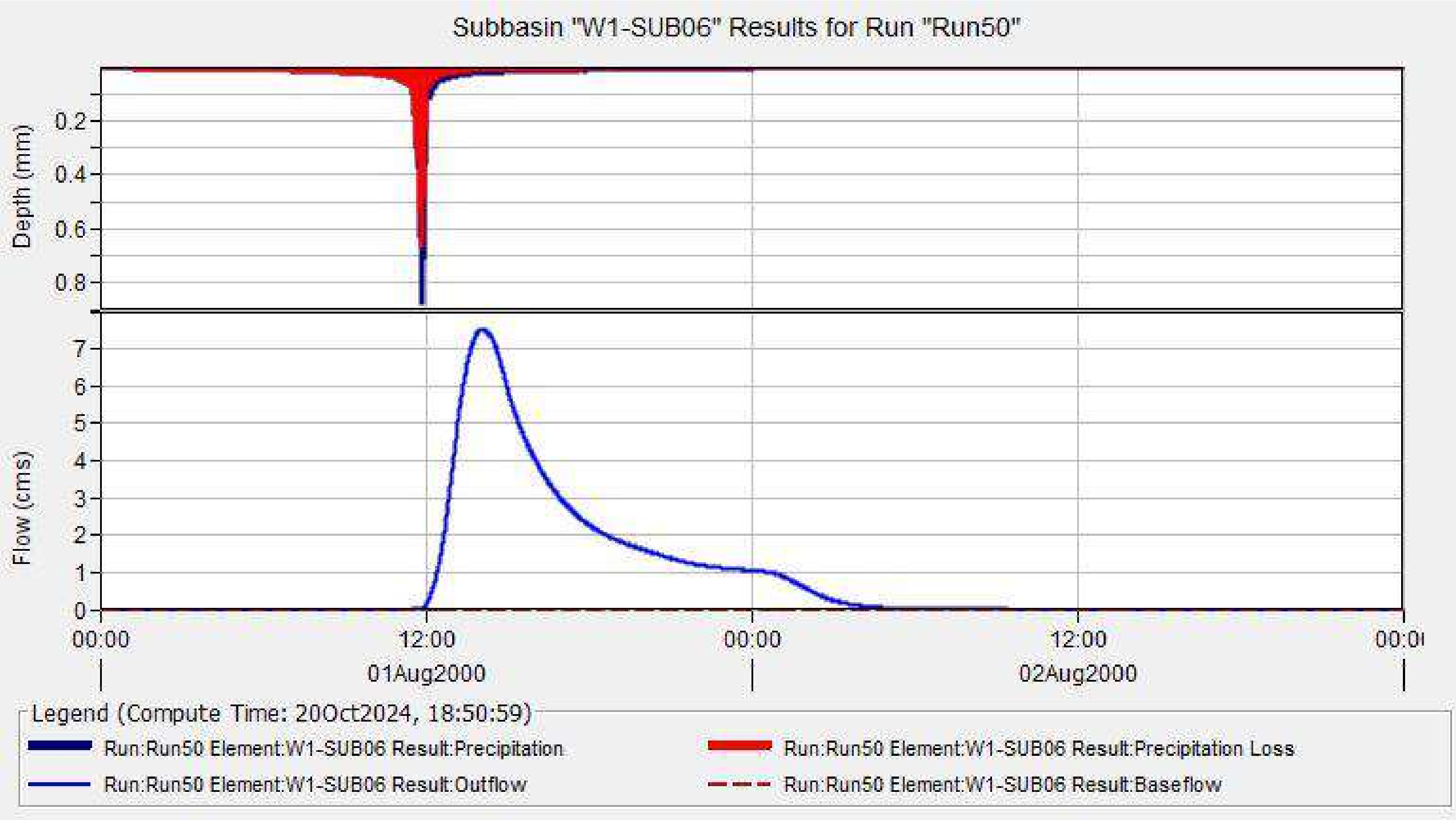

Subbasin "W1-SUB01" Results for Run "Run50"
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
16
12
8
4
0
00:00
12:00
00:00
12:00
00:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:50:59)
Run:Run50 Element:W1-SUB01 Result:Precipitation
Run:Run50 Element:W1-SUB01 Result:Precipitation Loss
Run:Run50 Element:W1-SUB01 Result:Outflow
Run:Run50 Element:W1-SUB01 Result:Baseflow

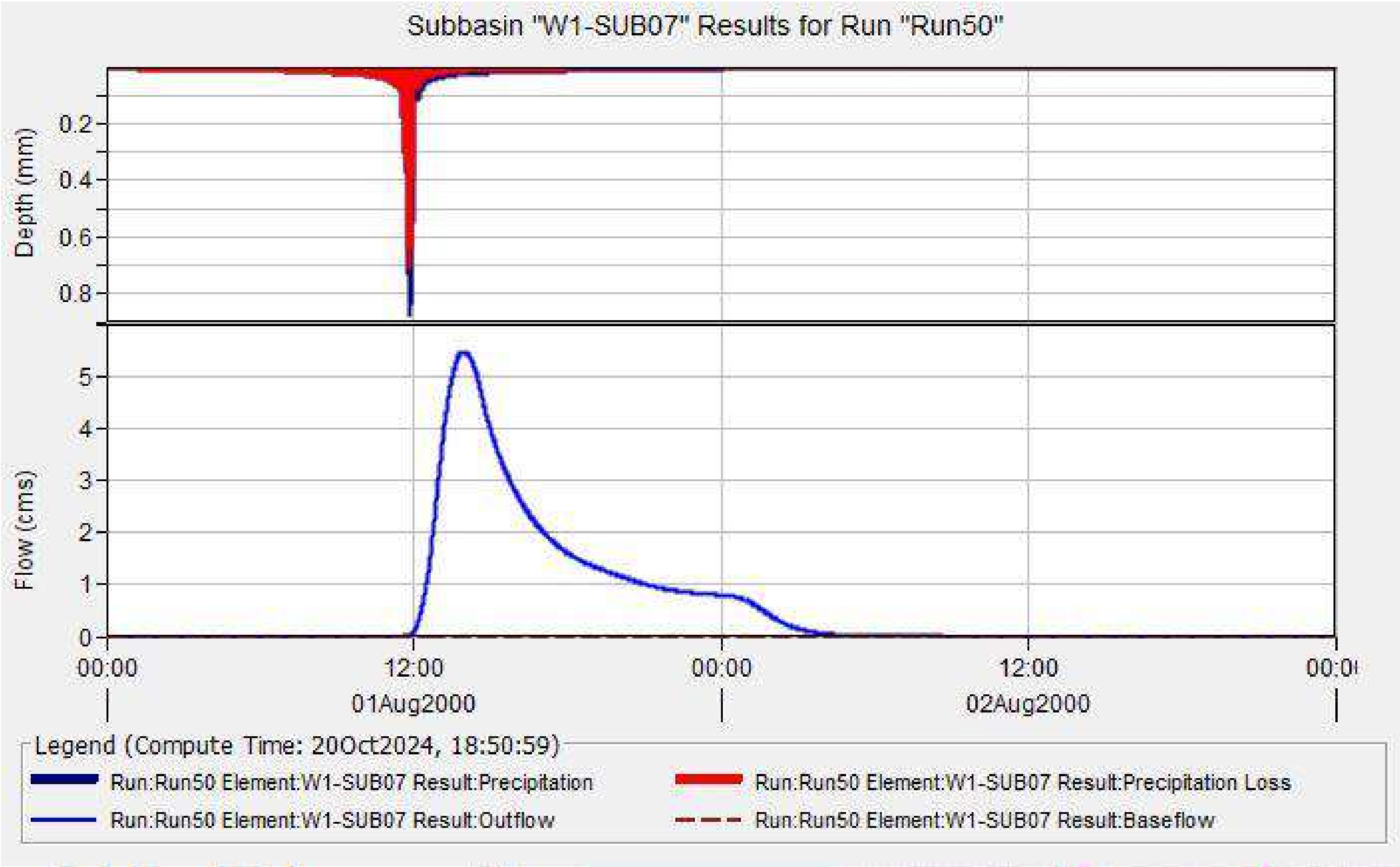

Subbasin "W1-SUB02" Results for Run "Run50"
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
7
6
5
4
3
2
1
0
00:00
12:00
00:00
12:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:50:59)
Run:Run50 Element:W1-SUB02 Result:Precipitation
Run:Run50 Element:W1-SUB02 Result:Precipitation Loss
Run:Run50 Element:W1-SUB02 Result:Outflow
Run:Run50 Element:W1-SUB02 Result:Baseflow

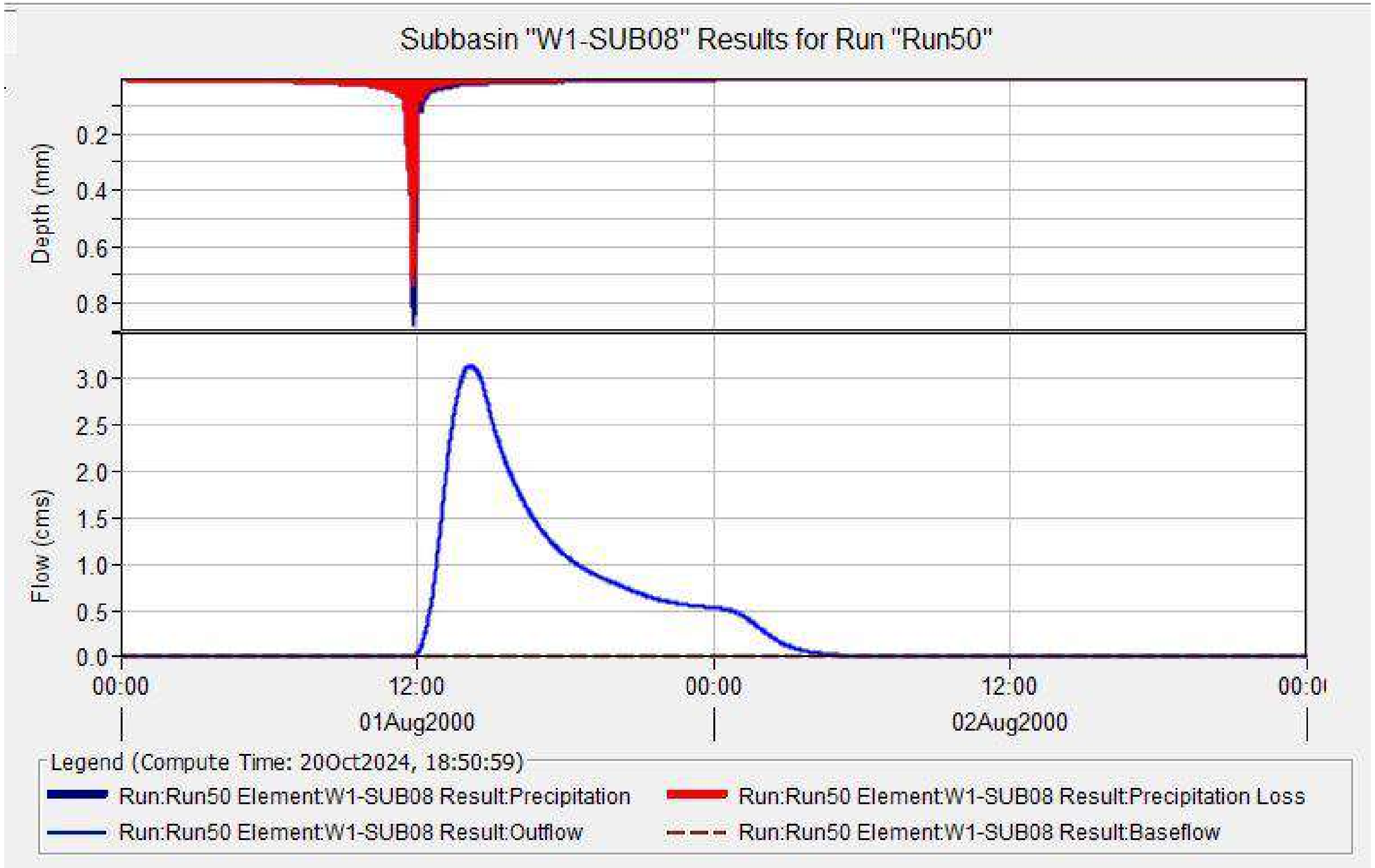

Subbasin "W1-SUB03" Results for Run "Run50"
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
10
8
6
4
2
0
00:00
12:00
00:00
12:00
00:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:50:59)
Run:Run50 Element:W1-SUB03 Result:Precipitation
Run:Run50 Element:W1-SUB03 Result:Precipitation Loss
Run:Run50 Element:W1-SUB03 Result:Outflow
Run:Run50 Element:W1-SUB03 Result:Baseflow

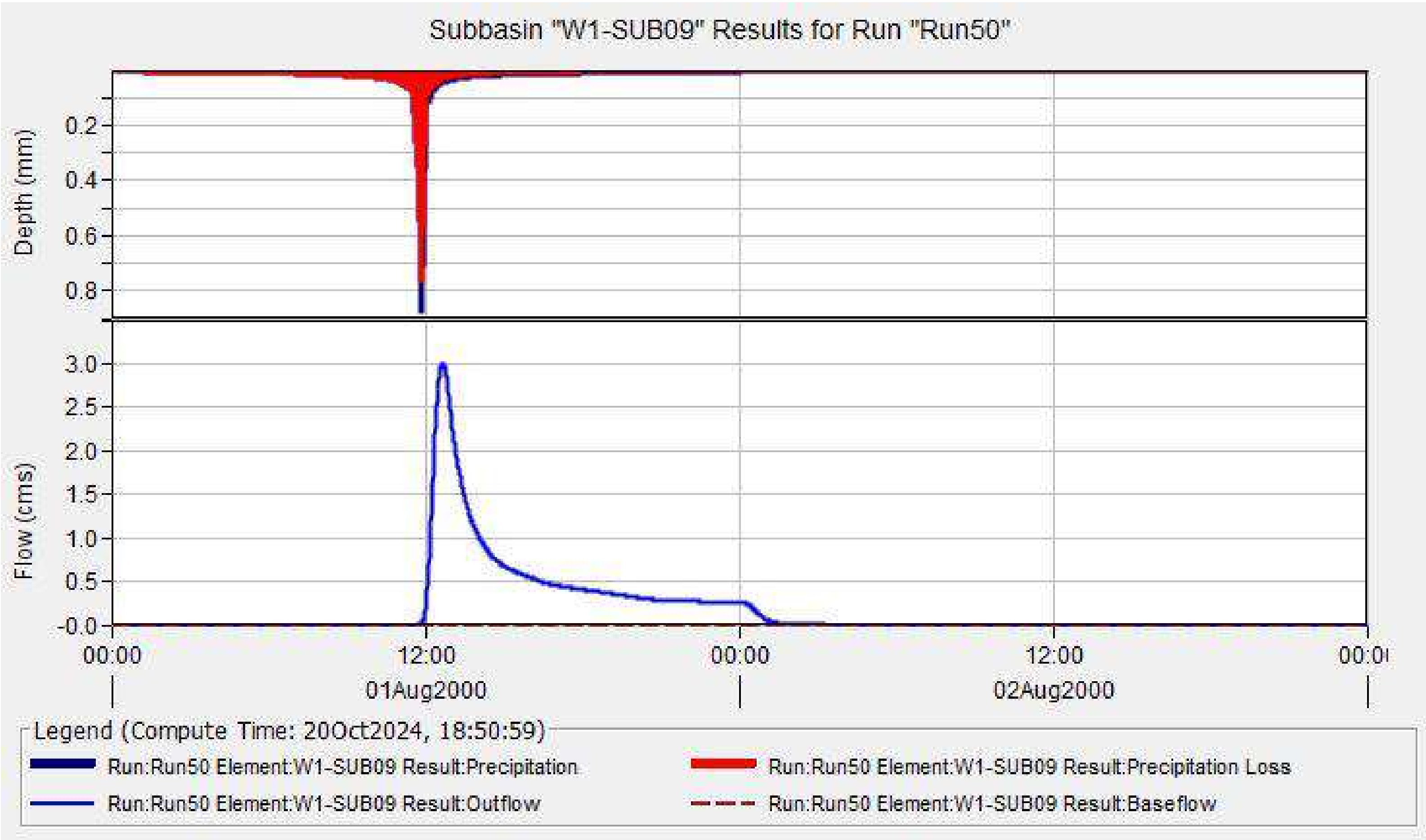

Subbasin "W1-SUB04" Results for Run "Run50"
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
6
5
4
3
2
1
-0
00:00
12:00
00:00
12:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:50:59)
Run:Run50 Element:W1-SUB04 Result:Precipitation
Run:Run50 Element:W1-SUB04 Result:Precipitation Loss
Run:Run50 Element:W1-SUB04 Result:Outflow
Run:Run50 Element:W1-SUB04 Result:Baseflow

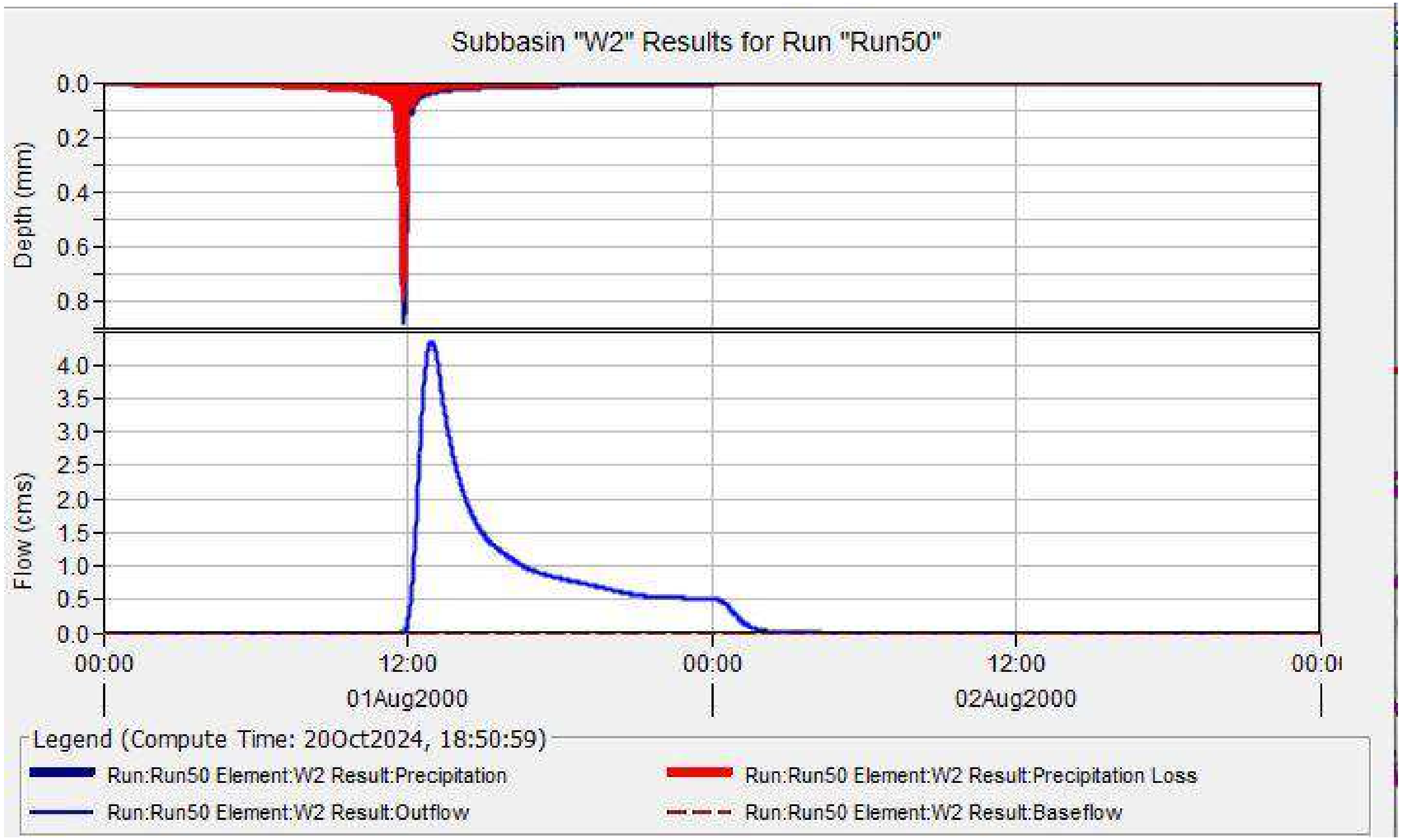

Subbasin "W1-SUB05" Results for Run "Run50"
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
6
5
4
3
2
1
-0
00:00
12:00
00:00
12:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:50:59)
Run:Run50 Element:W1-SUB05 Result:Precipitation
Run:Run50 Element:W1-SUB05 Result:Precipitation Loss
Run:Run50 Element:W1-SUB05 Result:Outflow
Run:Run50 Element:W1-SUB05 Result:Baseflow

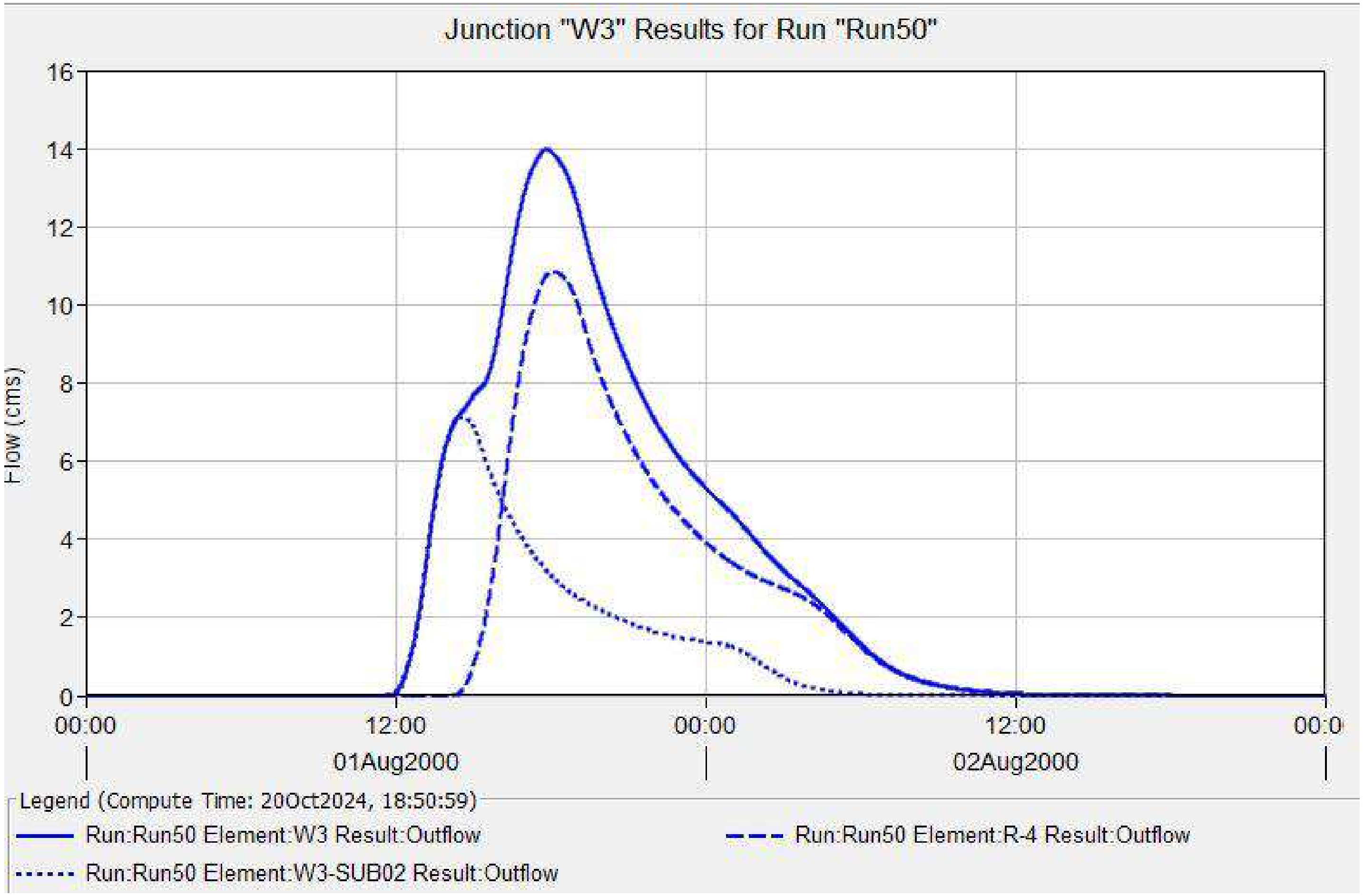

Subbasin "W1-SUB06" Results for Run "Run50"
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
7
6
5
4
3
2
1
0
00:00
12:00
01Aug2000
00:00
12:00
02Aug2000
Legend (Compute Time: 20Oct2024, 18:50:59)
Run:Run50 Element:W1-SUB06 Result:Precipitation
Run:Run50 Element:W1-SUB06 Result:Precipitation Loss
Run:Run50 Element:W1-SUB06 Result:Outflow
Run:Run50 Element:W1-SUB06 Result:Baseflow

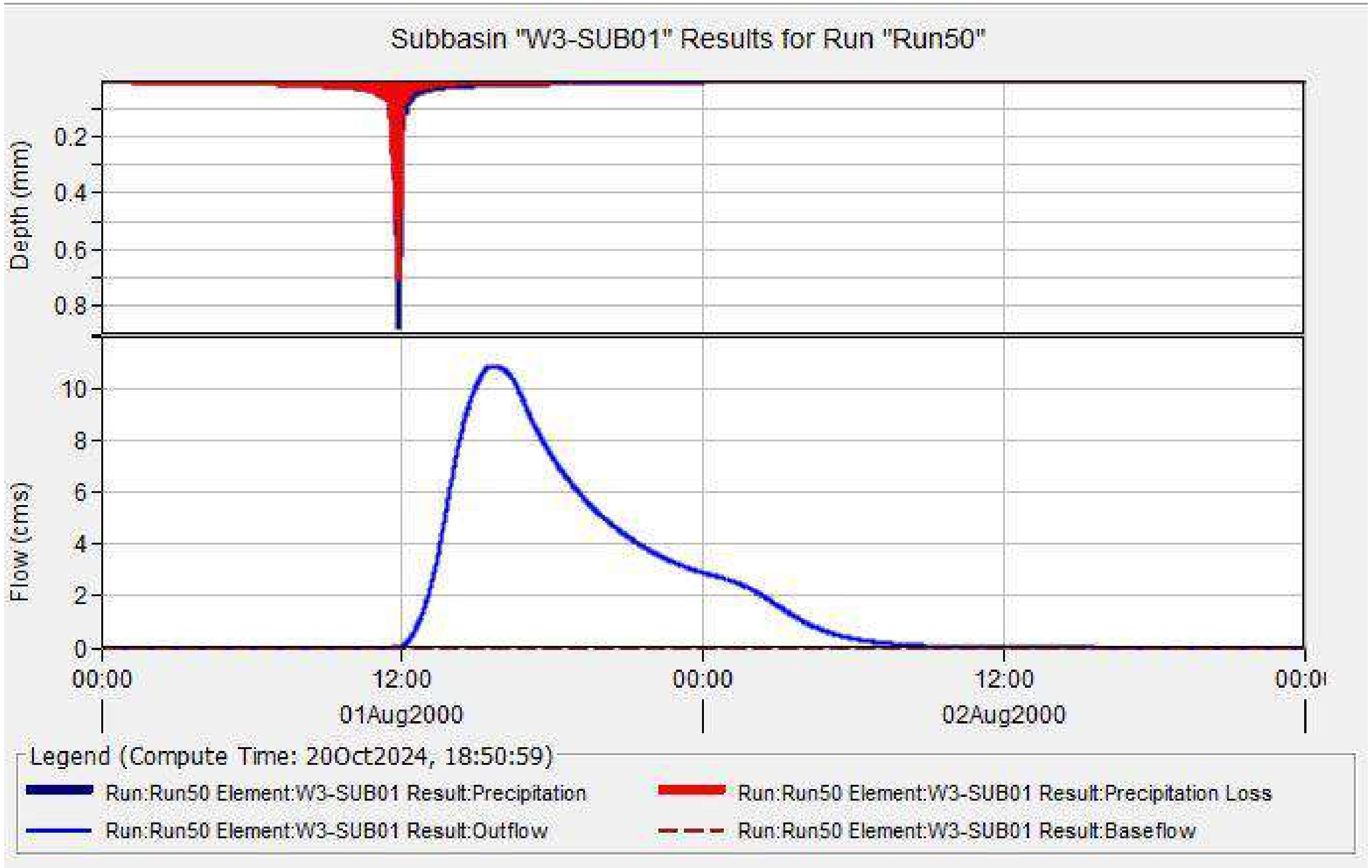

Subbasin "W1-SUB07" Results for Run "Run50"
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
5
4
3
2
1
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:50:59)
Run:Run50 Element:W1-SUB07 Result:Precipitation
Run:Run50 Element:W1-SUB07 Result:Precipitation Loss
Run:Run50 Element:W1-SUB07 Result:Outflow
Run:Run50 Element:W1-SUB07 Result:Baseflow

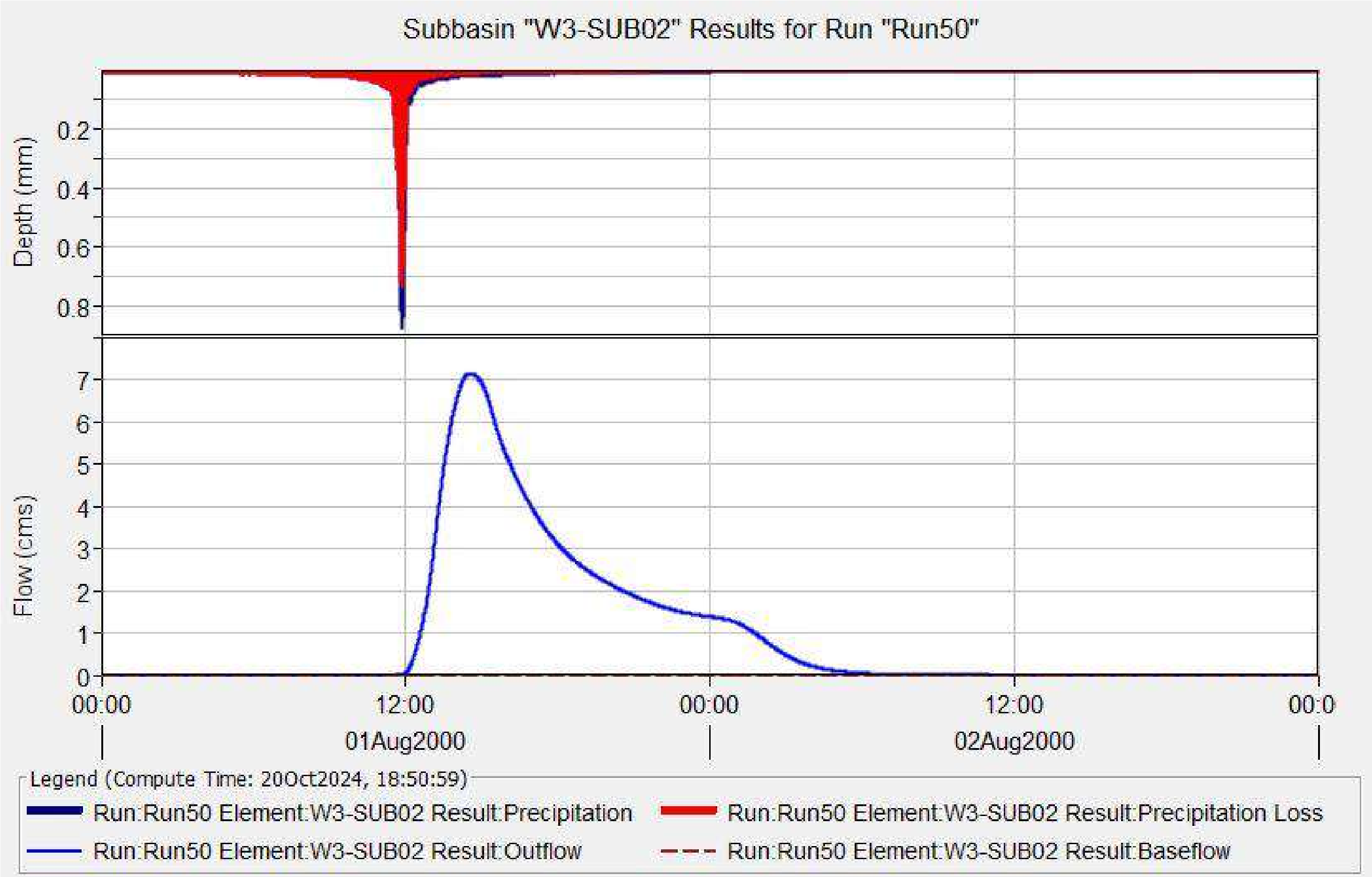

Subbasin "W1-SUB08" Results for Run "Run50"
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:50:59)
Run:Run50 Element:W1-SUB08 Result:Precipitation
Run:Run50 Element:W1-SUB08 Result:Precipitation Loss
Run:Run50 Element:W1-SUB08 Result:Outflow
Run:Run50 Element:W1-SUB08 Result:Baseflow

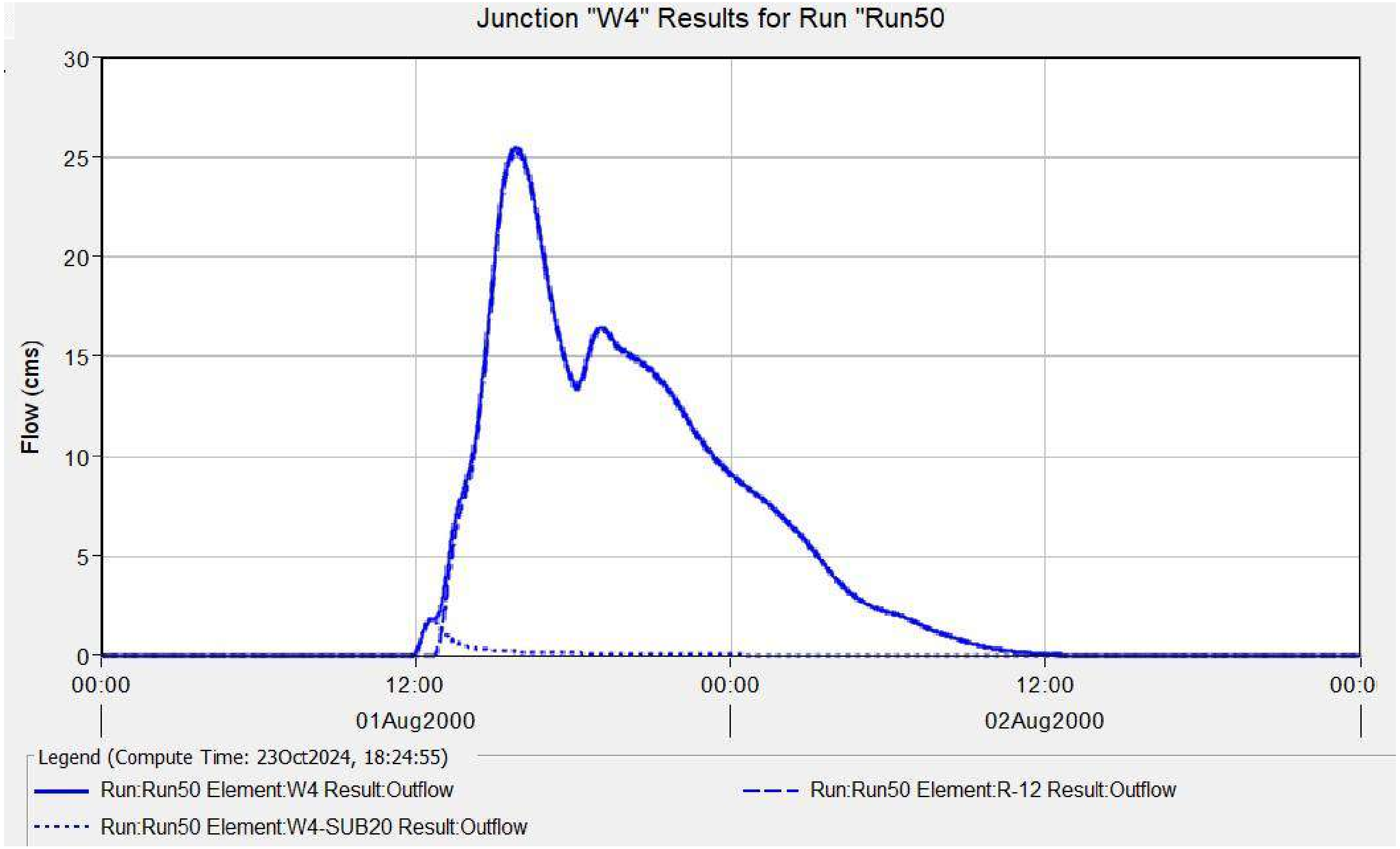

Subbasin "W1-SUB09" Results for Run "Run50"
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
3.0
2.5
2.0
1.5
1.0
0.5
-0.0
00:00
12:00
01Aug2000
00:00
12:00
02Aug2000
Legend (Compute Time: 20Oct2024, 18:50:59)
Run:Run50 Element:W1-SUB09 Result:Precipitation
Run:Run50 Element:W1-SUB09 Result:Precipitation Loss
Run:Run50 Element:W1-SUB09 Result:Outflow
Run:Run50 Element:W1-SUB09 Result:Baseflow

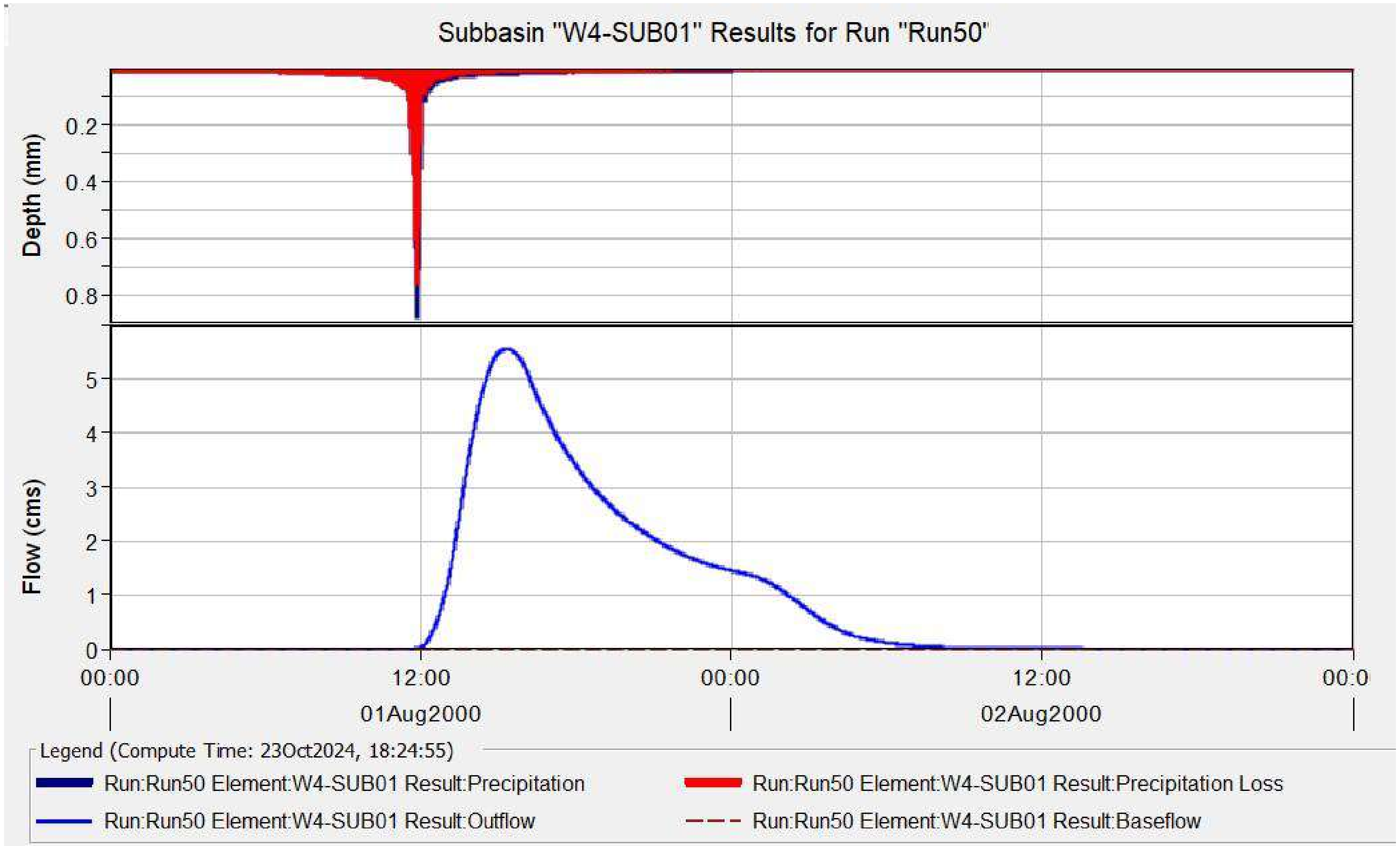

Subbasin "W2" Results for Run "Run50"
Depth (mm)
0.0
0.2
0.4
0.6
0.8
Flow (cms)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:50:59)
Run:Run50 Element:W2 Result:Precipitation
Run:Run50 Element:W2 Result:Precipitation Loss
Run:Run50 Element:W2 Result:Outflow
Run:Run50 Element:W2 Result:Baseflow

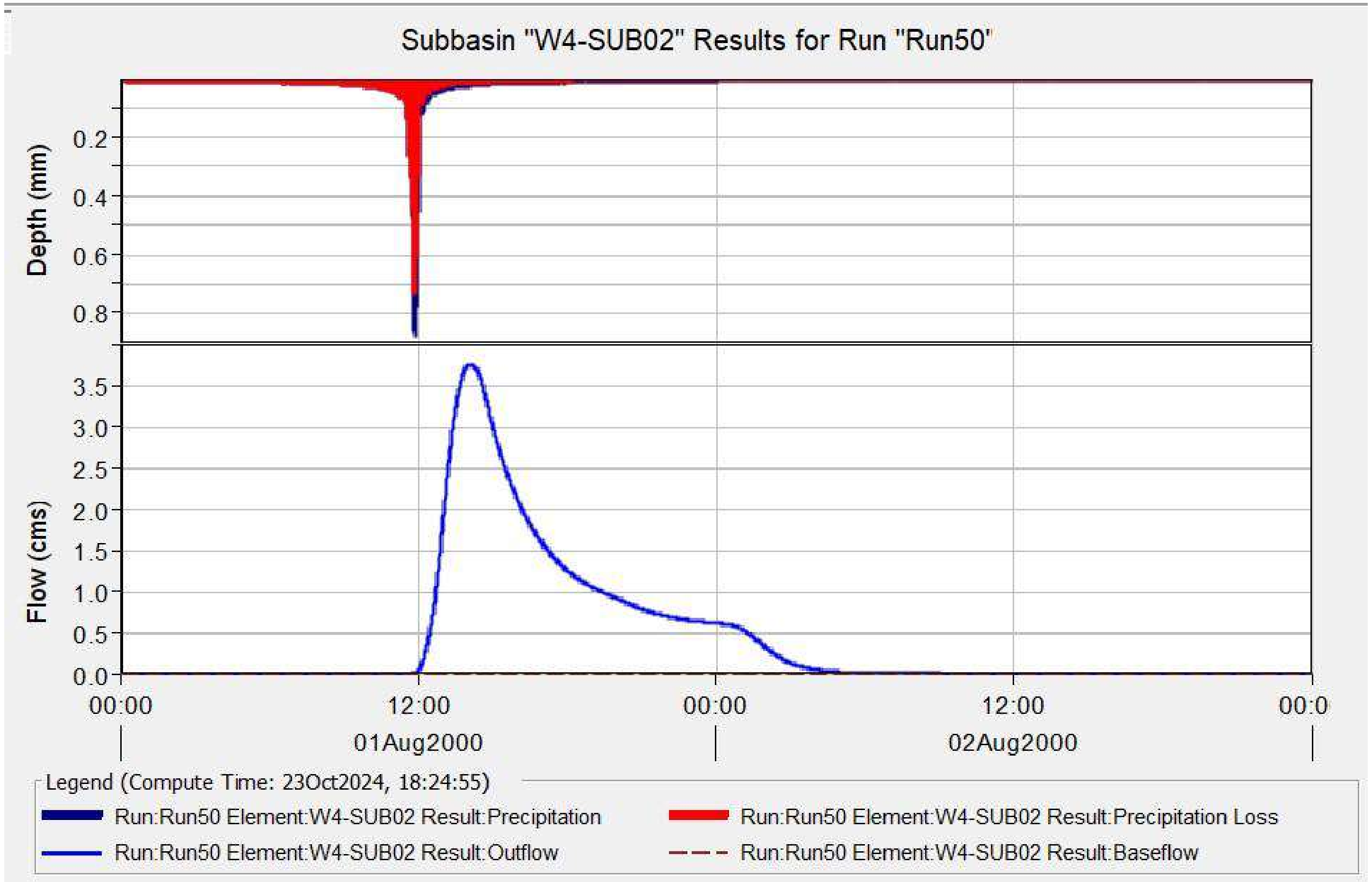

Junction "W3" Results for Run "Run50"
Flow (cms)
16
14
12
10
8
6
4
2
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:50:59)
Run:Run50 Element:W3 Result:Outflow
Run:Run50 Element:R-4 Result:Outflow
Run:Run50 Element:W3-SUB02 Result:Outflow

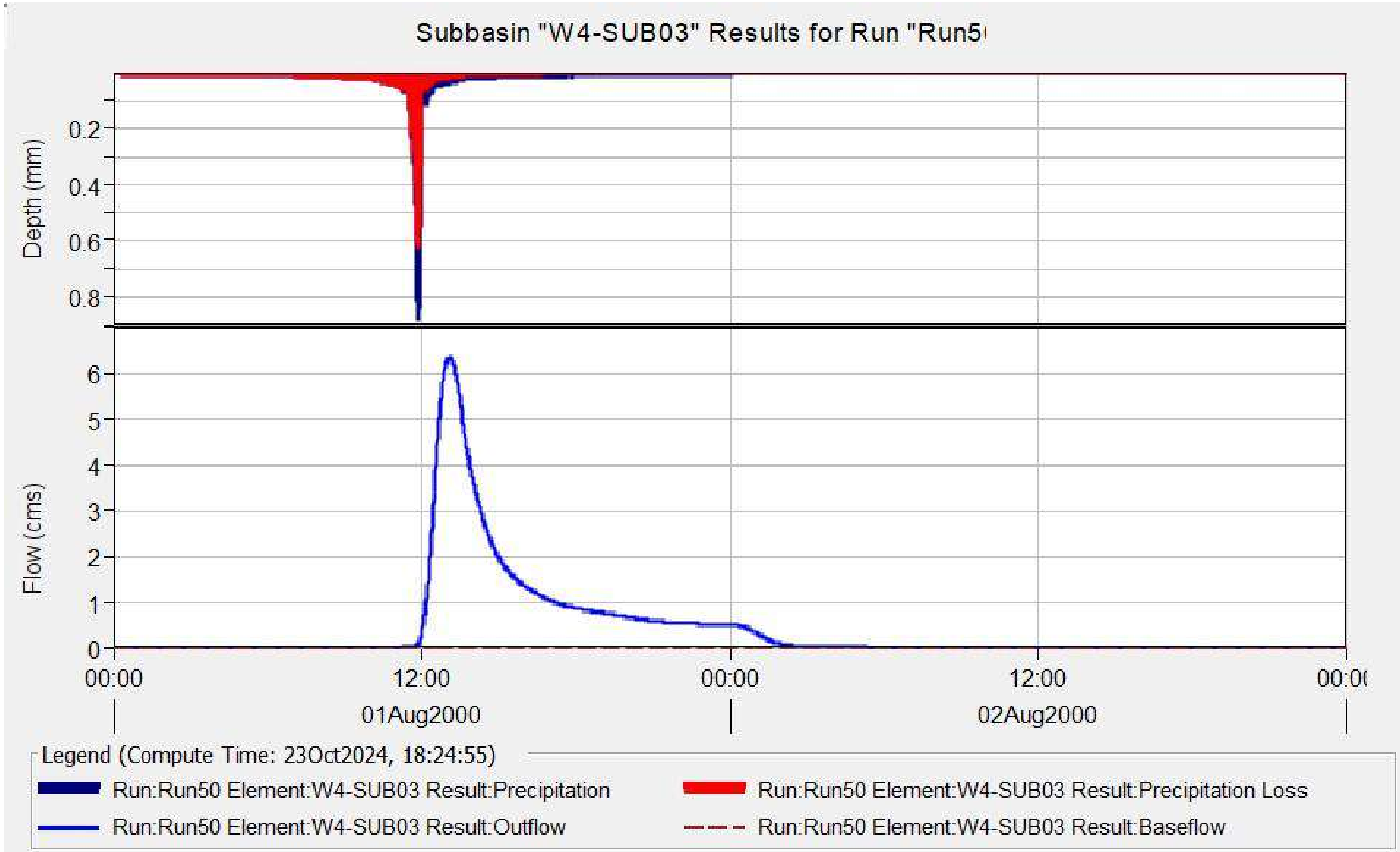

Subbasin "W3-SUB01" Results for Run "Run50"
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
10
8
6
4
2
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:50:59)
Run:Run50 Element:W3-SUB01 Result:Precipitation
Run:Run50 Element:W3-SUB01 Result:Precipitation Loss
Run:Run50 Element:W3-SUB01 Result:Outflow
Run:Run50 Element:W3-SUB01 Result:Baseflow

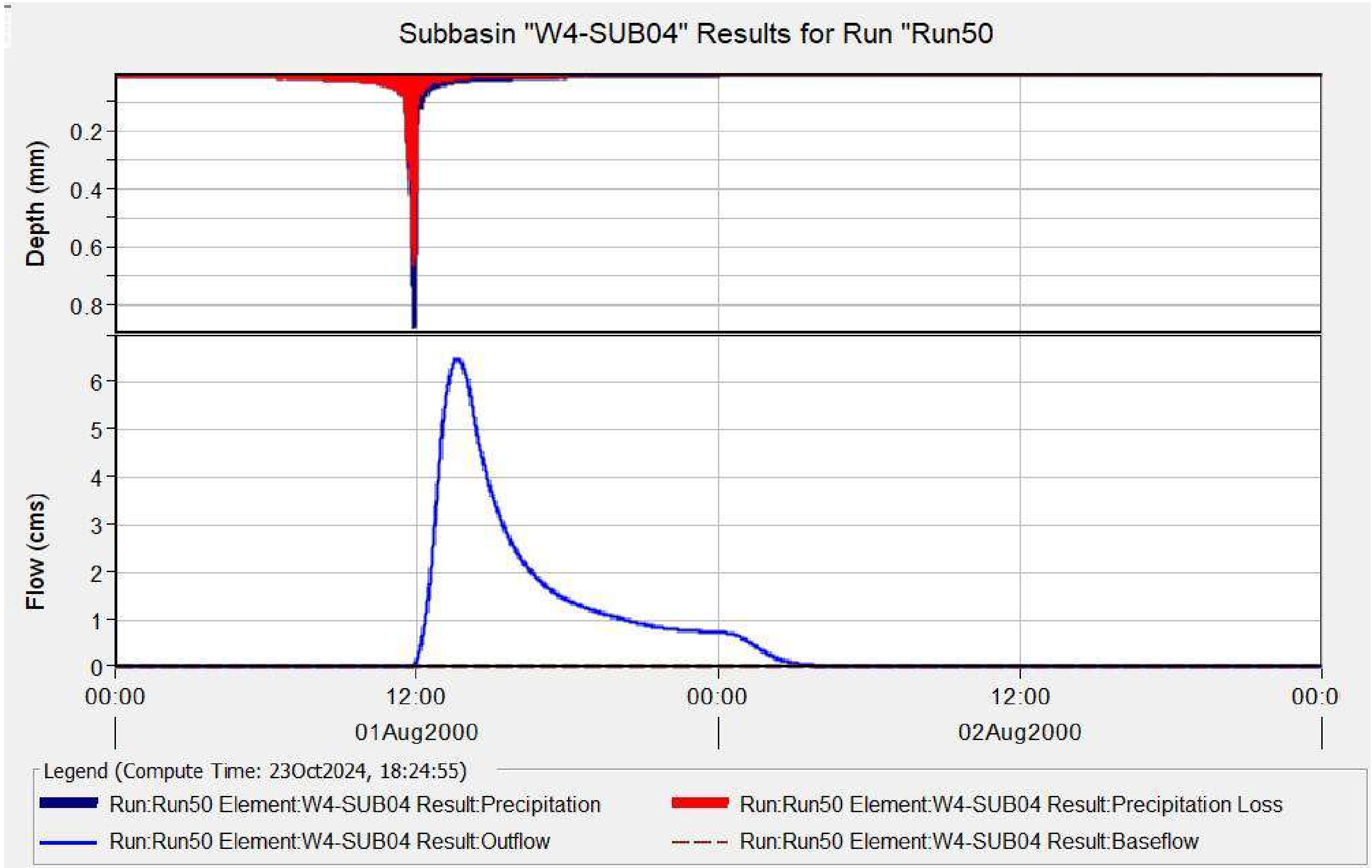

Subbasin "W3-SUB02" Results for Run "Run50"
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
7
6
5
4
3
2
1
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:50:59)
Run:Run50 Element:W3-SUB02 Result:Precipitation
Run:Run50 Element:W3-SUB02 Result:Precipitation Loss
Run:Run50 Element:W3-SUB02 Result:Outflow
Run:Run50 Element:W3-SUB02 Result:Baseflow

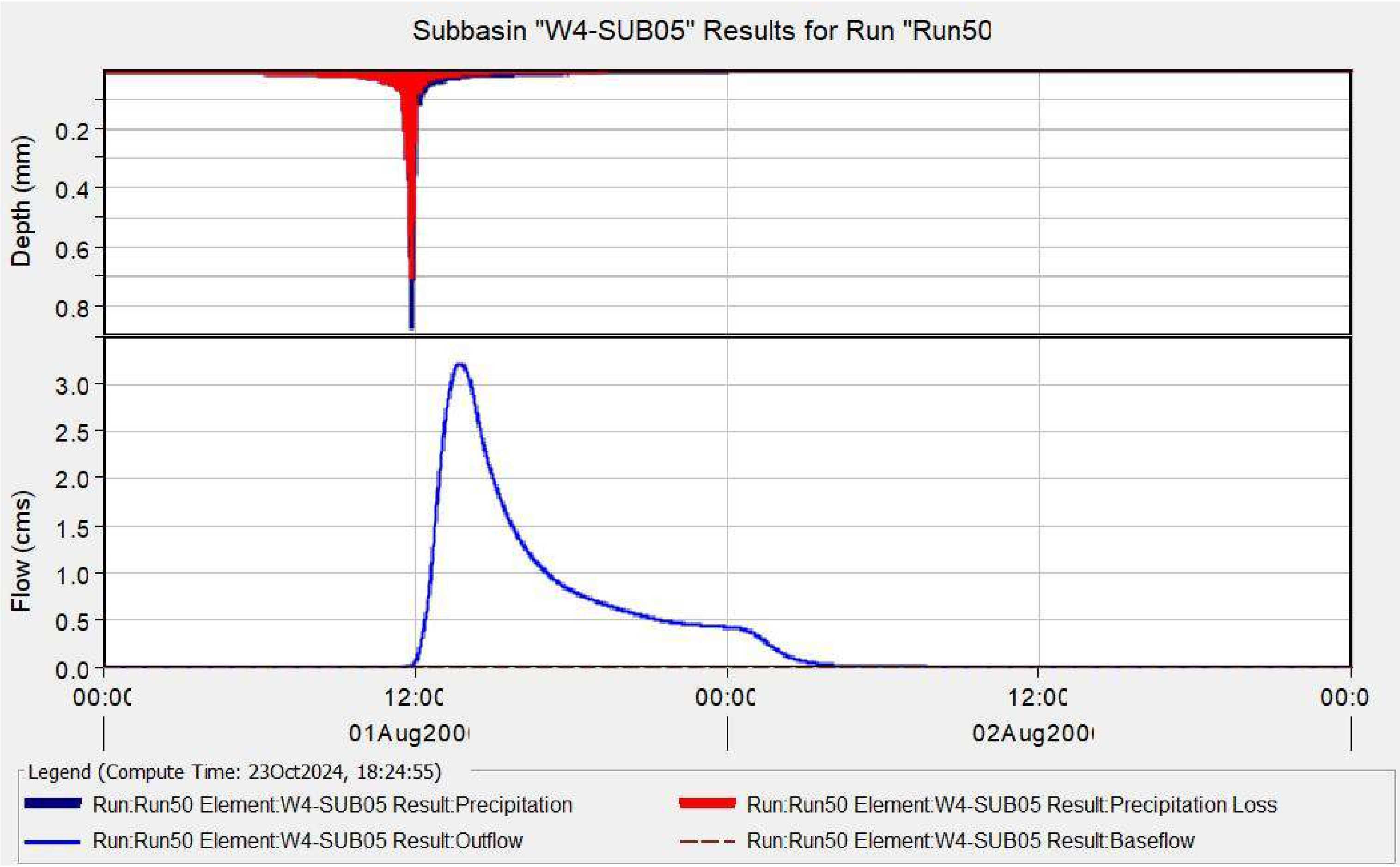

Junction "W4" Results for Run "Run50
Flow (cms)
30
25
20
15
10
5
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4 Result:Outflow
Run:Run50 Element:R-12 Result:Outflow
Run:Run50 Element:W4-SUB20 Result:Outflow

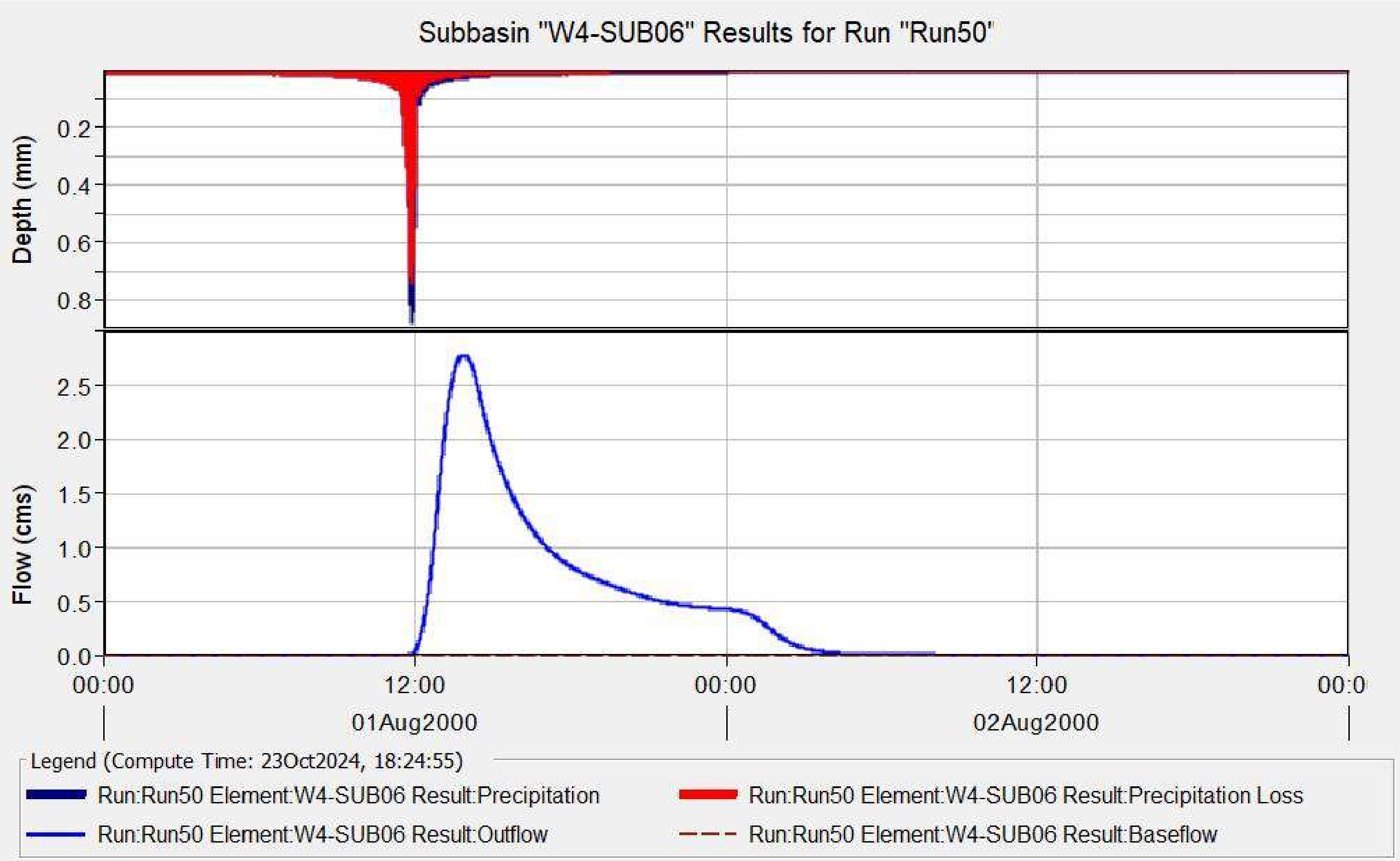

Subbasin "W4-SUB01" Results for Run "Run50"
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
5
4
3
2
1
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4-SUB01 Result:Precipitation
Run:Run50 Element:W4-SUB01 Result:Precipitation Loss
Run:Run50 Element:W4-SUB01 Result:Outflow
Run:Run50 Element:W4-SUB01 Result:Baseflow

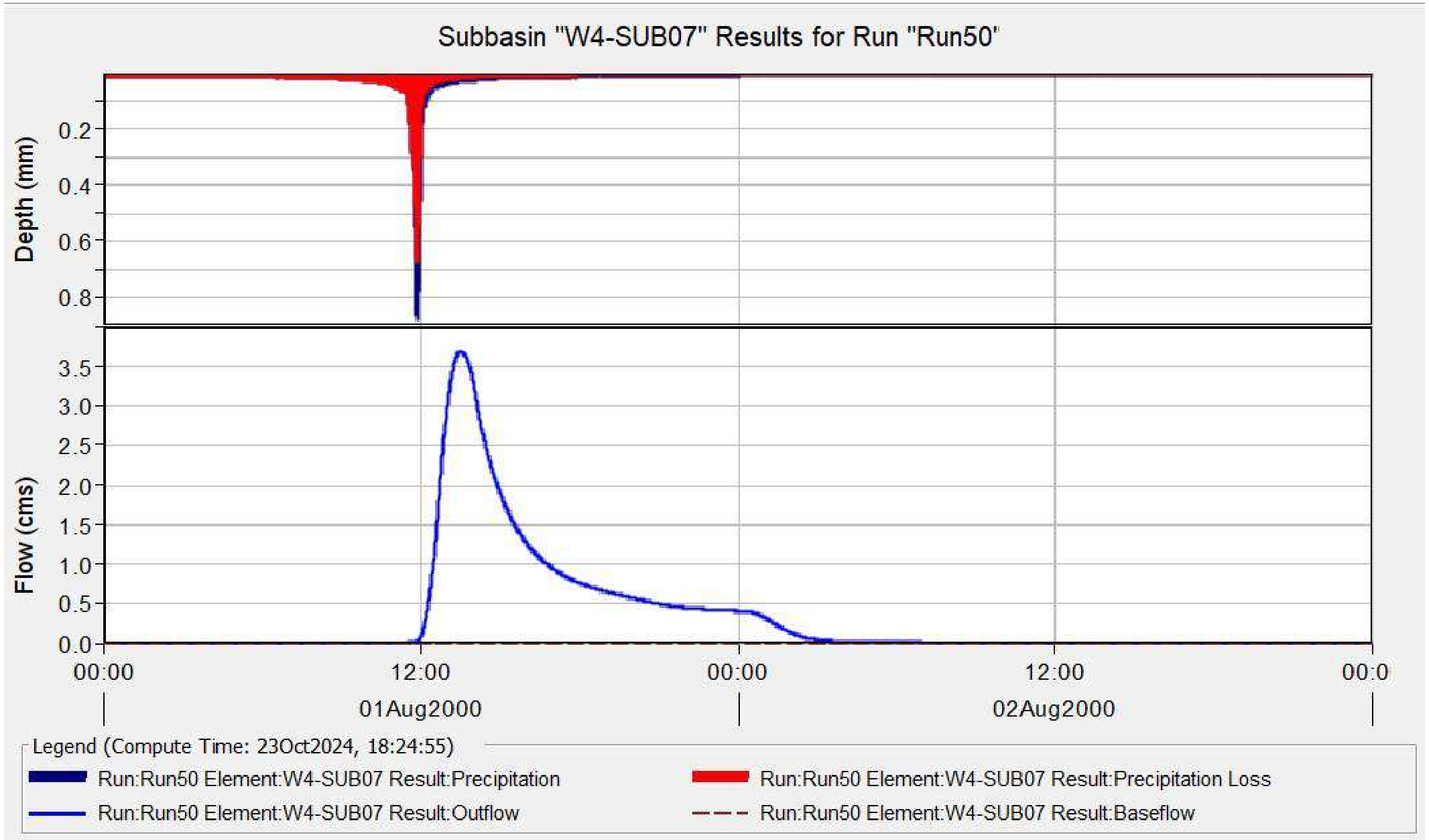

Subbasin "W4-SUB02" Results for Run "Run50"
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4-SUB02 Result:Precipitation
Run:Run50 Element:W4-SUB02 Result:Precipitation Loss
Run:Run50 Element:W4-SUB02 Result:Outflow
Run:Run50 Element:W4-SUB02 Result:Baseflow

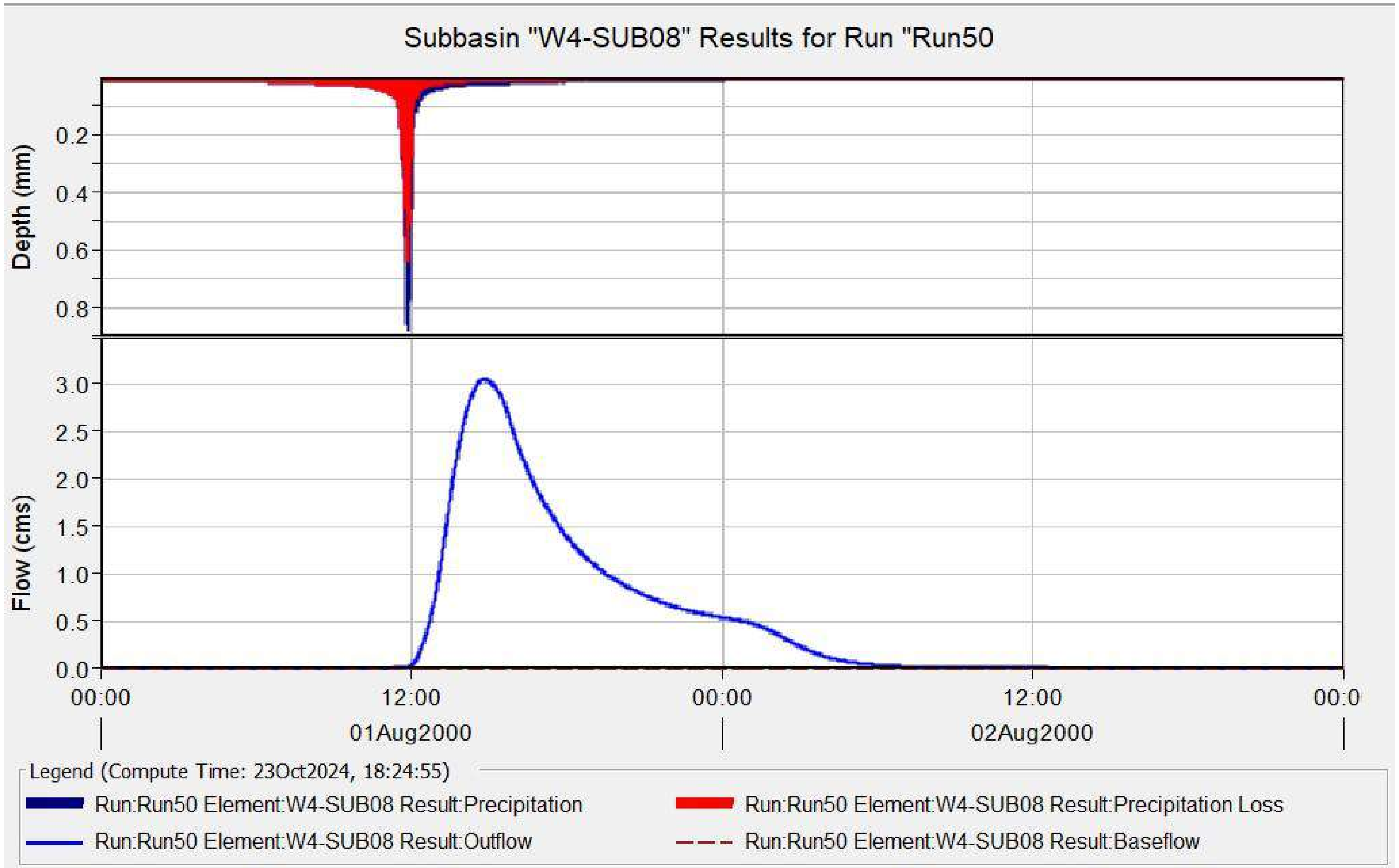

Subbasin "W4-SUB03" Results for Run "Run5
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
6
5
4
3
2
1
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4-SUB03 Result:Precipitation
Run:Run50 Element:W4-SUB03 Result:Precipitation Loss
Run:Run50 Element:W4-SUB03 Result:Outflow
Run:Run50 Element:W4-SUB03 Result:Baseflow

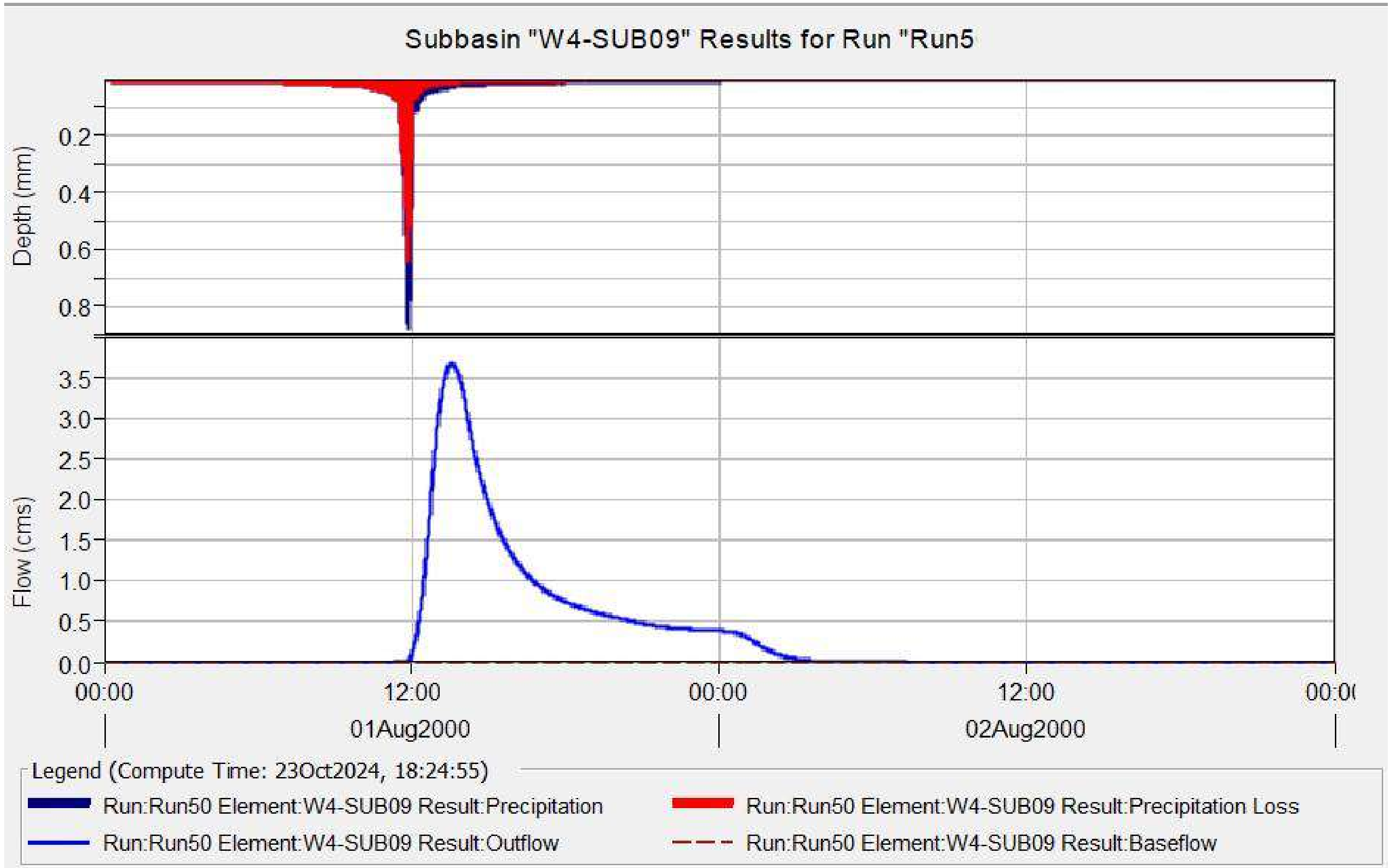

Subbasin "W4-SUB04" Results for Run "Run50
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
6
5
4
3
2
1
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4-SUB04 Result:Precipitation
Run:Run50 Element:W4-SUB04 Result:Precipitation Loss
Run:Run50 Element:W4-SUB04 Result:Outflow
Run:Run50 Element:W4-SUB04 Result:Baseflow

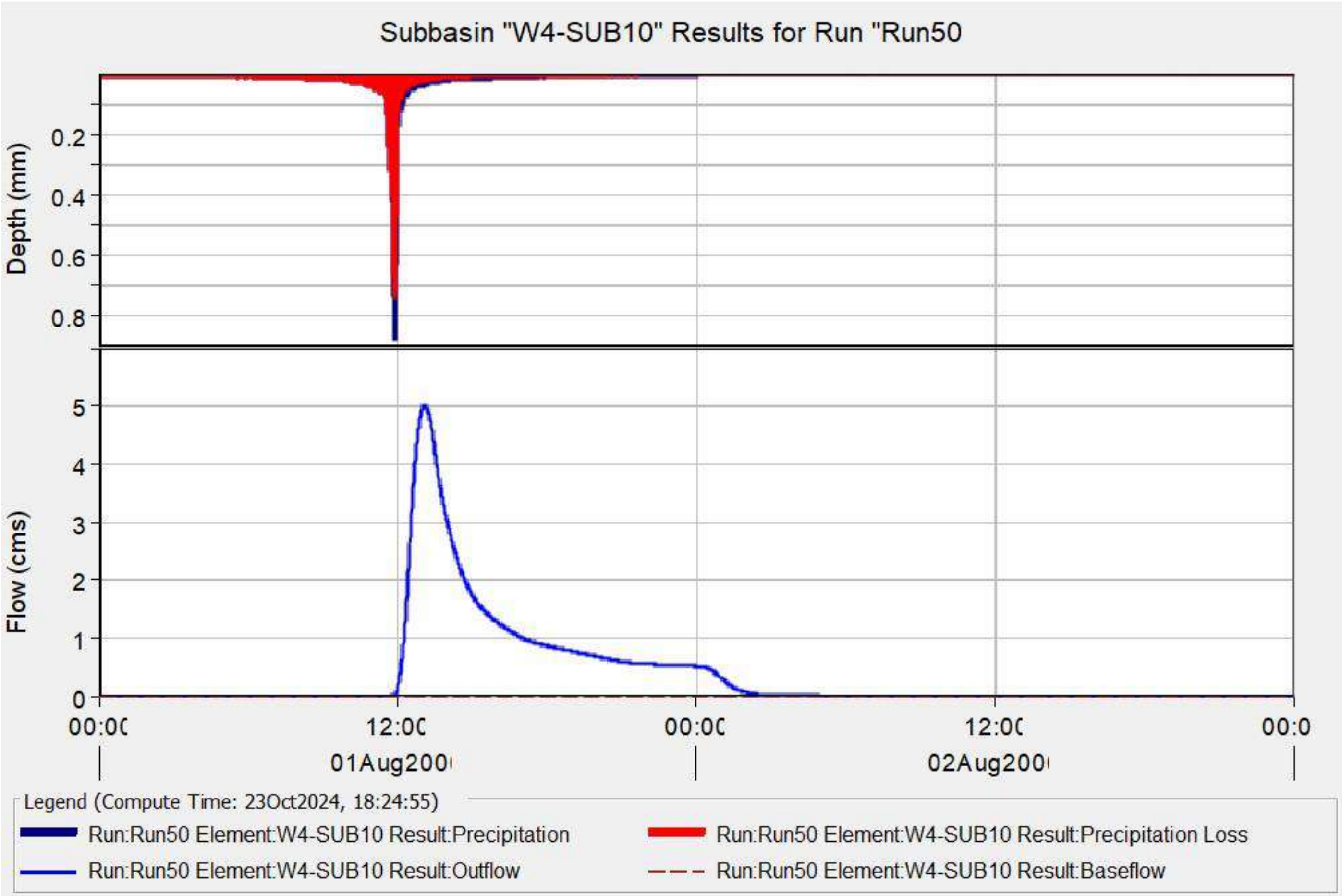

Subbasin "W4-SUB05" Results for Run "Run50
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug200
02Aug200
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4-SUB05 Result:Precipitation
Run:Run50 Element:W4-SUB05 Result:Precipitation Loss
Run:Run50 Element:W4-SUB05 Result:Outflow
Run:Run50 Element:W4-SUB05 Result:Baseflow

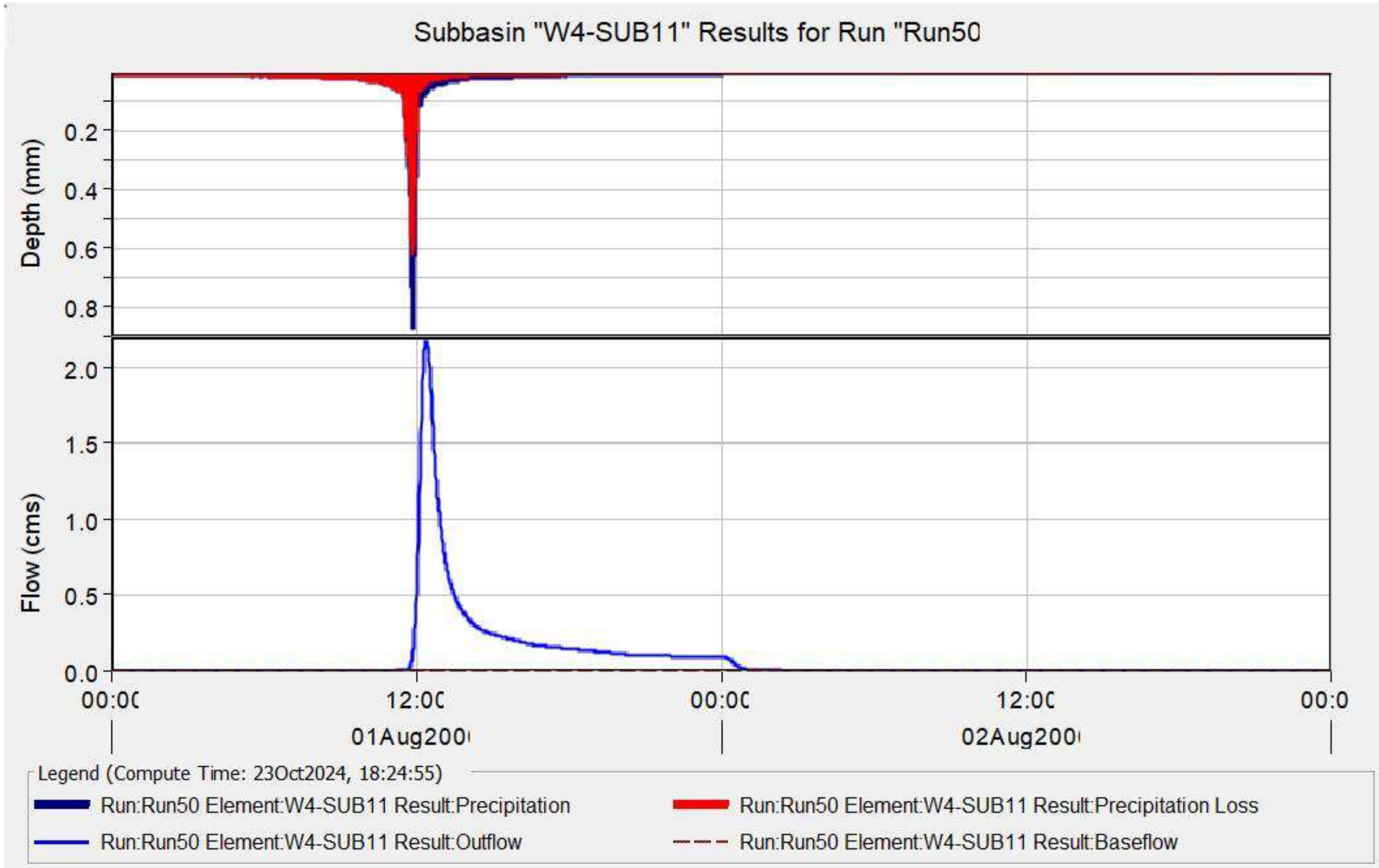

Subbasin "W4-SUB06" Results for Run "Run50"
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
2.5
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4-SUB06 Result:Precipitation
Run:Run50 Element:W4-SUB06 Result:Precipitation Loss
Run:Run50 Element:W4-SUB06 Result:Outflow
Run:Run50 Element:W4-SUB06 Result:Baseflow

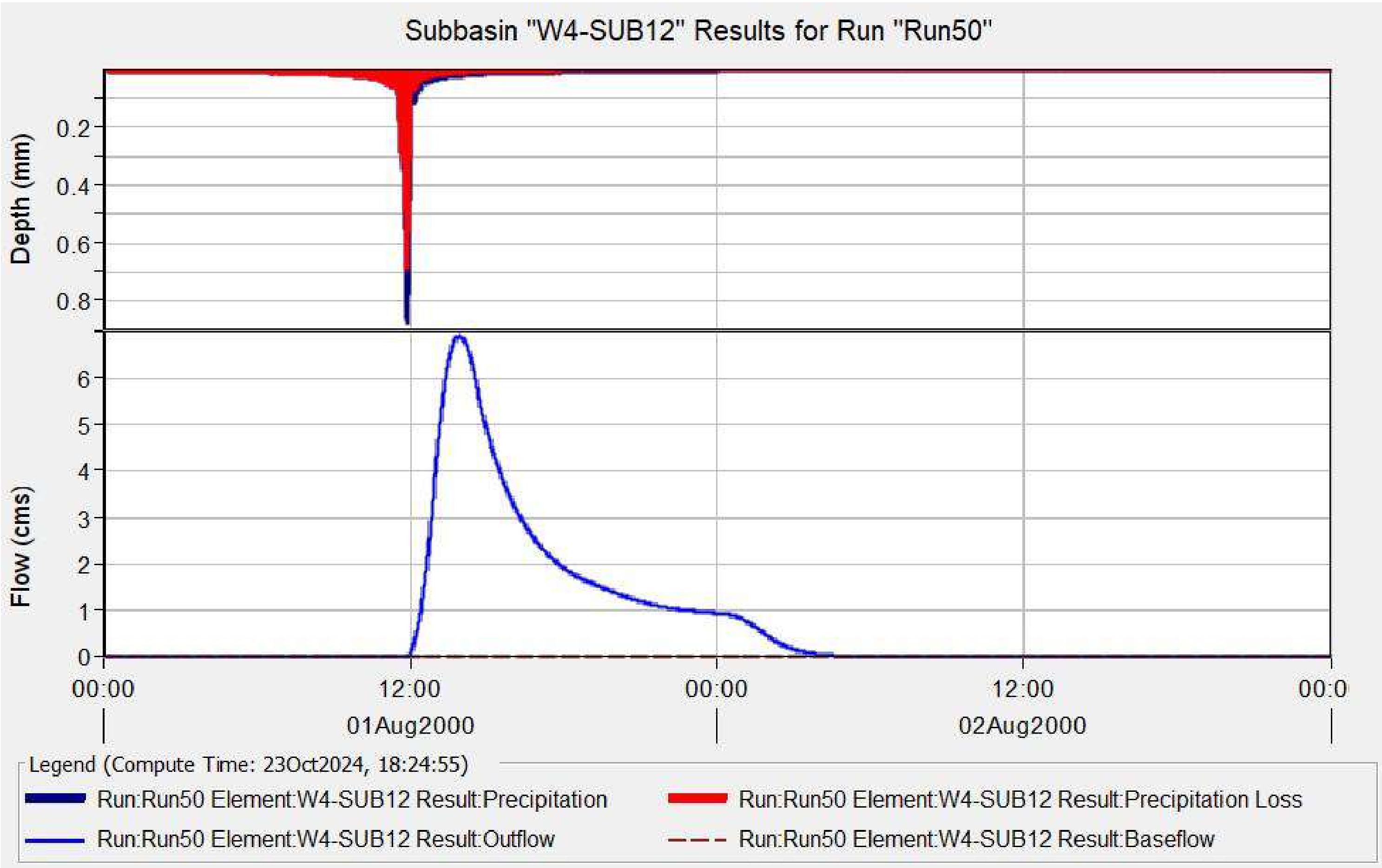

Subbasin "W4-SUB07" Results for Run "Run50"
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4-SUB07 Result:Precipitation
Run:Run50 Element:W4-SUB07 Result:Precipitation Loss
Run:Run50 Element:W4-SUB07 Result:Outflow
Run:Run50 Element:W4-SUB07 Result:Baseflow

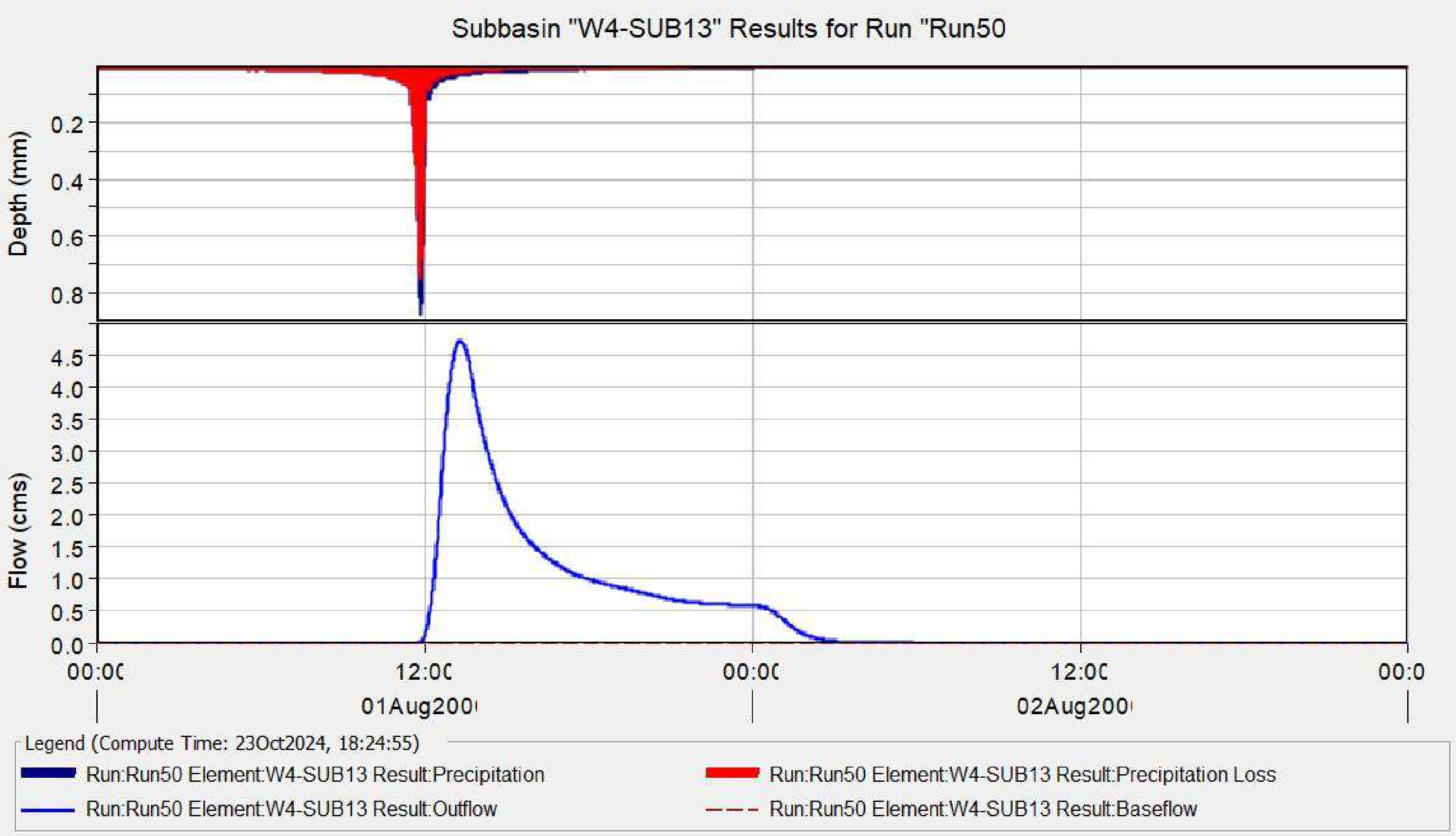

Subbasin "W4-SUB08" Results for Run "Run50
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4-SUB08 Result:Precipitation
Run:Run50 Element:W4-SUB08 Result:Precipitation Loss
Run:Run50 Element:W4-SUB08 Result:Outflow
Run:Run50 Element:W4-SUB08 Result:Baseflow

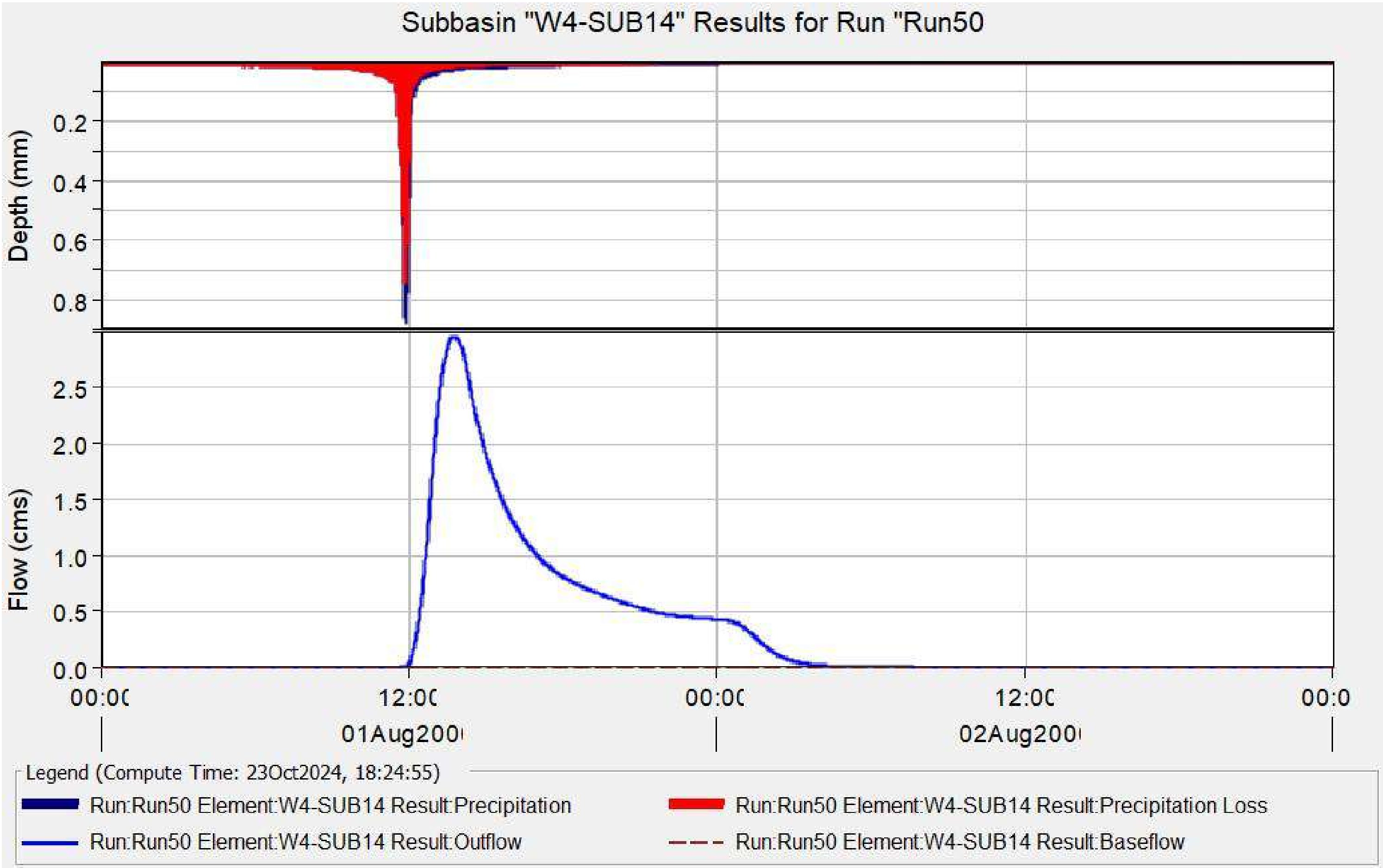

Subbasin "W4-SUB09" Results for Run "Run5
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0(
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4-SUB09 Result:Precipitation
Run:Run50 Element:W4-SUB09 Result:Precipitation Loss
Run:Run50 Element:W4-SUB09 Result:Outflow
Run:Run50 Element:W4-SUB09 Result:Baseflow

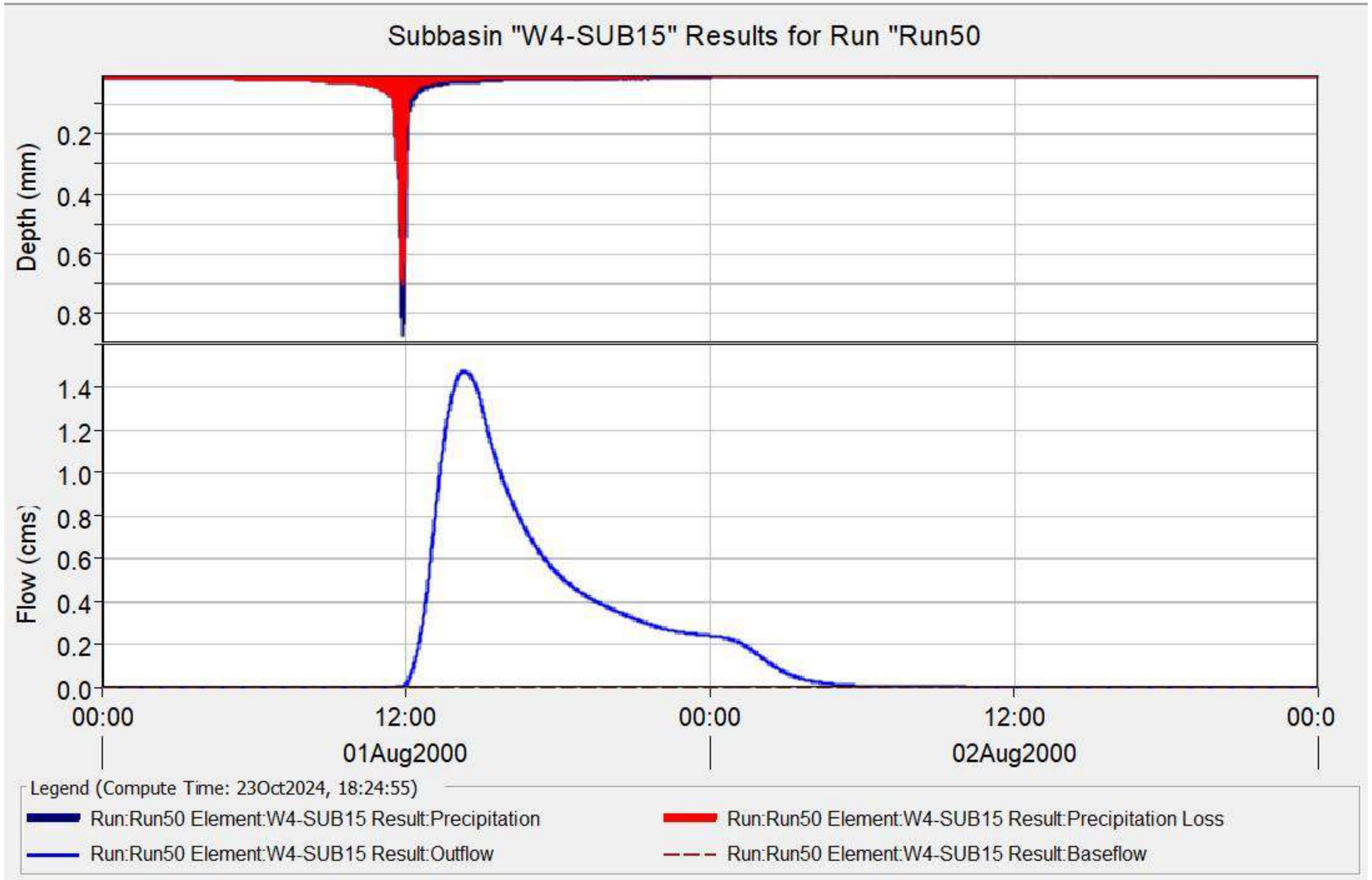

Subbasin "W4-SUB10" Results for Run "Run50
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
5
4
3
2
1
0
00:0C
12:0C
00:0C
12:0C
00:0
01Aug200
02Aug200
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4-SUB10 Result:Precipitation
Run:Run50 Element:W4-SUB10 Result:Precipitation Loss
Run:Run50 Element:W4-SUB10 Result:Outflow
Run:Run50 Element:W4-SUB10 Result:Baseflow

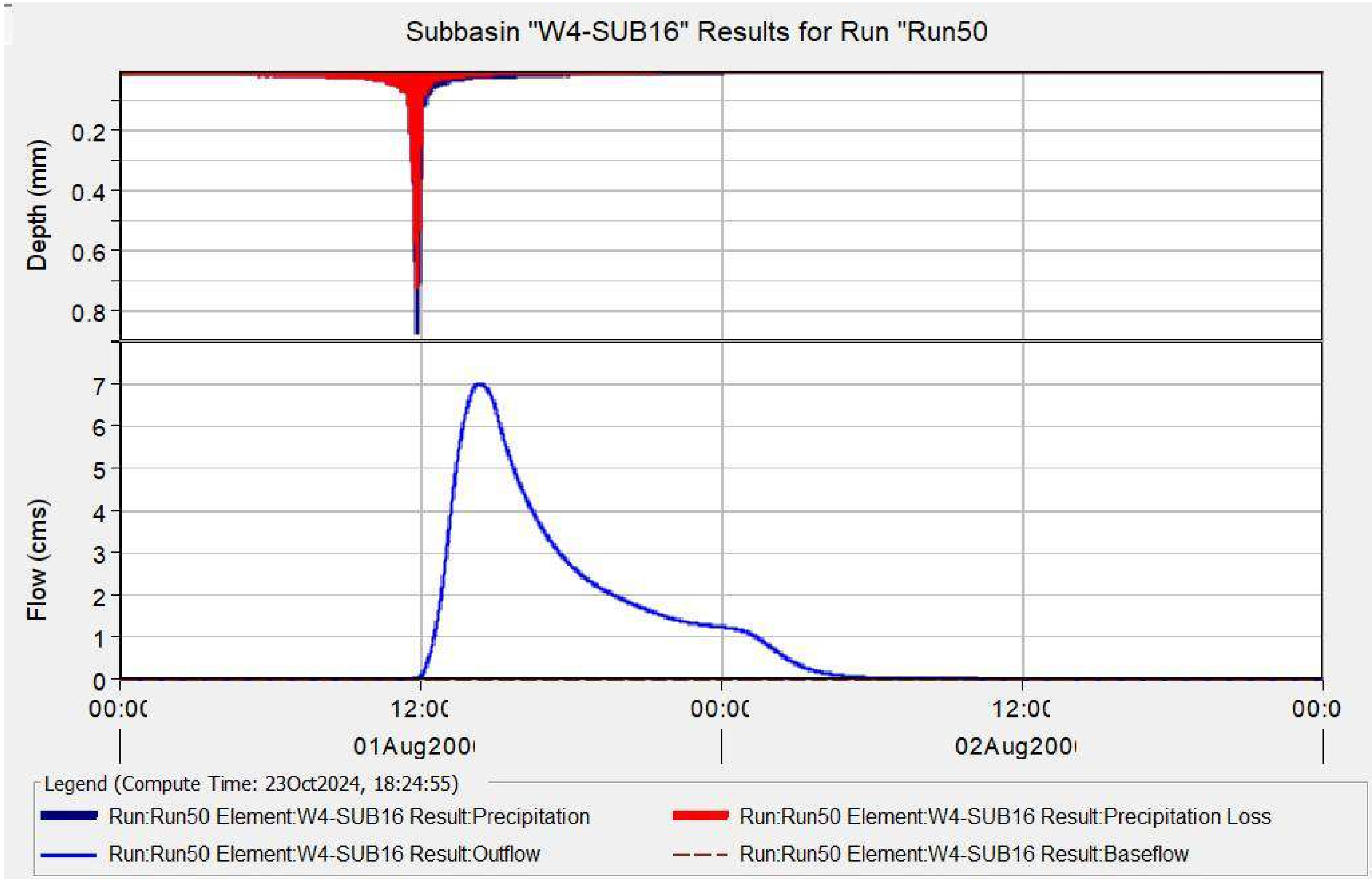

Subbasin "W4-SUB11" Results for Run "Run50
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug200
02Aug200
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4-SUB11 Result:Precipitation
Run:Run50 Element:W4-SUB11 Result:Precipitation Loss
Run:Run50 Element:W4-SUB11 Result:Outflow
Run:Run50 Element:W4-SUB11 Result:Baseflow

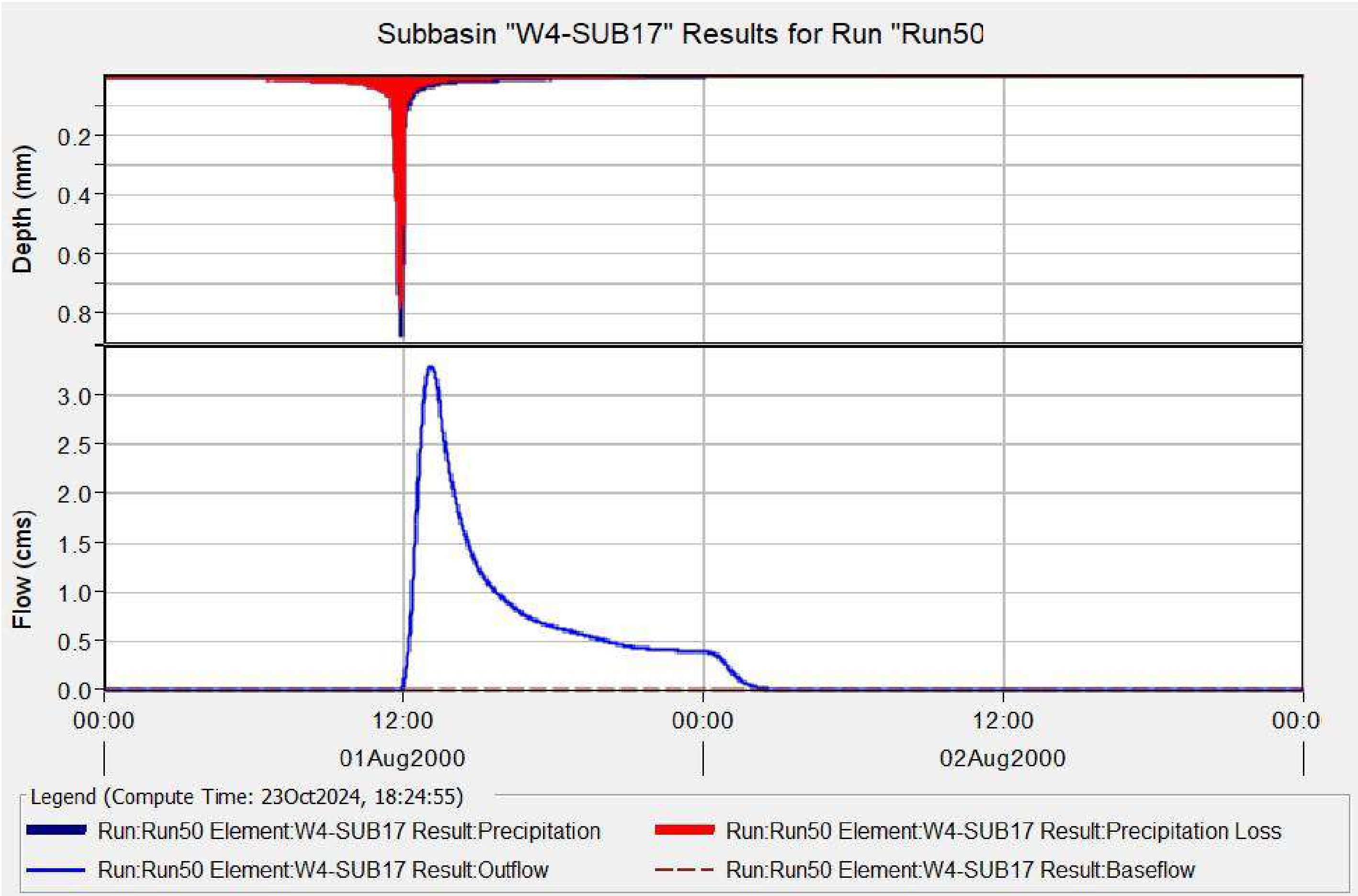

Subbasin "W4-SUB12" Results for Run "Run50"
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
6
5
4
3
2
1
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4-SUB12 Result:Precipitation
Run:Run50 Element:W4-SUB12 Result:Precipitation Loss
Run:Run50 Element:W4-SUB12 Result:Outflow
Run:Run50 Element:W4-SUB12 Result:Baseflow

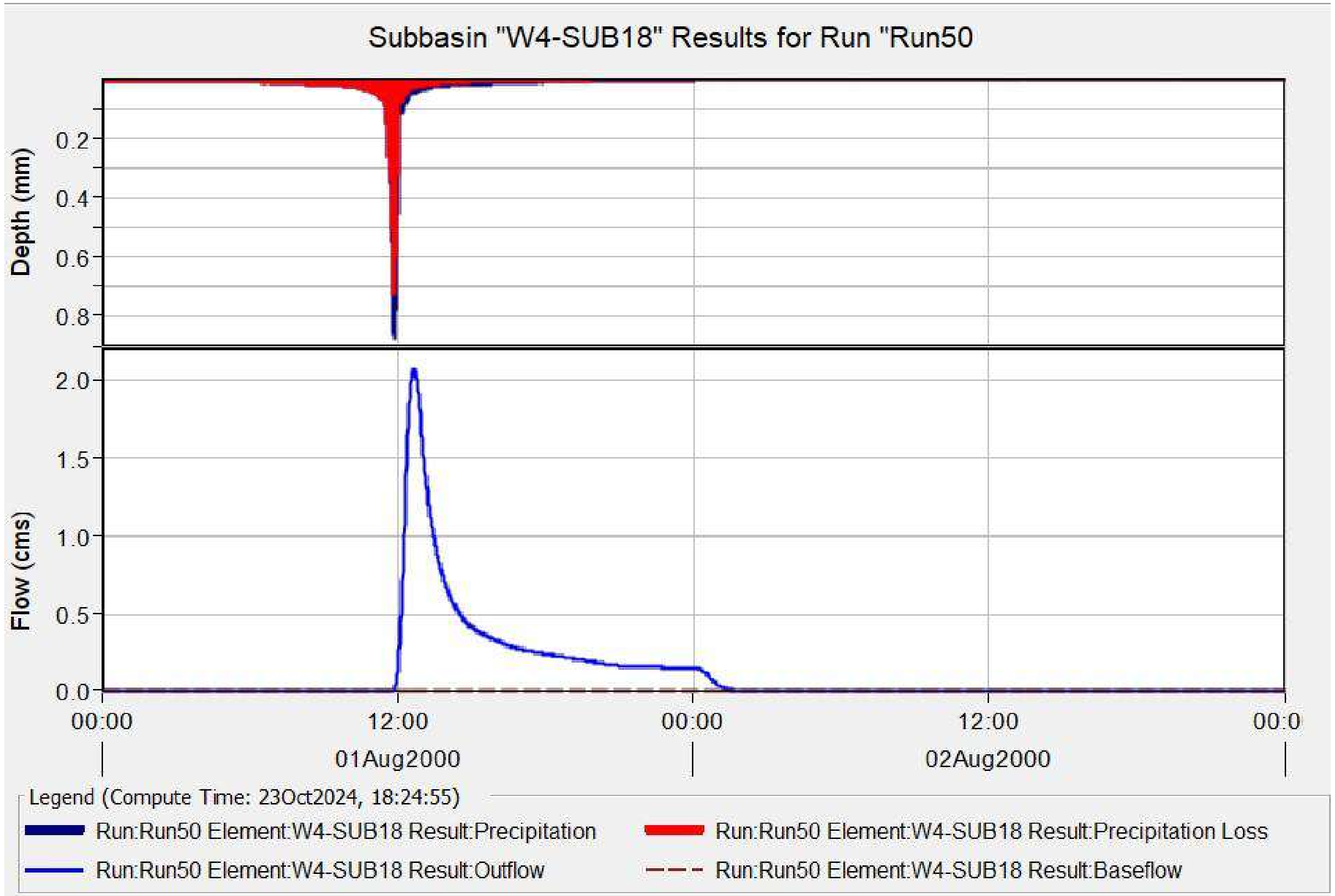

Subbasin "W4-SUB13" Results for Run "Run50
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug200
02Aug200
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4-SUB13 Result:Precipitation
Run:Run50 Element:W4-SUB13 Result:Precipitation Loss
Run:Run50 Element:W4-SUB13 Result:Outflow
Run:Run50 Element:W4-SUB13 Result:Baseflow

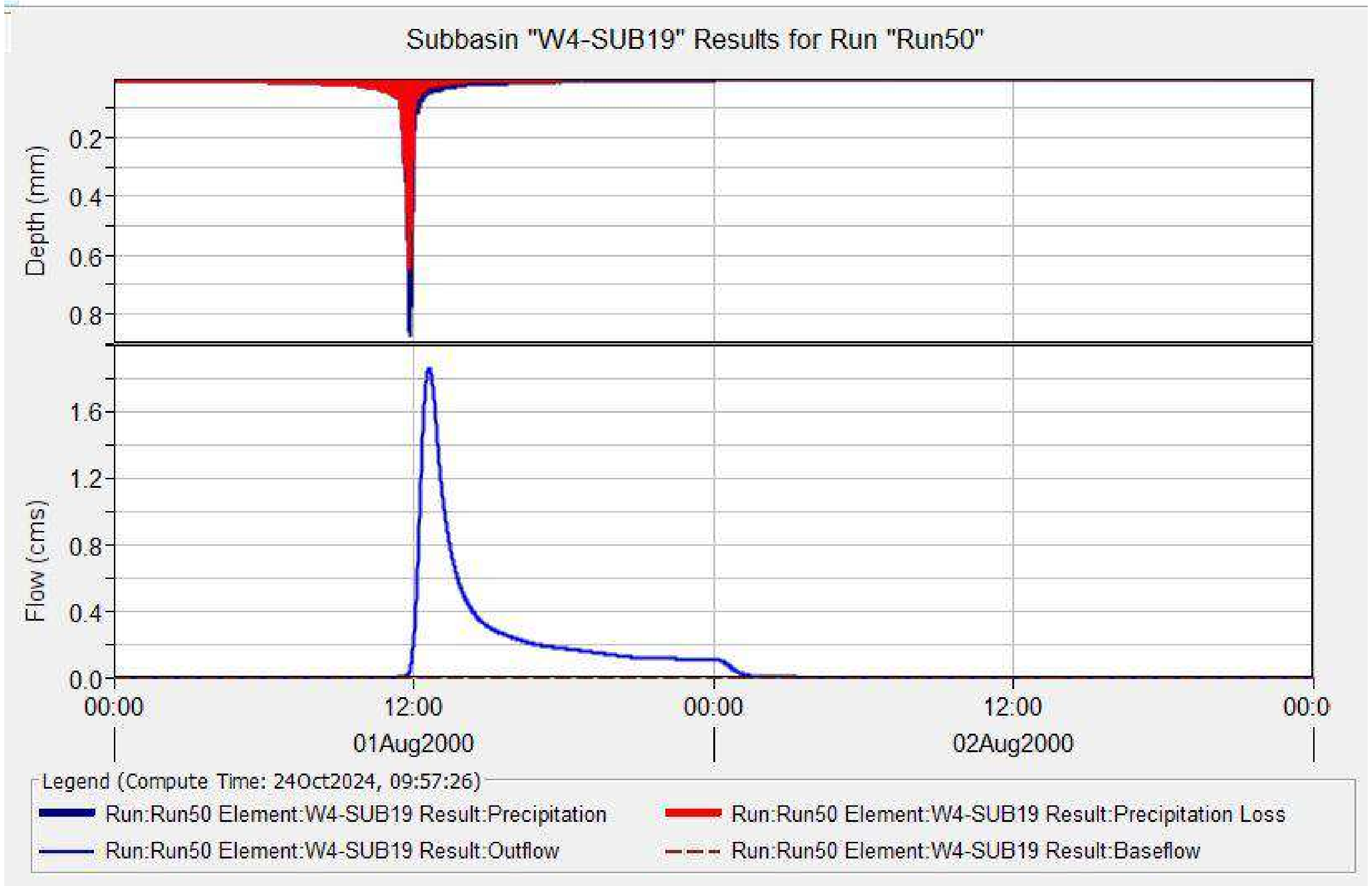

Subbasin "W4-SUB14" Results for Run "Run50
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
2.5
2.0
1.5
1.0
0.5
0.0
00:0(
12:0(
00:0(
12:0(
00:0
01Aug200
02Aug200
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4-SUB14 Result:Precipitation
Run:Run50 Element:W4-SUB14 Result:Precipitation Loss
Run:Run50 Element:W4-SUB14 Result:Outflow
Run:Run50 Element:W4-SUB14 Result:Baseflow

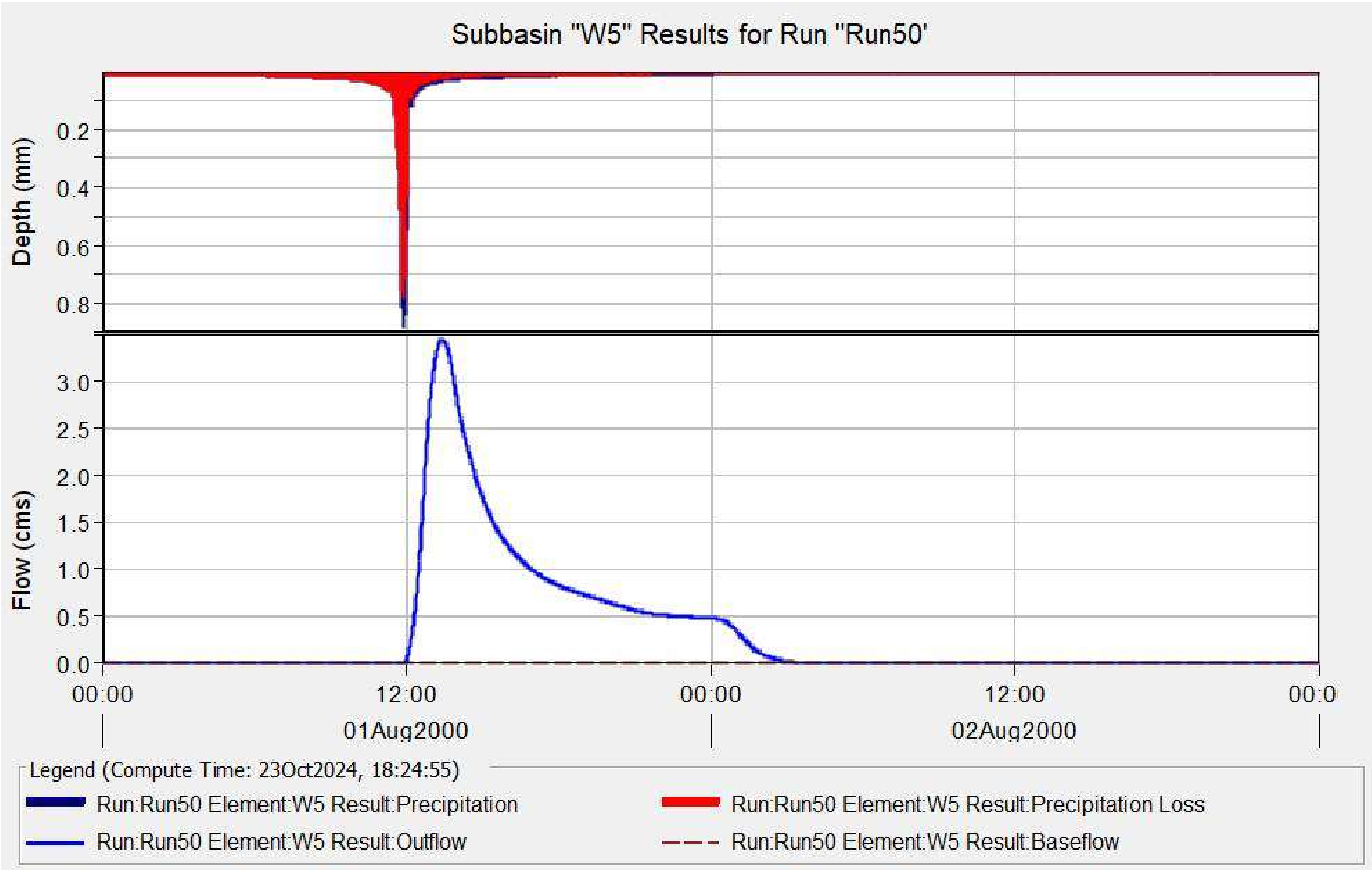

Subbasin "W4-SUB15" Results for Run "Run50
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4-SUB15 Result:Precipitation
Run:Run50 Element:W4-SUB15 Result:Precipitation Loss
Run:Run50 Element:W4-SUB15 Result:Outflow
Run:Run50 Element:W4-SUB15 Result:Baseflow

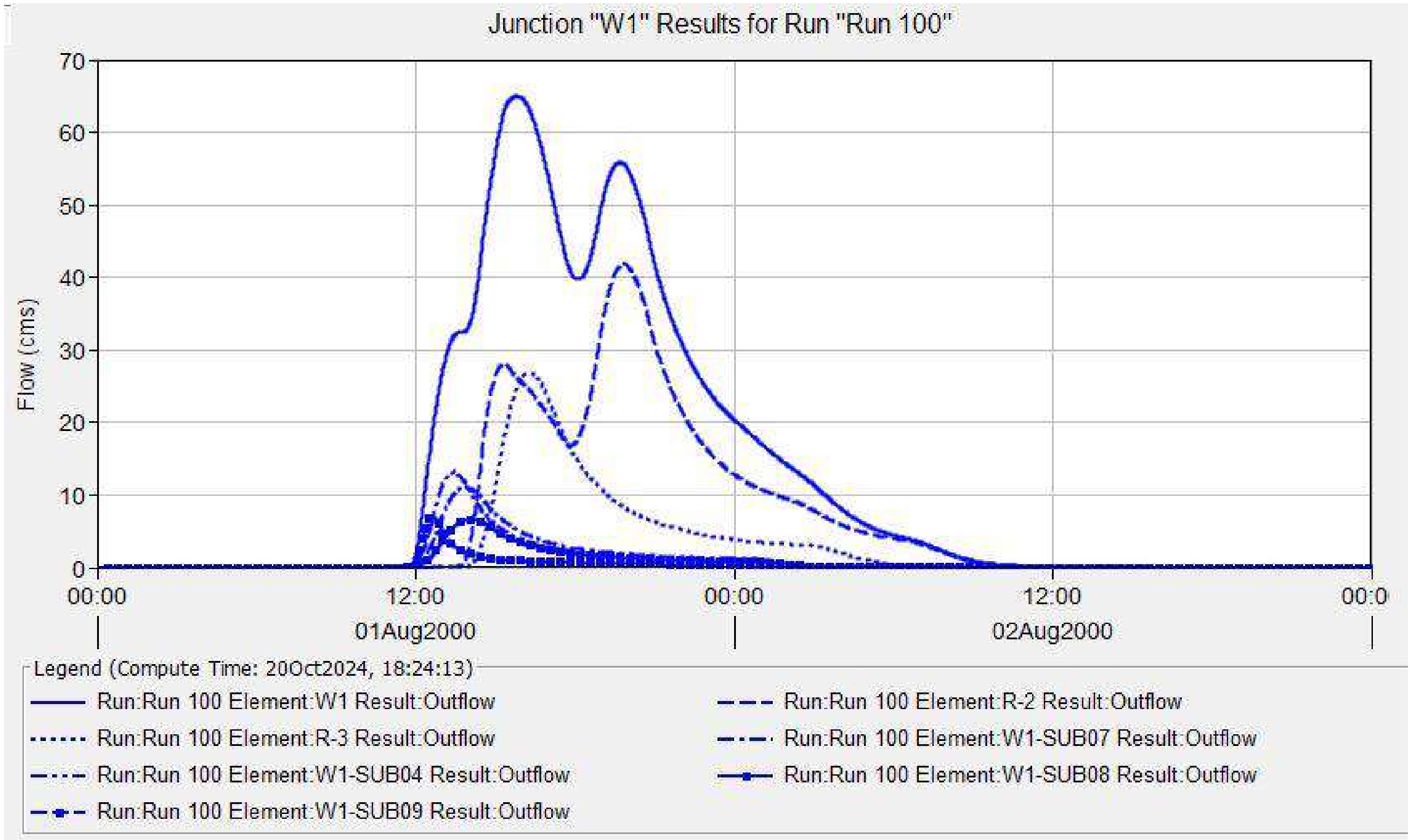

Subbasin "W4-SUB16" Results for Run "Run50
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
7
6
5
4
3
2
1
0
00:0(
12:0(
00:0(
12:0(
00:0
01Aug200
02Aug200
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4-SUB16 Result:Precipitation
Run:Run50 Element:W4-SUB16 Result:Precipitation Loss
Run:Run50 Element:W4-SUB16 Result:Outflow
Run:Run50 Element:W4-SUB16 Result:Baseflow

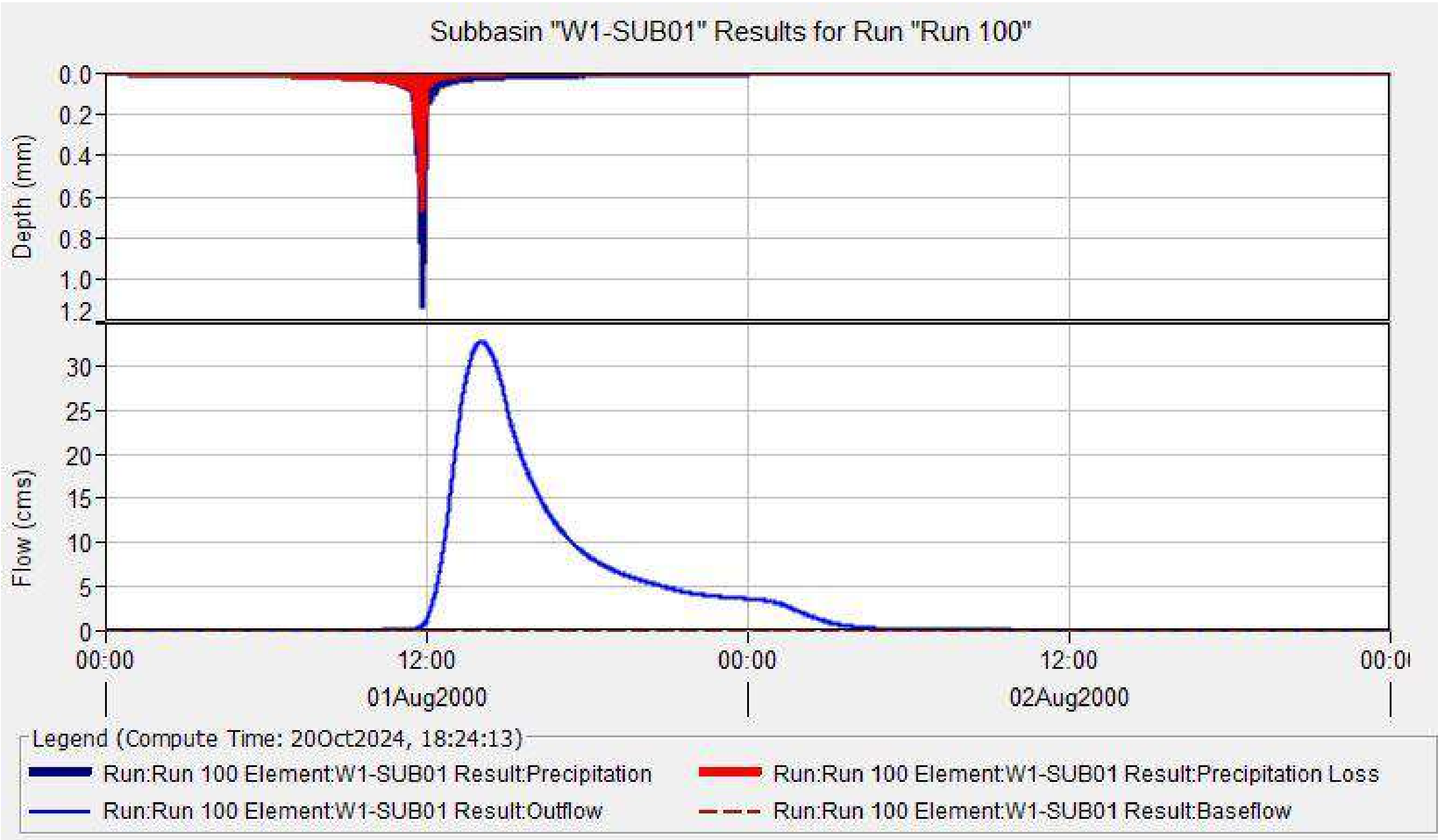

Subbasin "W4-SUB17" Results for Run "Run50
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4-SUB17 Result:Precipitation
Run:Run50 Element:W4-SUB17 Result:Precipitation Loss
Run:Run50 Element:W4-SUB17 Result:Outflow
Run:Run50 Element:W4-SUB17 Result:Baseflow

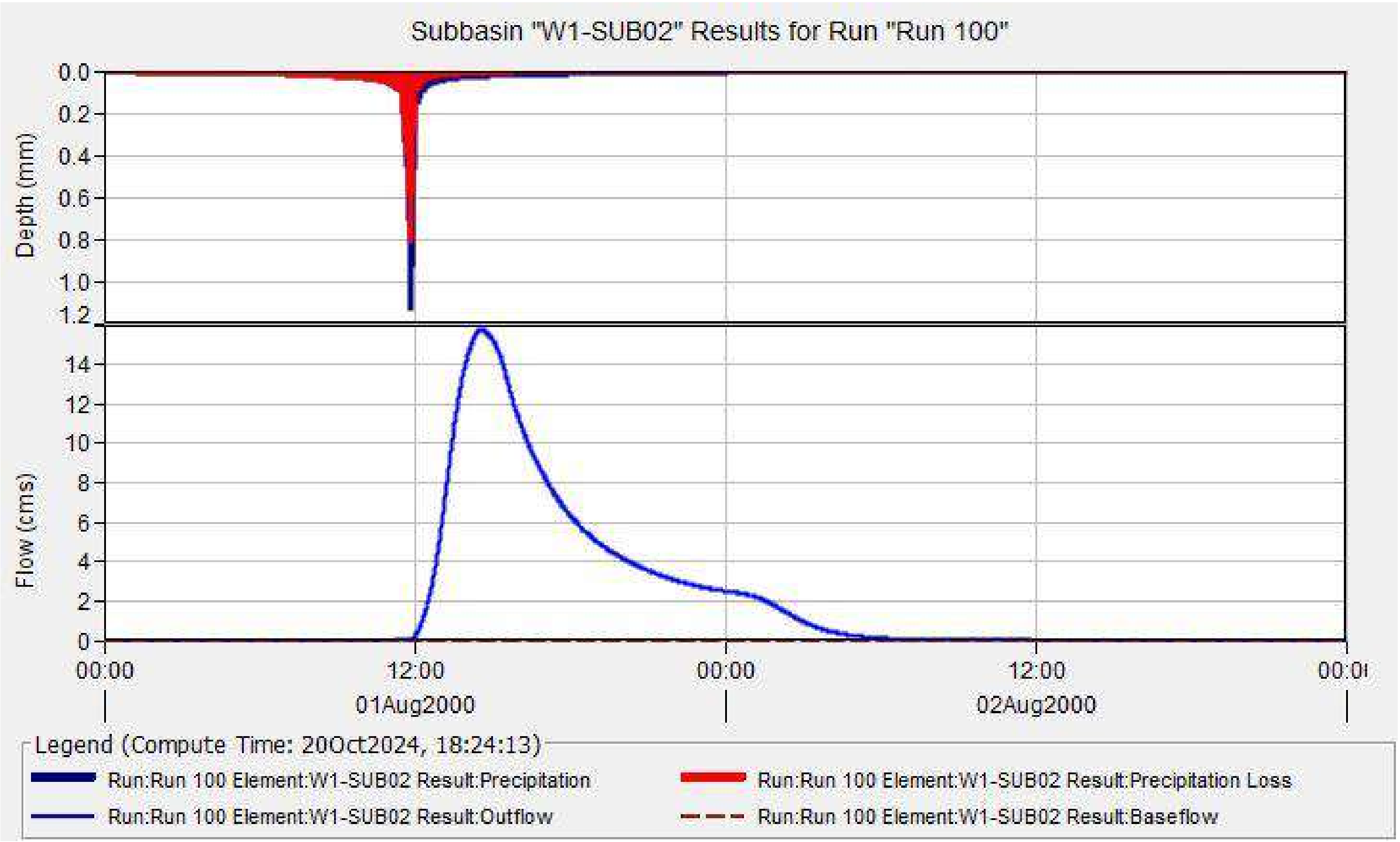

Subbasin "W4-SUB18" Results for Run "Run50
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W4-SUB18 Result:Precipitation
Run:Run50 Element:W4-SUB18 Result:Precipitation Loss
Run:Run50 Element:W4-SUB18 Result:Outflow
Run:Run50 Element:W4-SUB18 Result:Baseflow

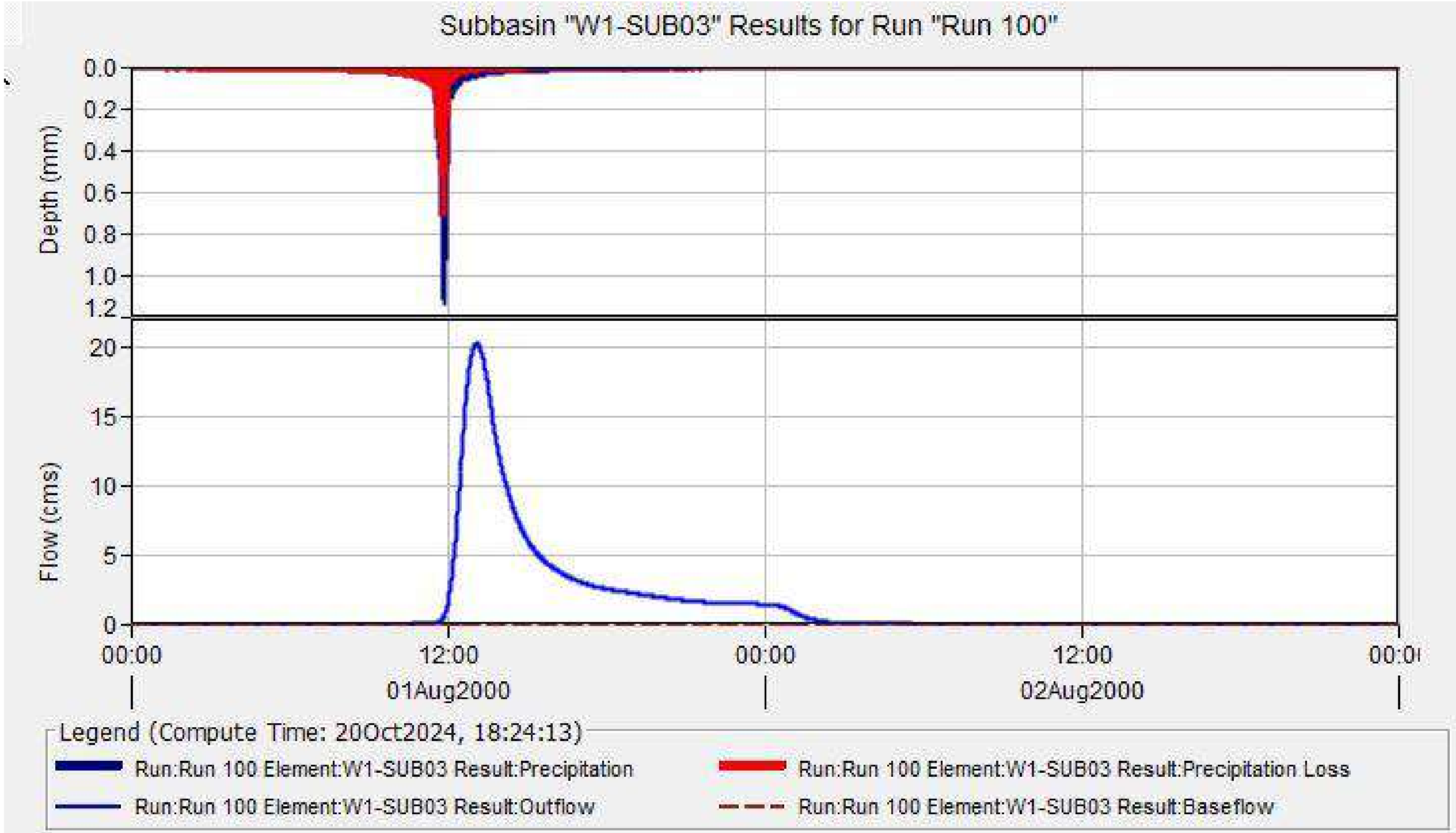

Subbasin "W4-SUB19" Results for Run "Run50"
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
1.6
1.2
0.8
0.4
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 24Oct2024, 09:57:26)
Run:Run50 Element:W4-SUB19 Result:Precipitation
Run:Run50 Element:W4-SUB19 Result:Precipitation Loss
Run:Run50 Element:W4-SUB19 Result:Outflow
Run:Run50 Element:W4-SUB19 Result:Baseflow

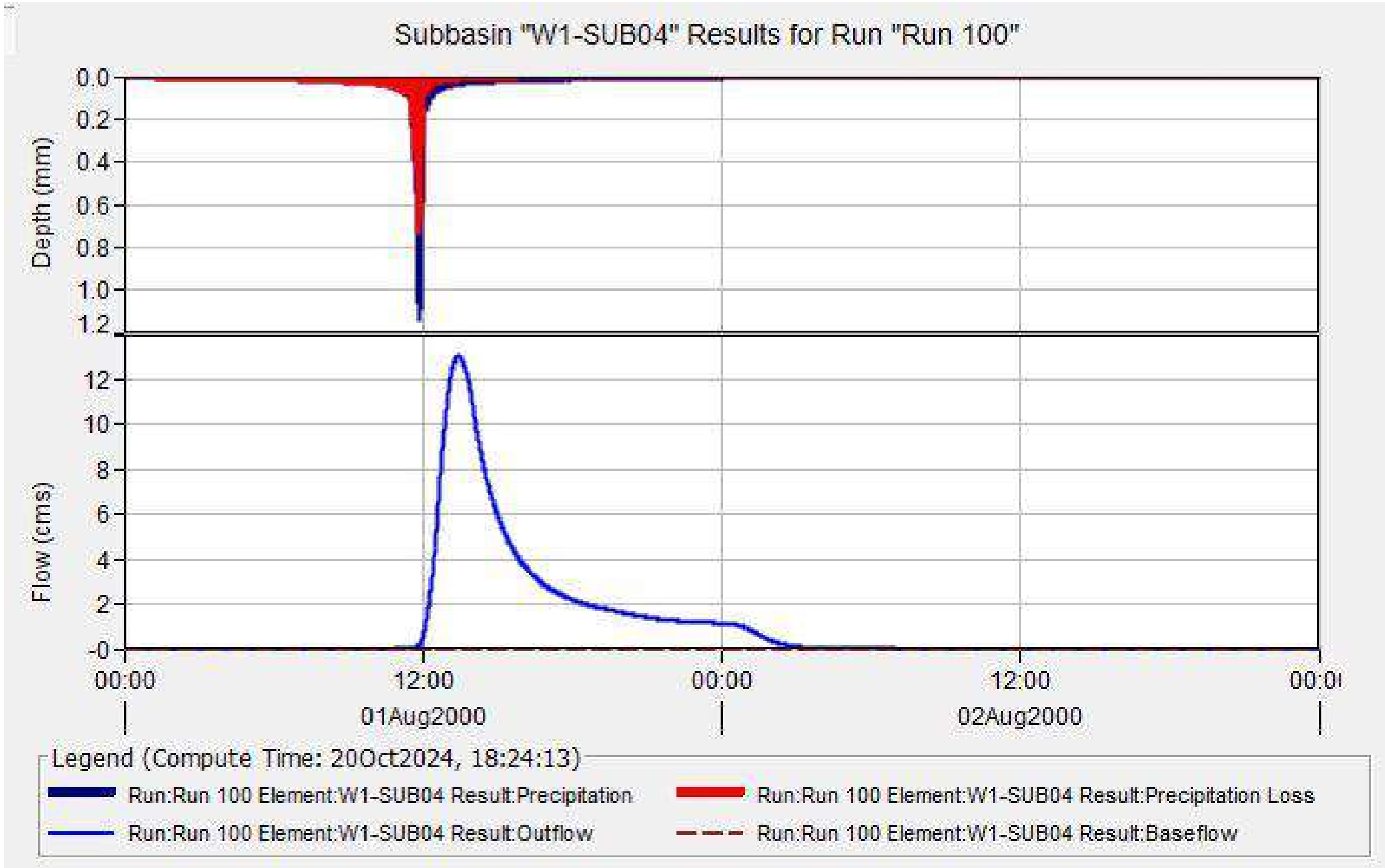

Subbasin "W5" Results for Run "Run50'
Depth (mm)
0.2
0.4
0.6
0.8
Flow (cms)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 18:24:55)
Run:Run50 Element:W5 Result:Precipitation
Run:Run50 Element:W5 Result:Precipitation Loss
Run:Run50 Element:W5 Result:Outflow
Run:Run50 Element:W5 Result:Baseflow

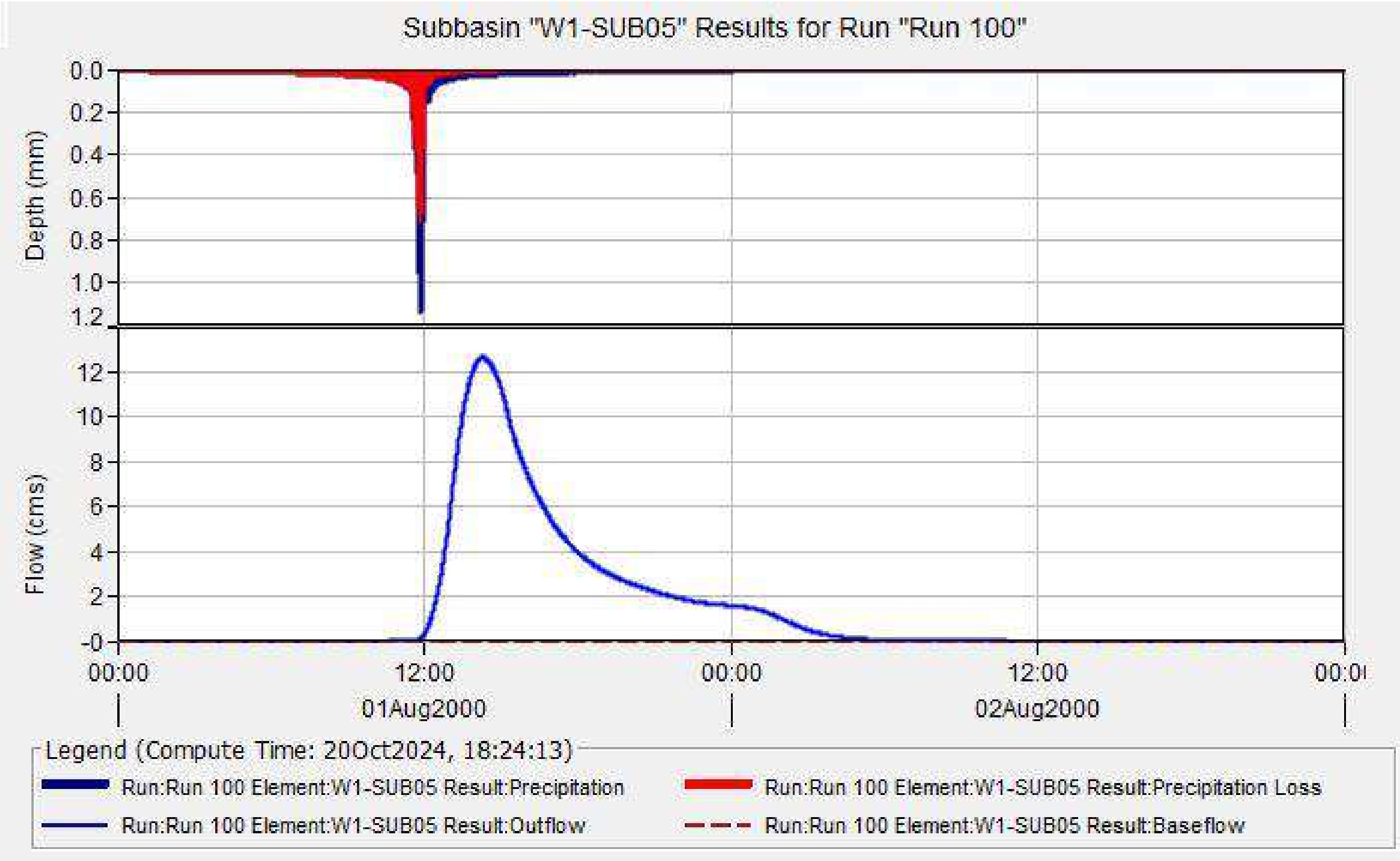

Junction "W1" Results for Run "Run 100"
Flow (cms)
70
60
50
40
30
20
10
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:24:13)
Run:Run 100 Element:W1 Result:Outflow
Run:Run 100 Element:R-2 Result:Outflow
Run:Run 100 Element:R-3 Result:Outflow
Run:Run 100 Element:W1-SUB07 Result:Outflow
Run:Run 100 Element:W1-SUB04 Result:Outflow
Run:Run 100 Element:W1-SUB08 Result:Outflow
Run:Run 100 Element:W1-SUB09 Result:Outflow

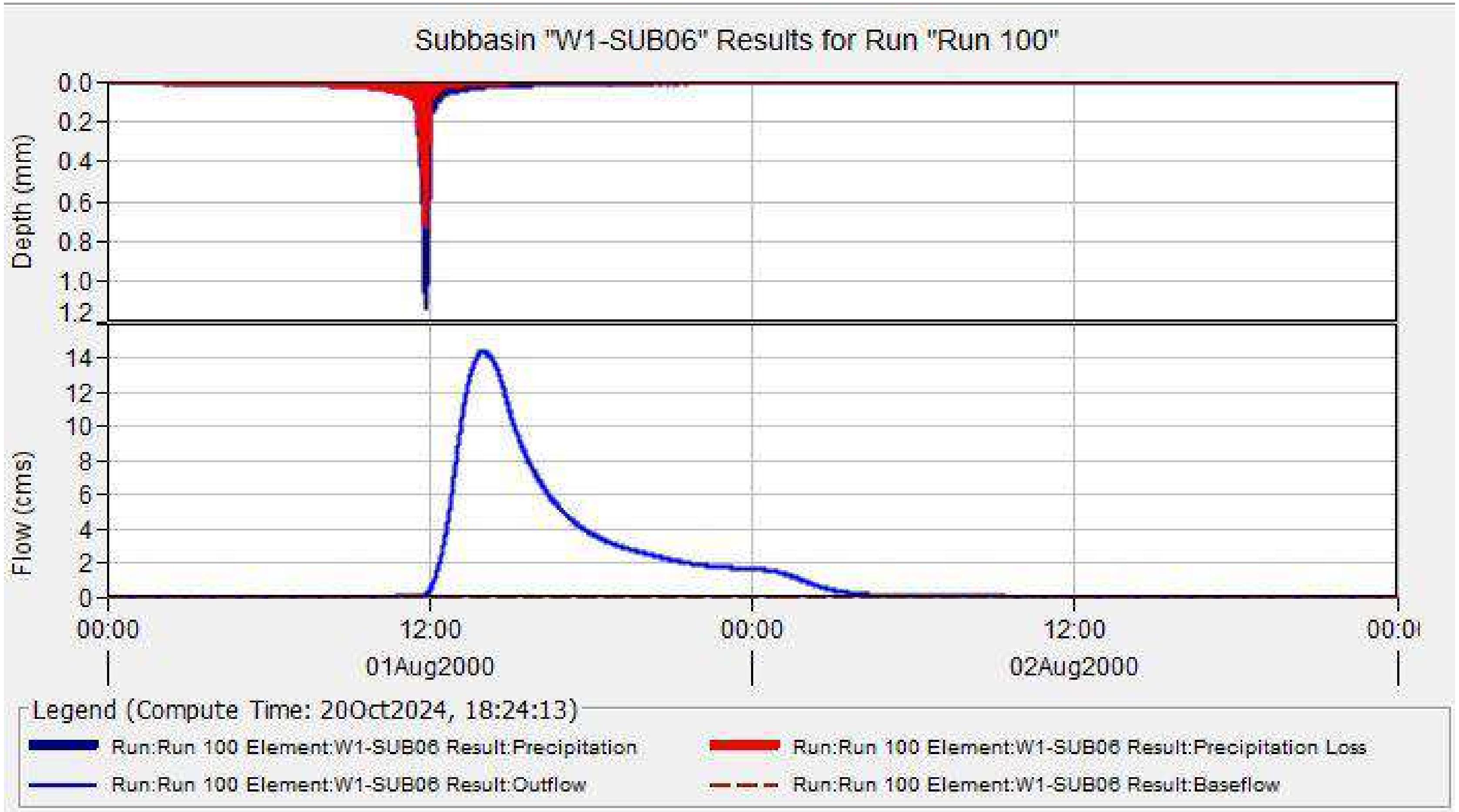

Subbasin "W1-SUB01" Results for Run "Run 100"
Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Flow (cms)
30
25
20
15
10
5
0
00:00
12:00
00:00
12:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:24:13)
Run:Run 100 Element:W1-SUB01 Result:Precipitation
Run:Run 100 Element:W1-SUB01 Result:Precipitation Loss
Run:Run 100 Element:W1-SUB01 Result:Outflow
Run:Run 100 Element:W1-SUB01 Result:Baseflow

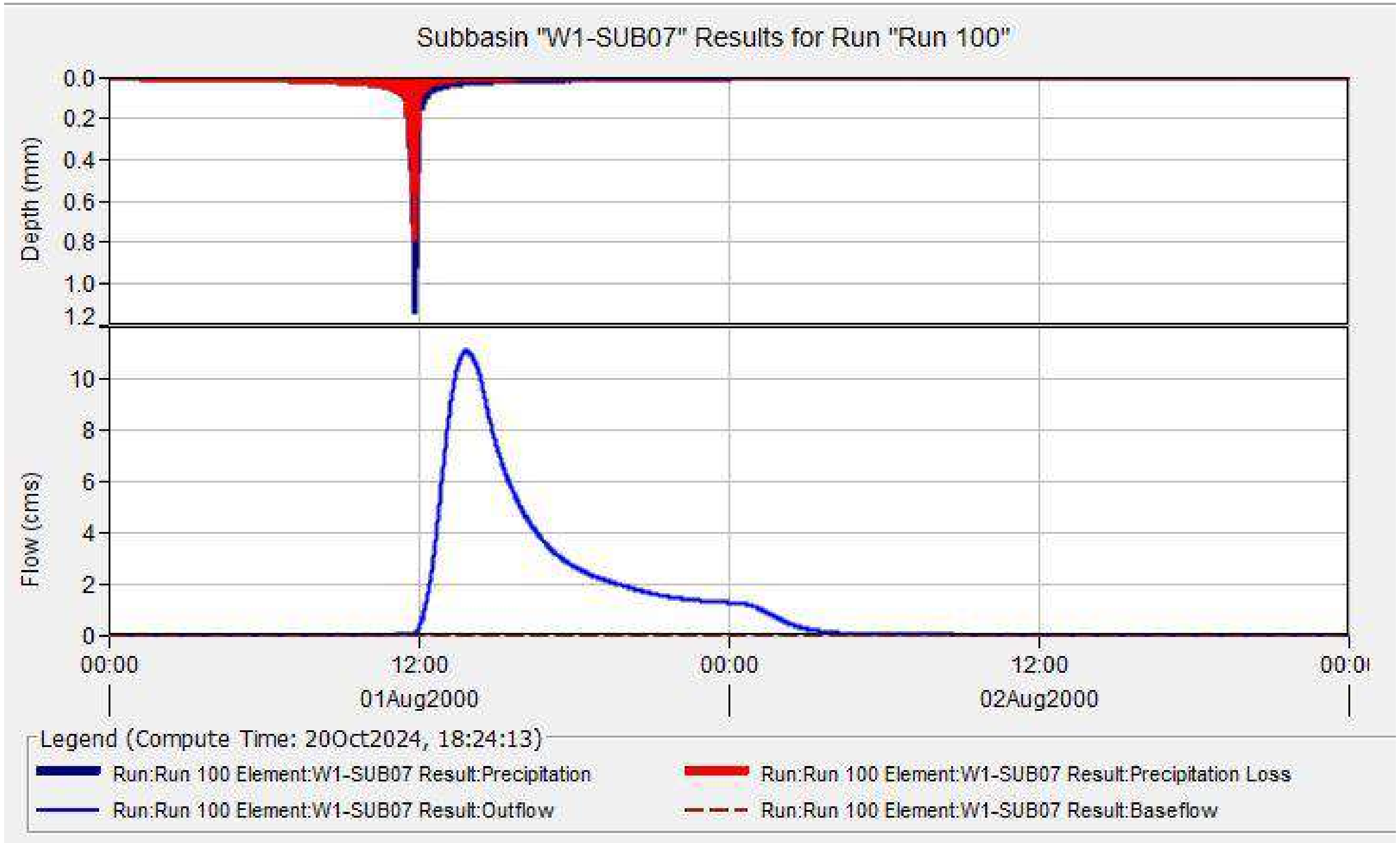

Subbasin "W1-SUB02" Results for Run "Run 100"
Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Flow (cms)
14
12
10
8
6
4
2
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:24:13)
Run:Run 100 Element:W1-SUB02 Result:Precipitation
Run:Run 100 Element:W1-SUB02 Result:Precipitation Loss
Run:Run 100 Element:W1-SUB02 Result:Outflow
Run:Run 100 Element:W1-SUB02 Result:Baseflow

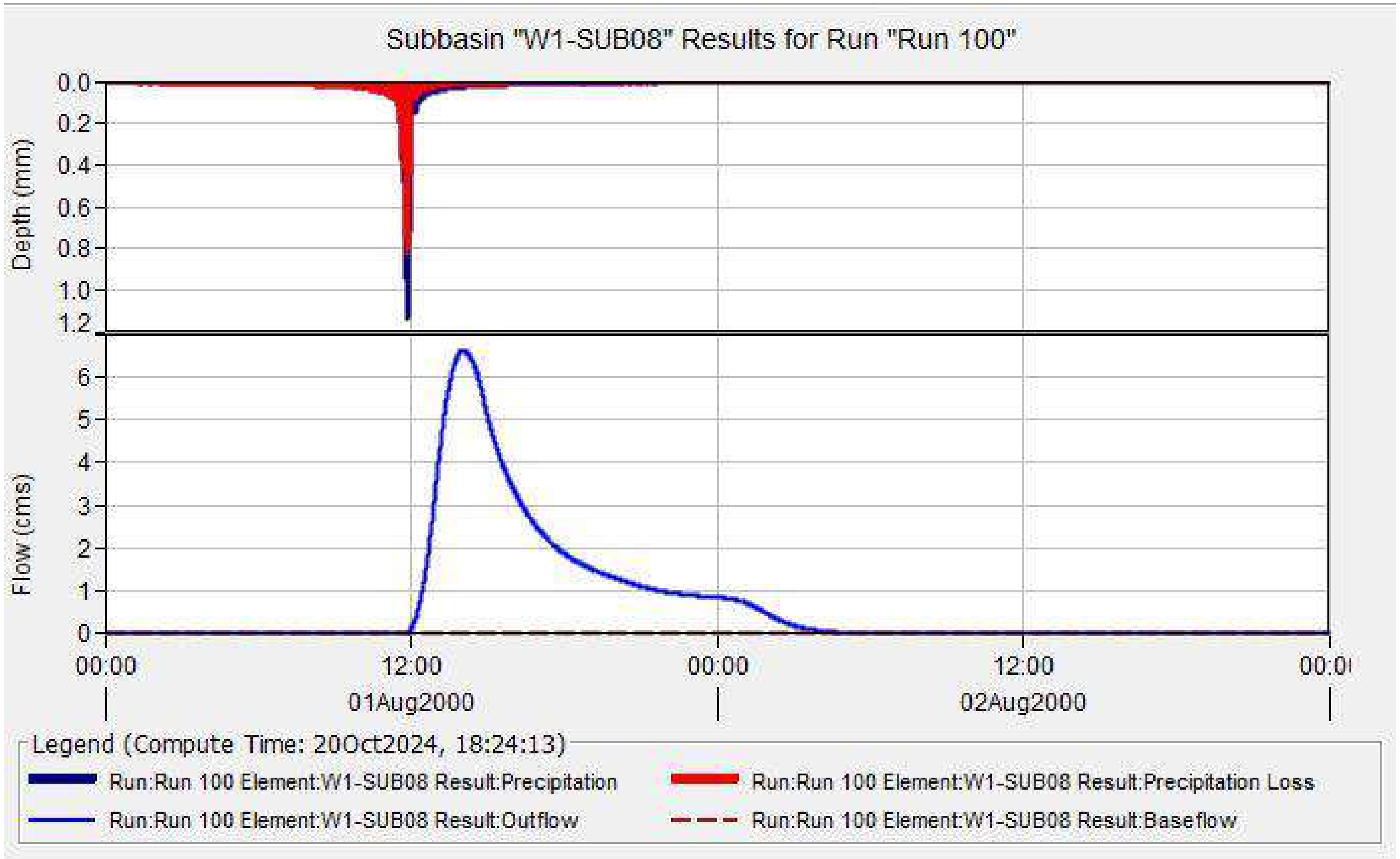

Subbasin "W1-SUB03" Results for Run "Run 100"
Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Flow (cms)
20
15
10
5
0
00:00
12:00
00:00
12:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:24:13)
Run:Run 100 Element:W1-SUB03 Result:Precipitation
Run:Run 100 Element:W1-SUB03 Result:Precipitation Loss
Run:Run 100 Element:W1-SUB03 Result:Outflow
Run:Run 100 Element:W1-SUB03 Result:Baseflow

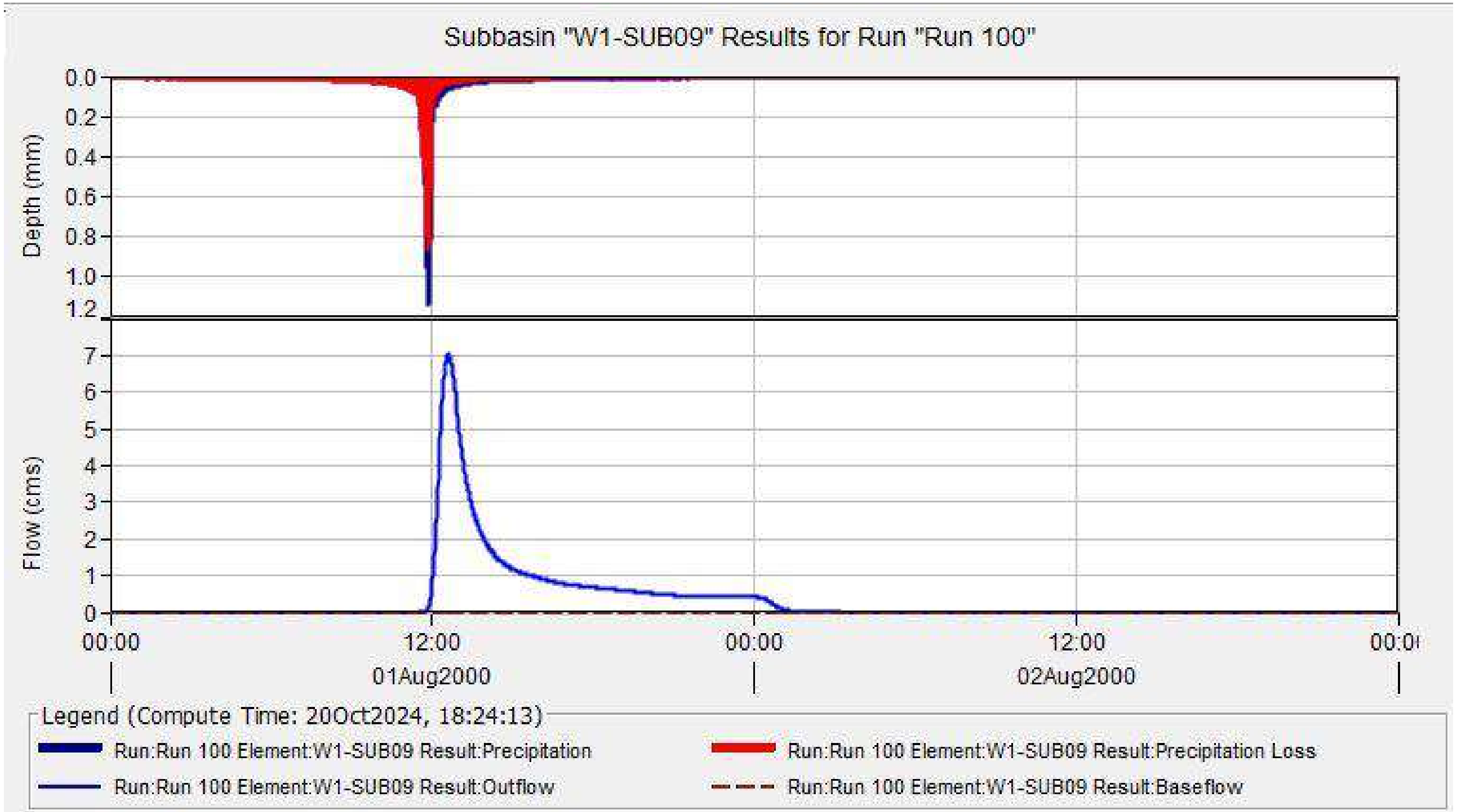

Subbasin "W1-SUB04" Results for Run "Run 100"
Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Flow (cms)
12
10
8
6
4
2
-0
00:00
12:00
00:00
12:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:24:13)
Run:Run 100 Element:W1-SUB04 Result:Precipitation
Run:Run 100 Element:W1-SUB04 Result:Precipitation Loss
Run:Run 100 Element:W1-SUB04 Result:Outflow
Run:Run 100 Element:W1-SUB04 Result:Baseflow

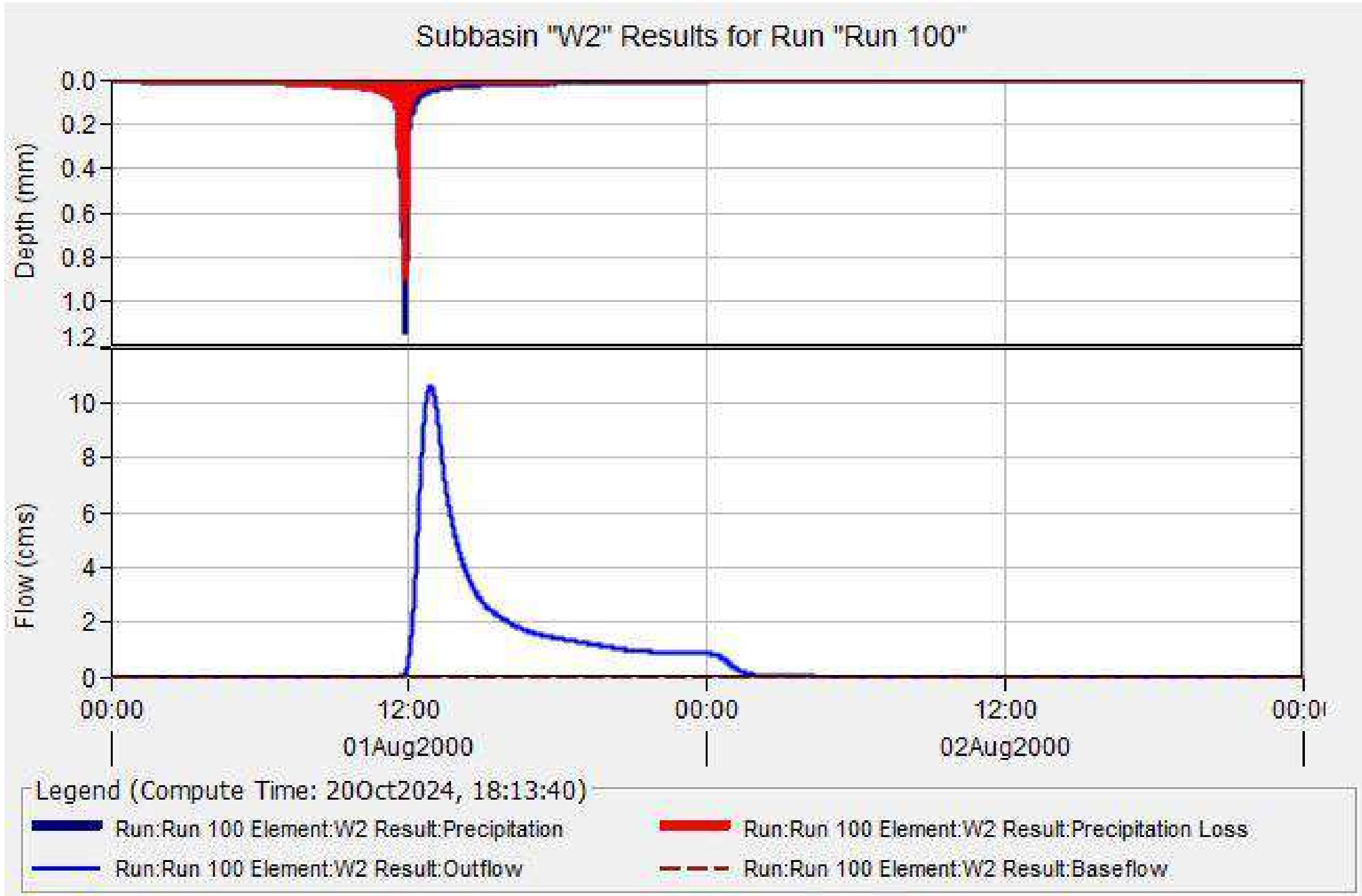

Subbasin "W1-SUB05" Results for Run "Run 100"
Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Flow (cms)
12
10
8
6
4
2
-0
00:00
12:00
00:00
12:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:24:13)
Run:Run 100 Element:W1-SUB05 Result:Precipitation
Run:Run 100 Element:W1-SUB05 Result:Precipitation Loss
Run:Run 100 Element:W1-SUB05 Result:Outflow
Run:Run 100 Element:W1-SUB05 Result:Baseflow

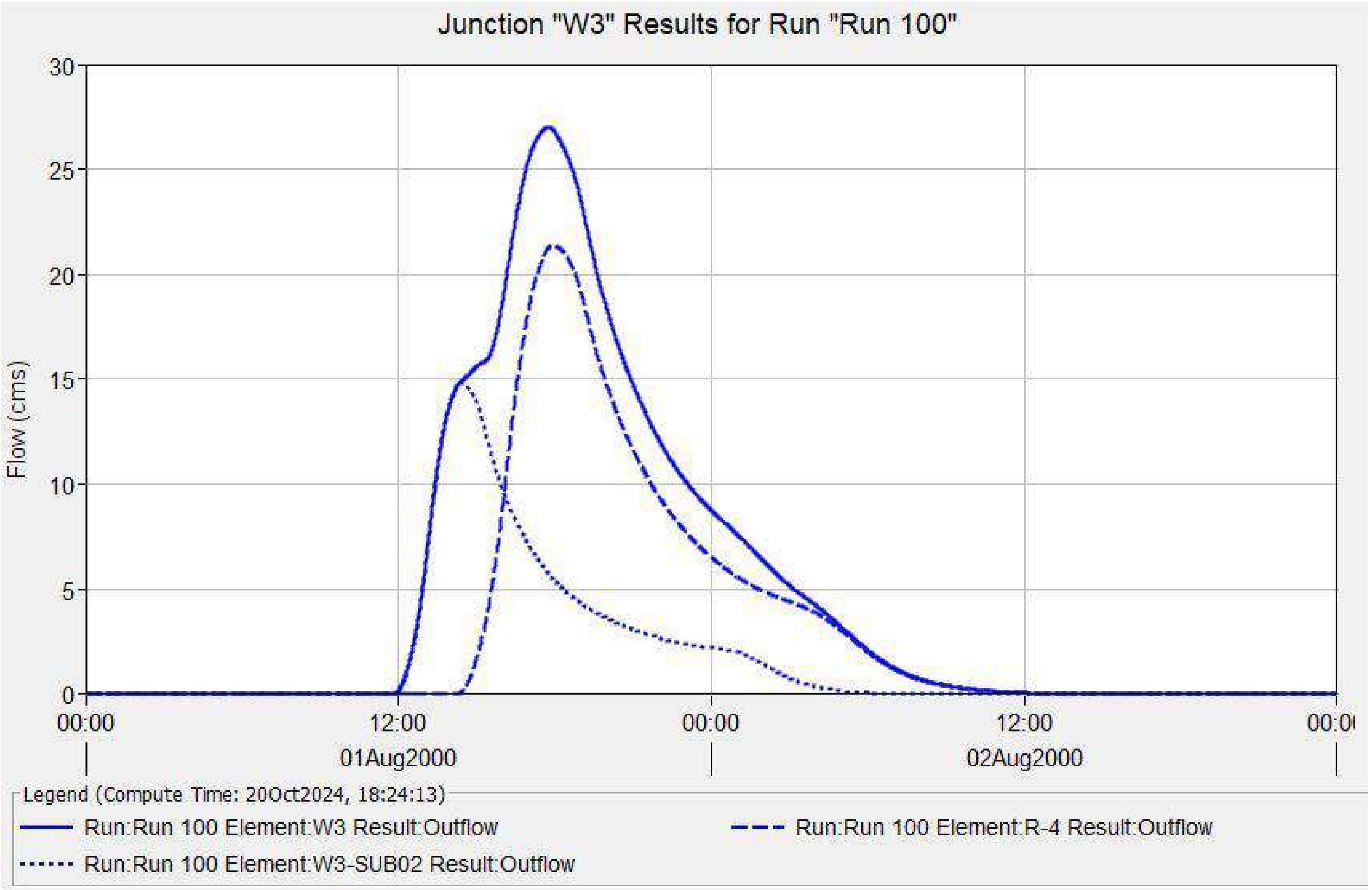

Subbasin "W1-SUB06" Results for Run "Run 100"
Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Flow (cms)
14
12
10
8
6
4
2
0
00:00
12:00
00:00
12:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:24:13)
Run:Run 100 Element:W1-SUB06 Result:Precipitation
Run:Run 100 Element:W1-SUB06 Result:Precipitation Loss
Run:Run 100 Element:W1-SUB06 Result:Outflow
Run:Run 100 Element:W1-SUB06 Result:Baseflow

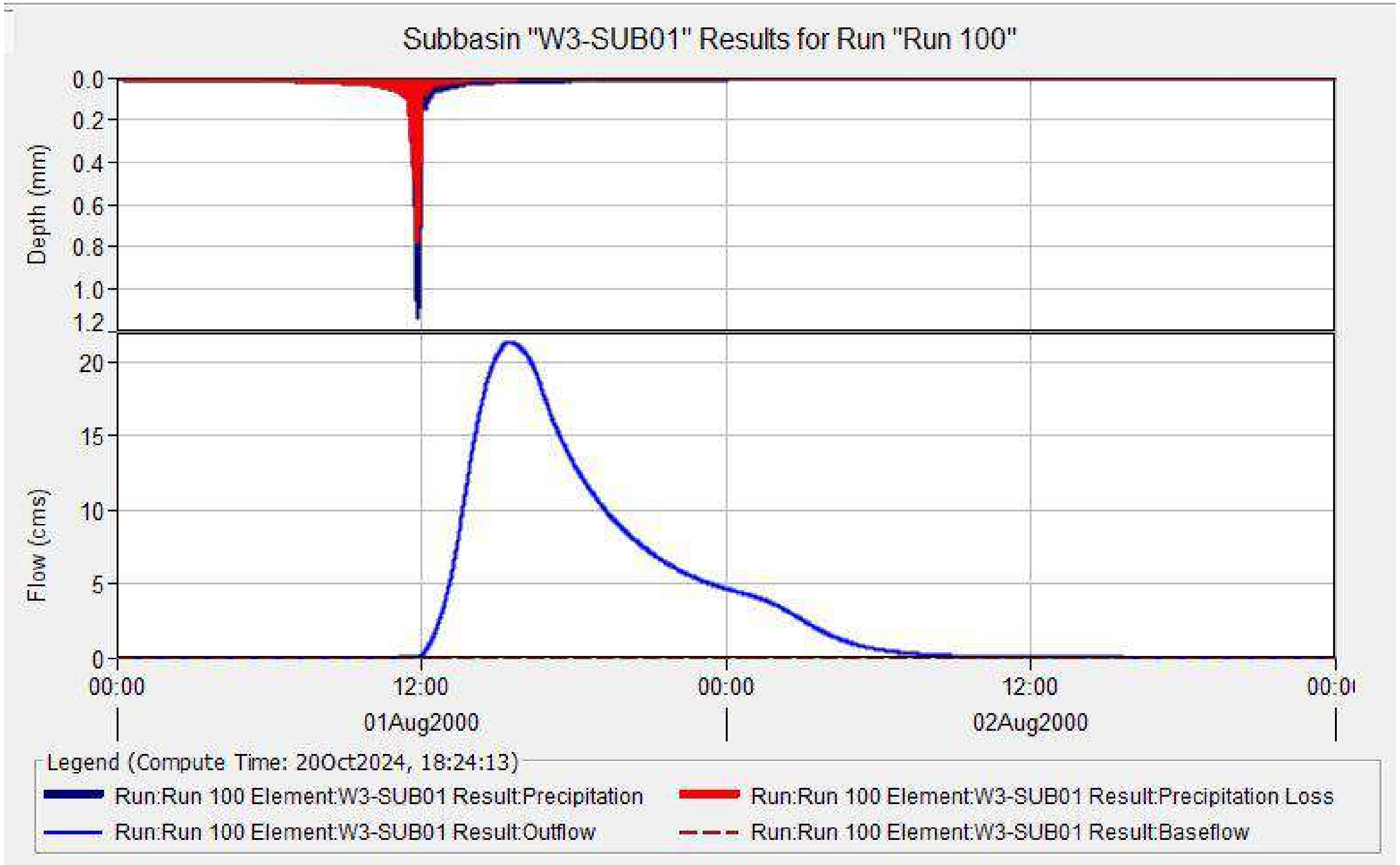

Subbasin "W1-SUB07" Results for Run "Run 100"
Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Flow (cms)
10
8
6
4
2
0
00:00
12:00
00:00
12:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:24:13)
Run:Run 100 Element:W1-SUB07 Result:Precipitation
Run:Run 100 Element:W1-SUB07 Result:Precipitation Loss
Run:Run 100 Element:W1-SUB07 Result:Outflow
Run:Run 100 Element:W1-SUB07 Result:Baseflow

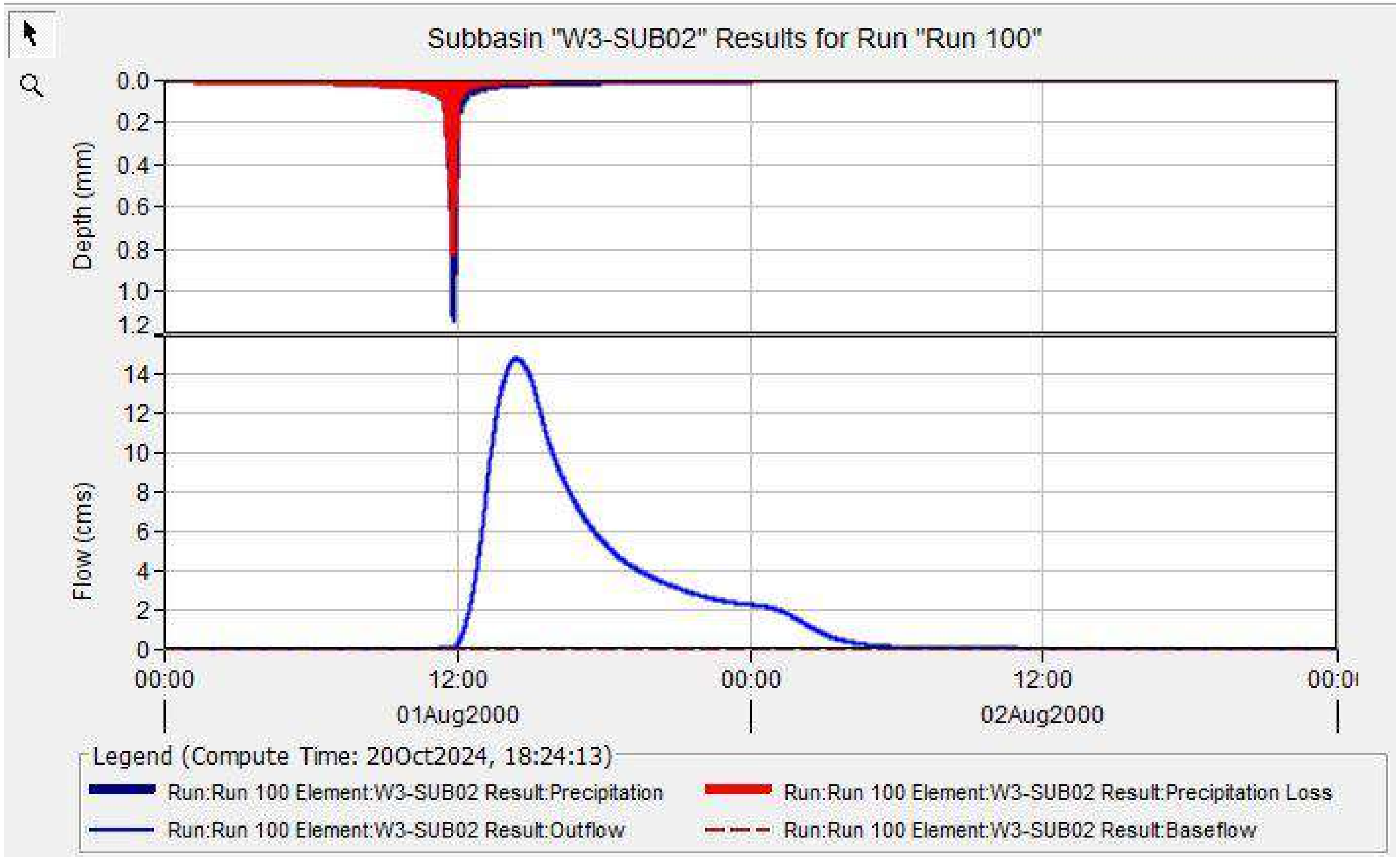

Subbasin "W1-SUB08" Results for Run "Run 100"
Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Flow (cms)
6
5
4
3
2
1
0
00:00
12:00
00:00
12:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:24:13)
Run:Run 100 Element:W1-SUB08 Result:Precipitation
Run:Run 100 Element:W1-SUB08 Result:Precipitation Loss
Run:Run 100 Element:W1-SUB08 Result:Outflow
Run:Run 100 Element:W1-SUB08 Result:Baseflow

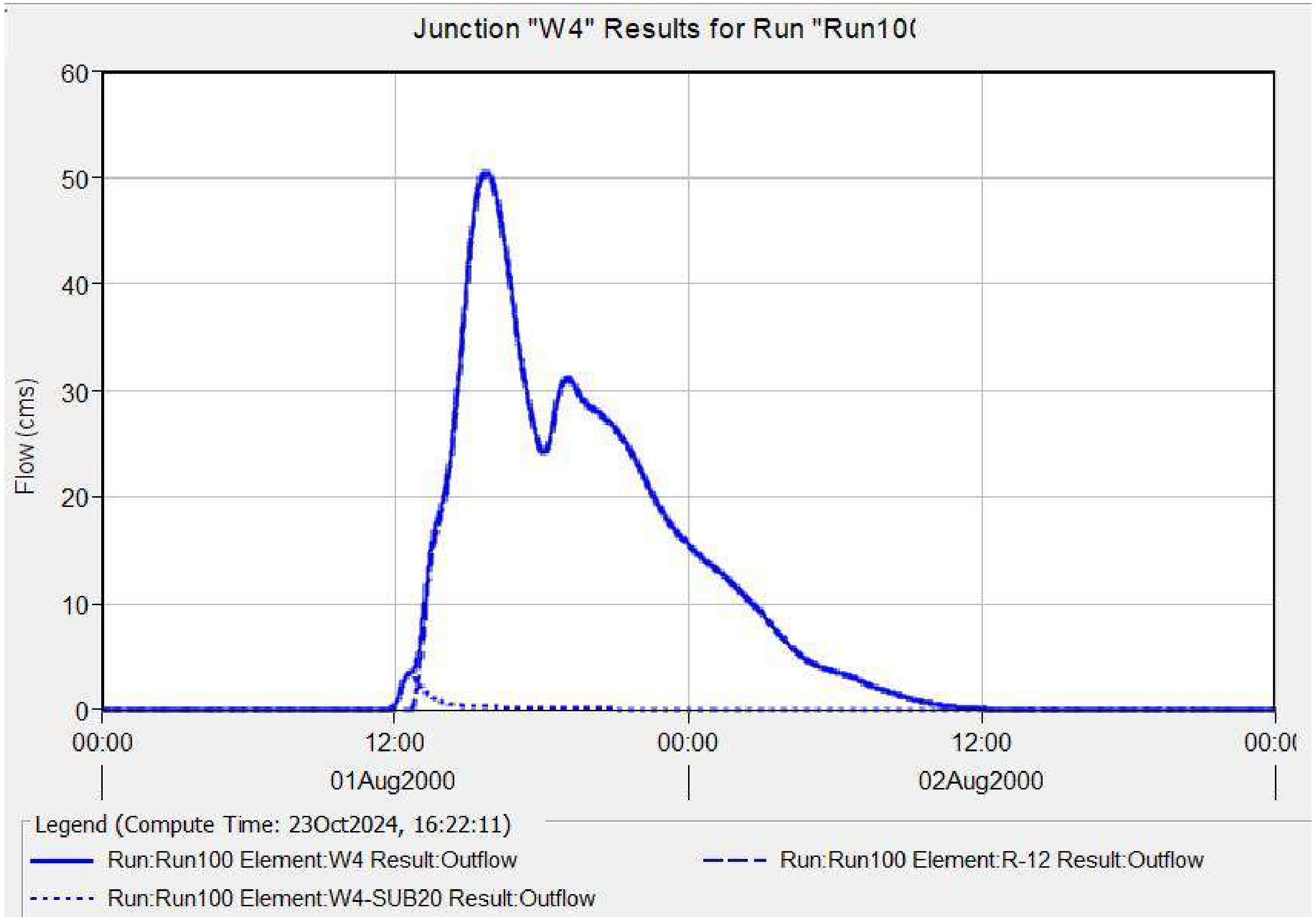

Subbasin "W1-SUB09" Results for Run "Run 100"
Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Flow (cms)
7
6
5
4
3
2
1
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:24:13)
Run:Run 100 Element:W1-SUB09 Result:Precipitation
Run:Run 100 Element:W1-SUB09 Result:Precipitation Loss
Run:Run 100 Element:W1-SUB09 Result:Outflow
Run:Run 100 Element:W1-SUB09 Result:Baseflow

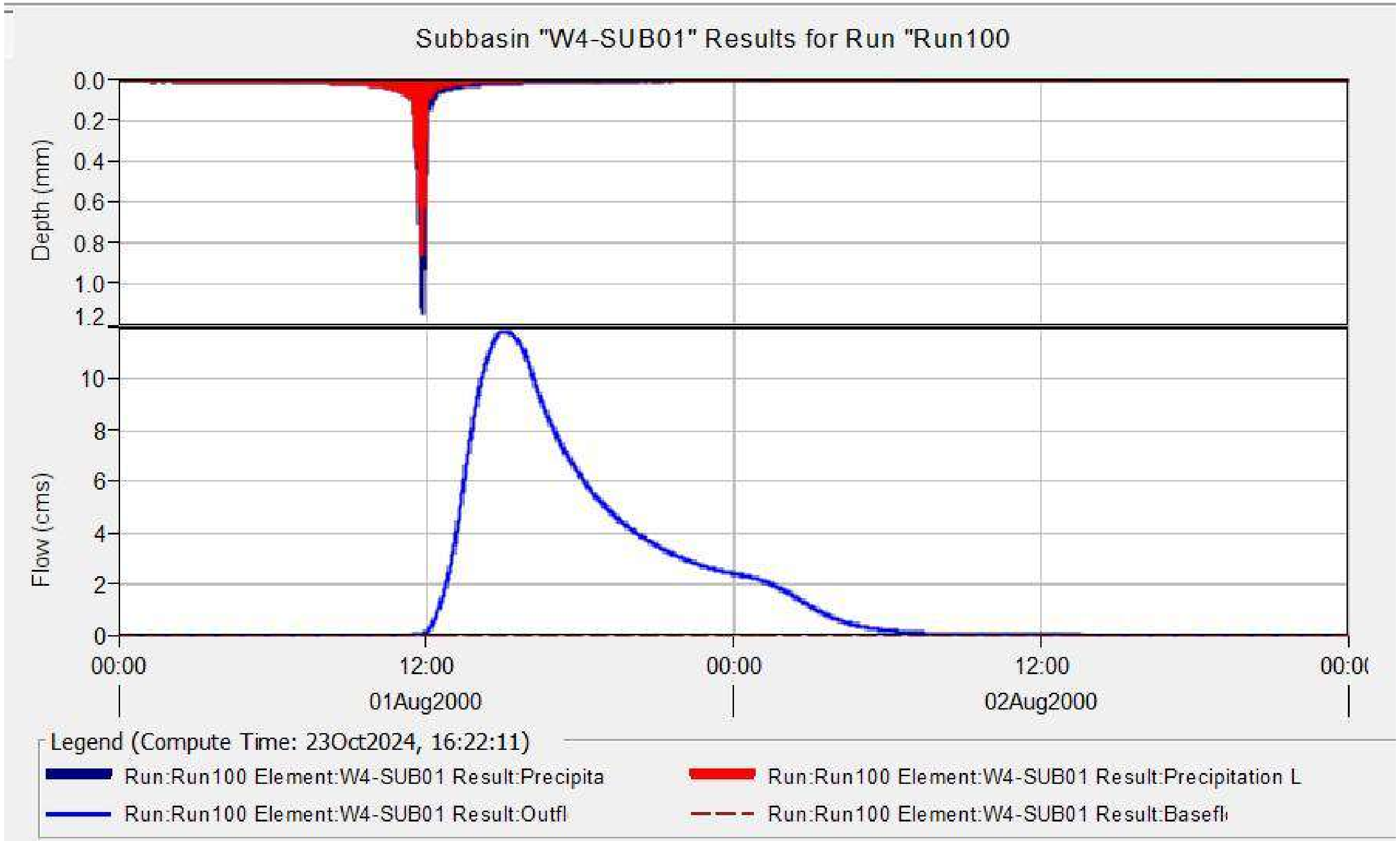

Subbasin "W2" Results for Run "Run 100"
Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Flow (cms)
10
8
6
4
2
0
00:00
12:00
00:00
12:00
00:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:13:40)
Run:Run 100 Element:W2 Result:Precipitation
Run:Run 100 Element:W2 Result:Precipitation Loss
Run:Run 100 Element:W2 Result:Outflow
Run:Run 100 Element:W2 Result:Baseflow

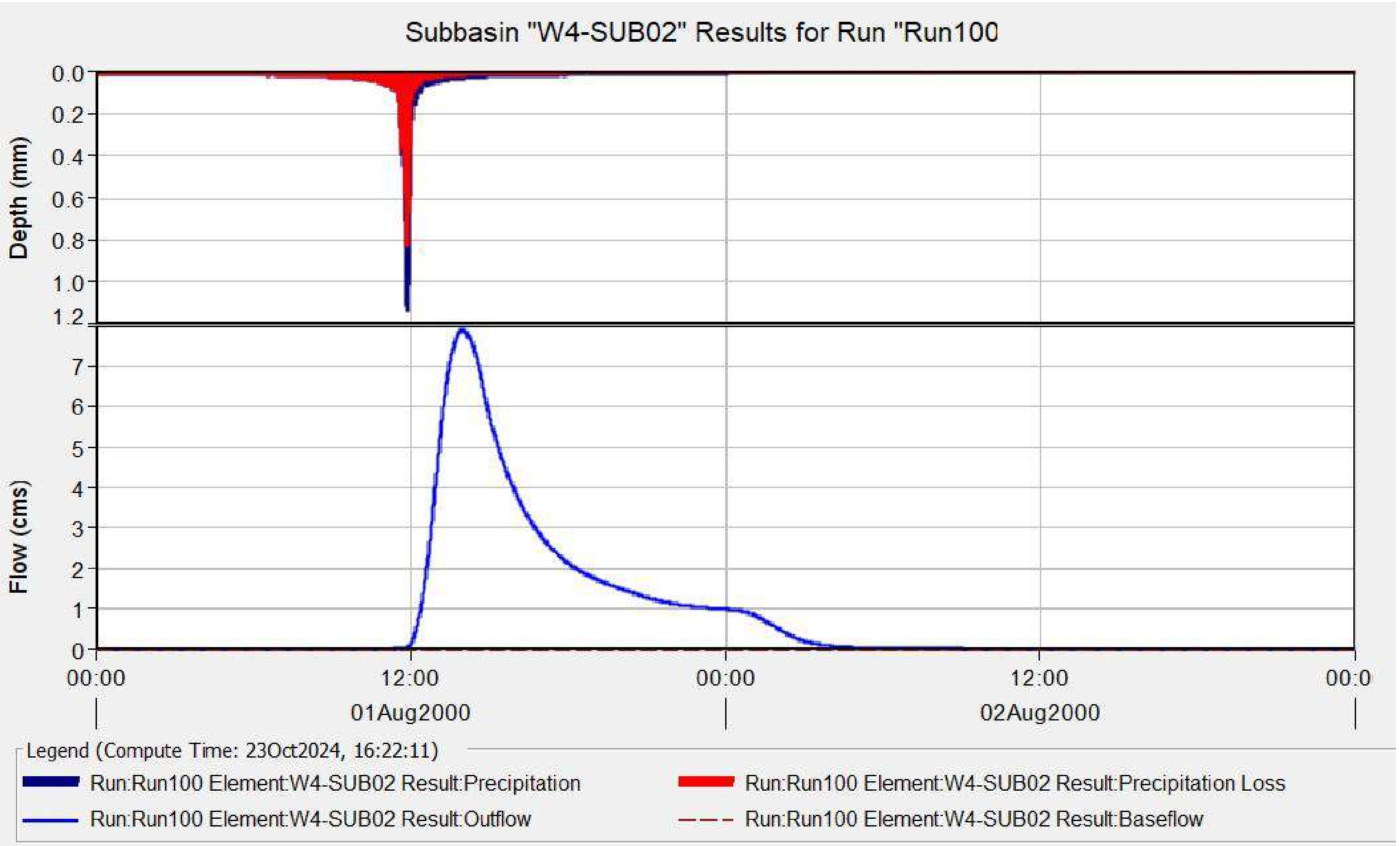

Junction "W3" Results for Run "Run 100"
Flow (cms)
30
25
20
15
10
5
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:24:13)
Run:Run 100 Element:W3 Result:Outflow
Run:Run 100 Element:R-4 Result:Outflow
Run:Run 100 Element:W3-SUB02 Result:Outflow

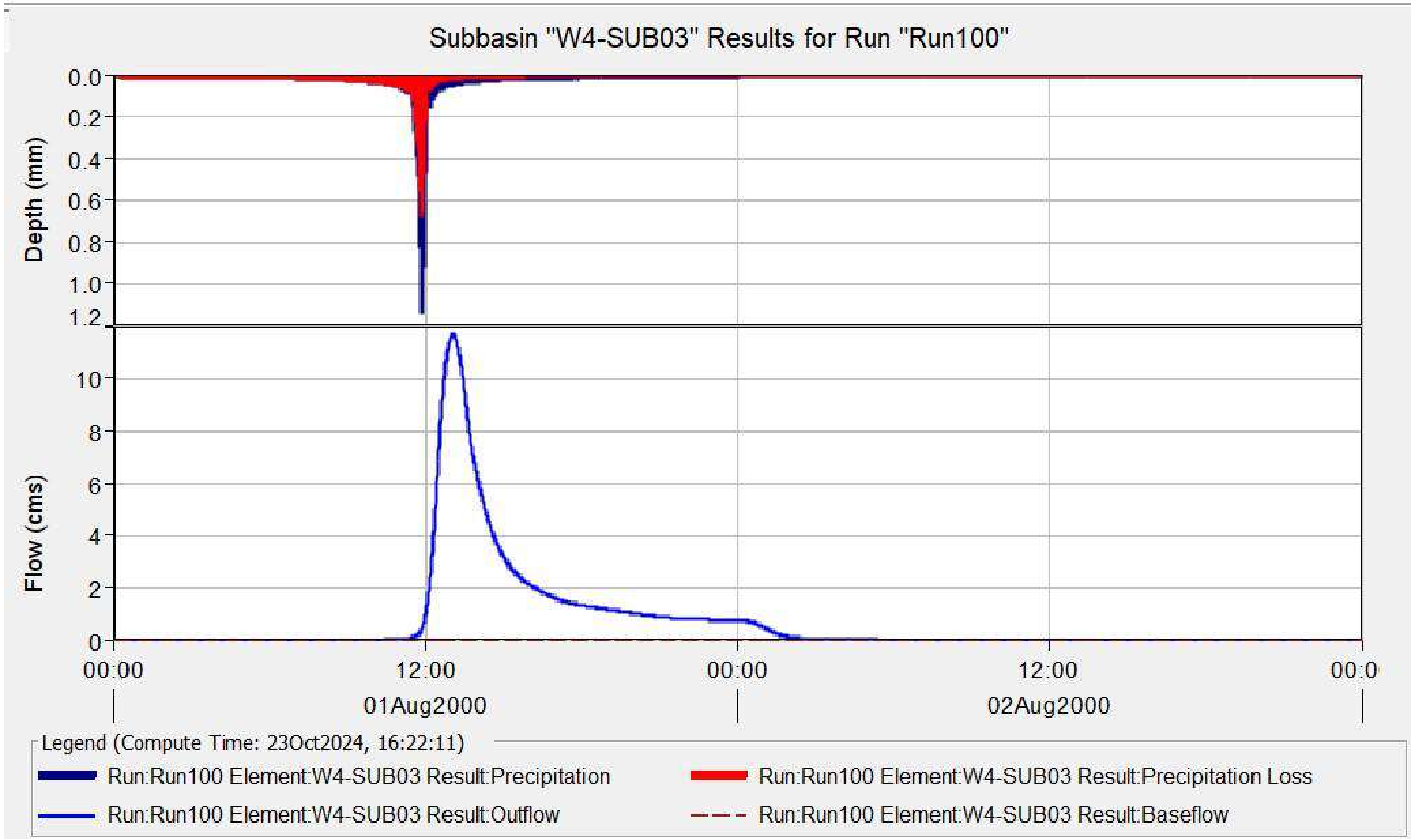

Subbasin "W3-SUB01" Results for Run "Run 100"
Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Flow (cms)
20
15
10
5
0
00:00
12:00
00:00
12:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:24:13)
Run:Run 100 Element:W3-SUB01 Result:Precipitation
Run:Run 100 Element:W3-SUB01 Result:Precipitation Loss
Run:Run 100 Element:W3-SUB01 Result:Outflow
Run:Run 100 Element:W3-SUB01 Result:Baseflow

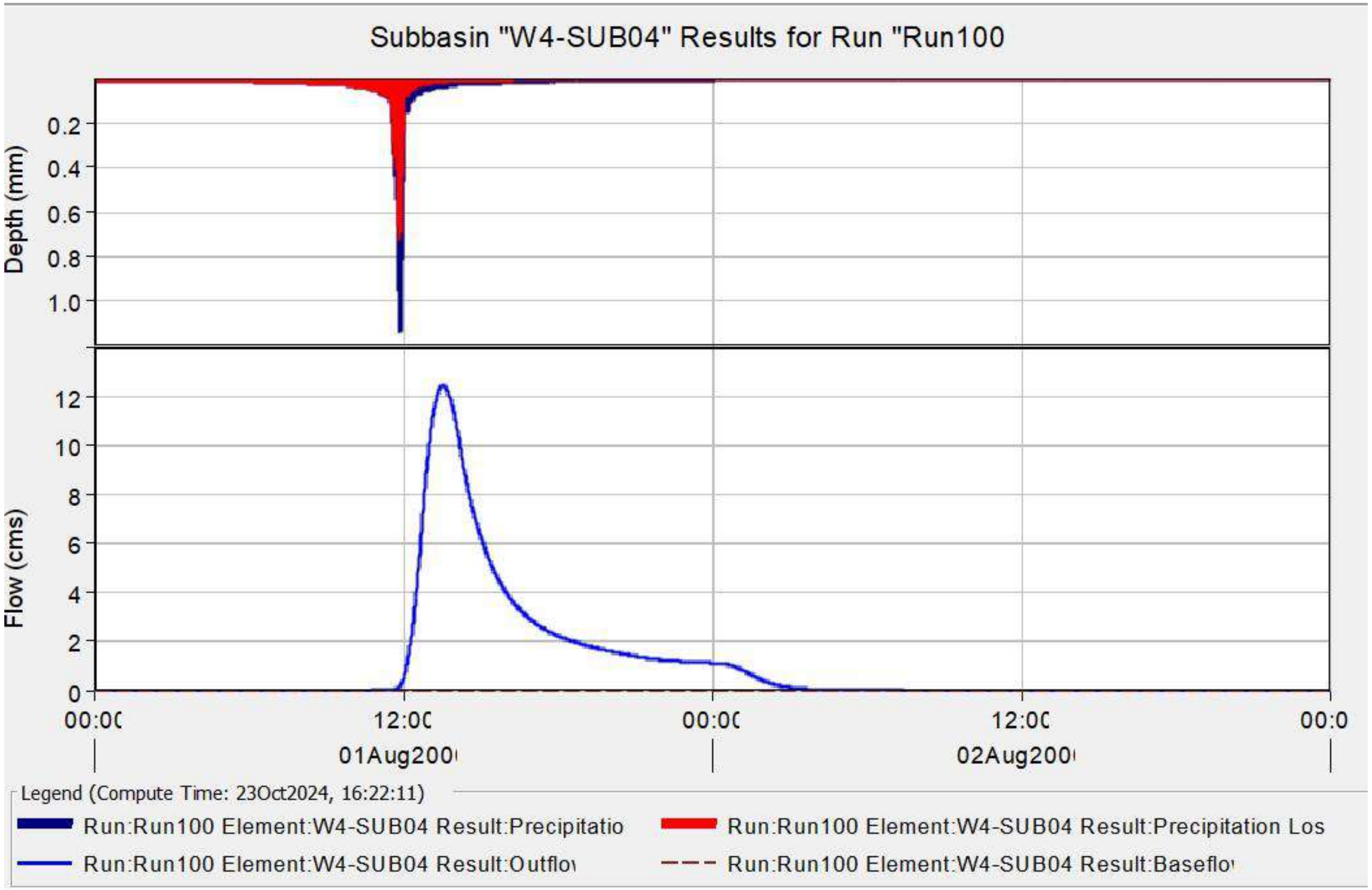

Subbasin "W3-SUB02" Results for Run "Run 100"
Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Flow (cms)
14
12
10
8
6
4
2
0
00:00
12:00
00:00
12:00
01Aug2000
02Aug2000
Legend (Compute Time: 20Oct2024, 18:24:13)
Run:Run 100 Element:W3-SUB02 Result:Precipitation
Run:Run 100 Element:W3-SUB02 Result:Precipitation Loss
Run:Run 100 Element:W3-SUB02 Result:Outflow
Run:Run 100 Element:W3-SUB02 Result:Baseflow

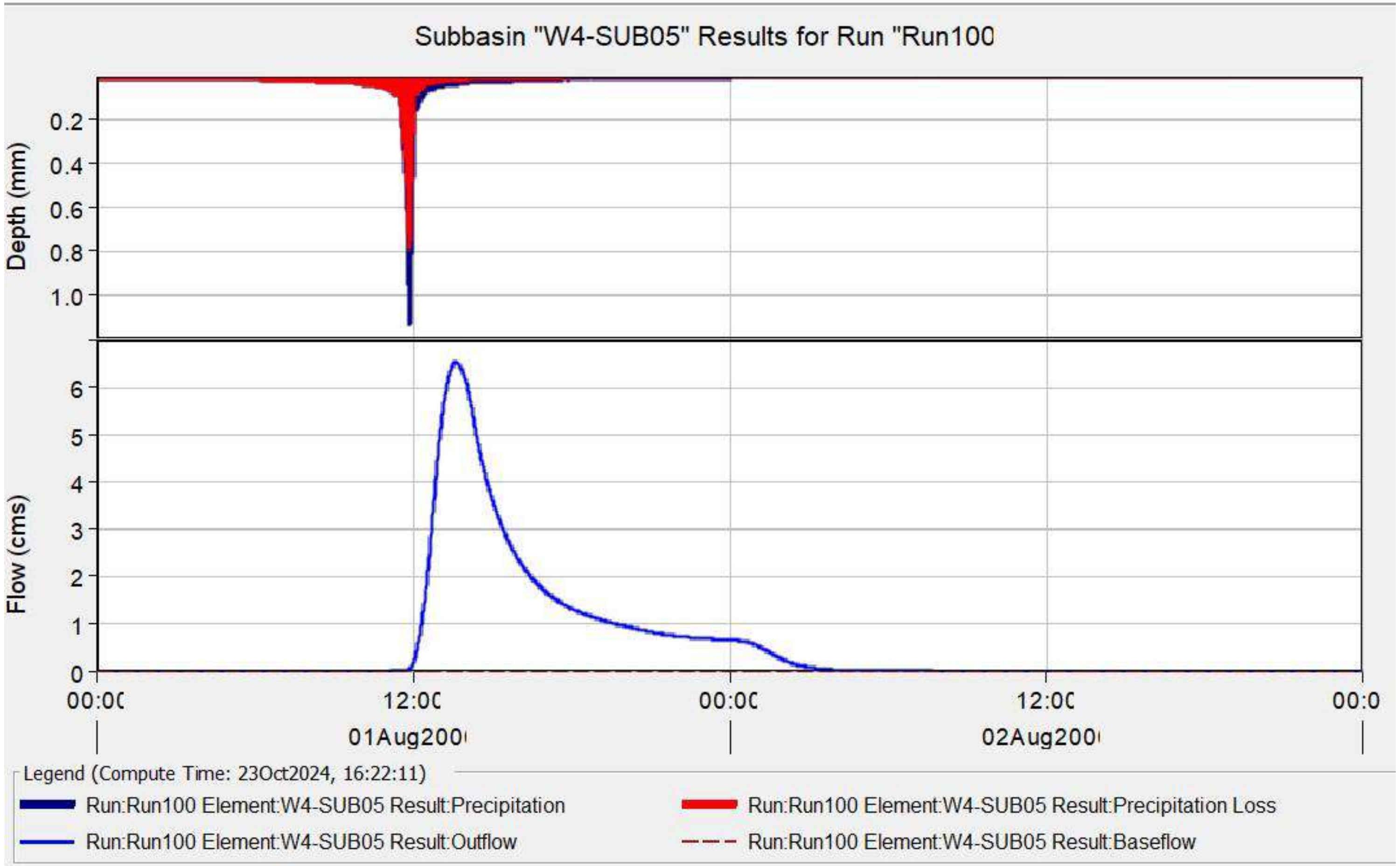

Junction "W4" Results for Run "Run10(
Flow (cms)
60
50
40
30
20
10
0
00:00
12:00
00:00
12:00
00:0(
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 16:22:11)
Run:Run100 Element:W4 Result:Outflow
Run:Run100 Element:R-12 Result:Outflow
Run:Run100 Element:W4-SUB20 Result:Outflow

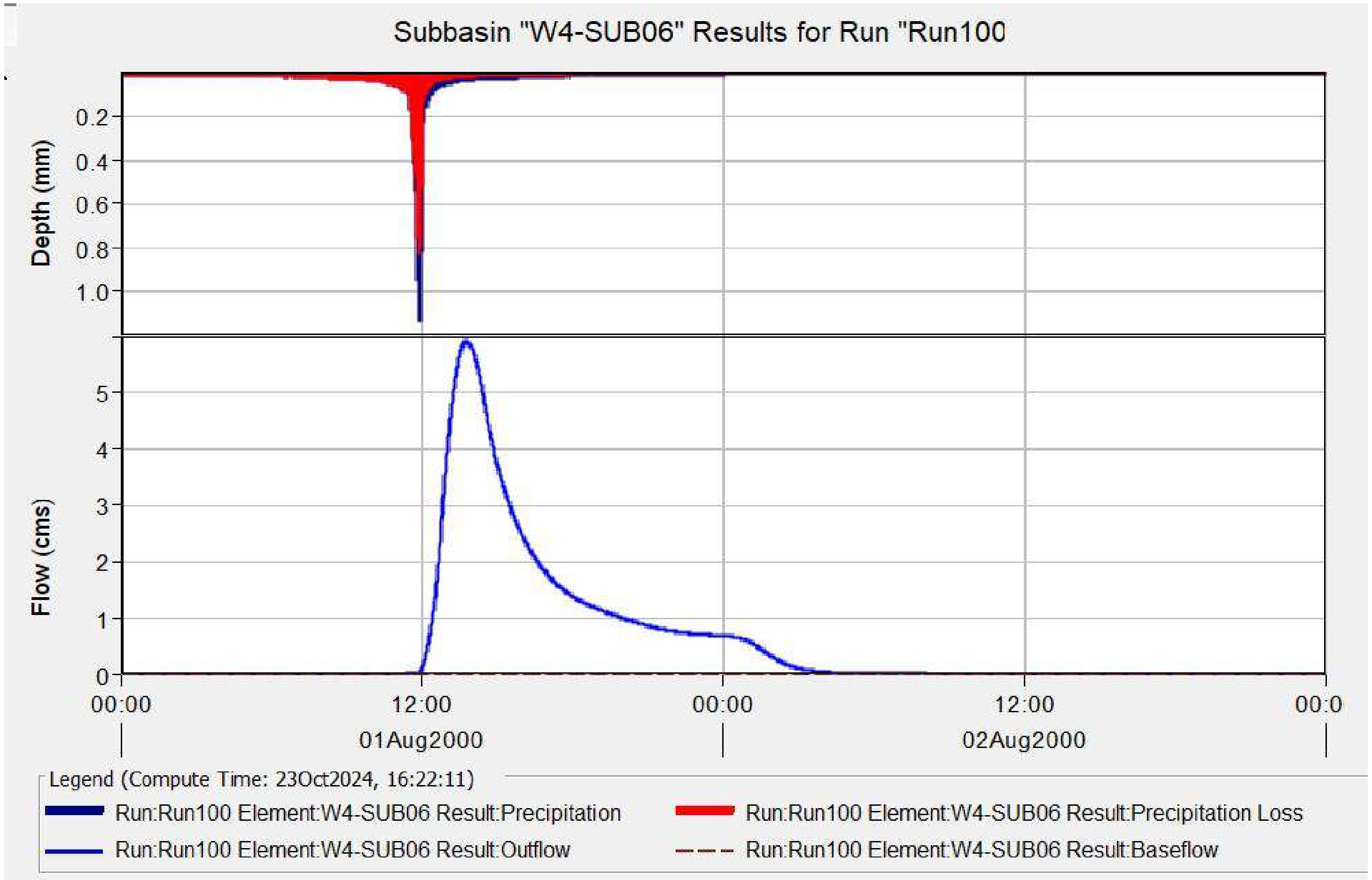

Subbasin "W4-SUB01" Results for Run "Run100
Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Flow (cms)
10
8
6
4
2
0
00:00
12:00
00:00
12:00
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 16:22:11)
Run:Run100 Element:W4-SUB01 Result:Precipita
Run:Run100 Element:W4-SUB01 Result:Precipitation L
Run:Run100 Element:W4-SUB01 Result:Outfl
Run:Run100 Element:W4-SUB01 Result:Basefl

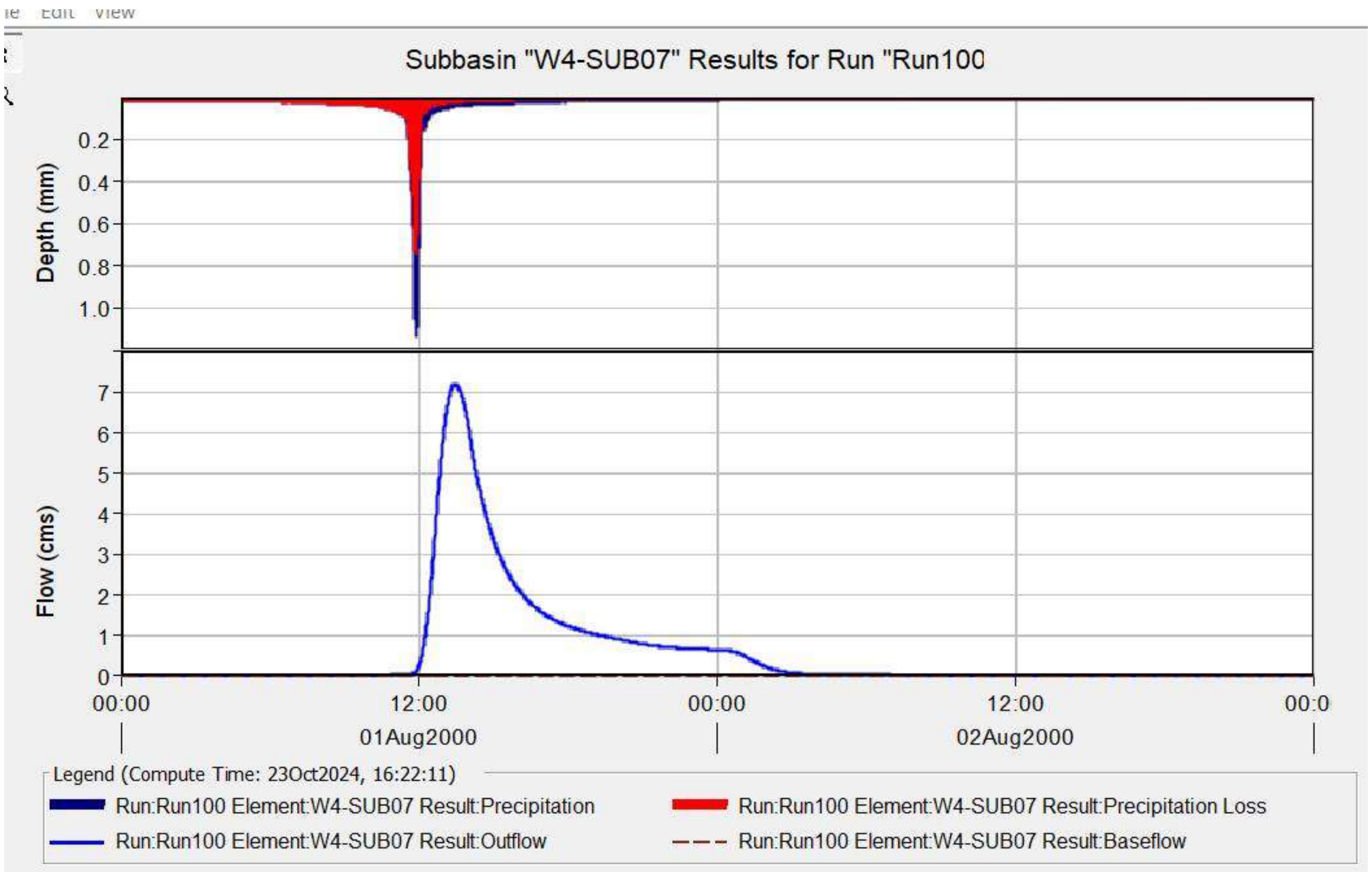

Subbasin "W4-SUB02" Results for Run "Run100
Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Flow (cms)
7
6
5
4
3
2
1
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 16:22:11)
Run:Run100 Element:W4-SUB02 Result:Precipitation
Run:Run100 Element:W4-SUB02 Result:Precipitation Loss
Run:Run100 Element:W4-SUB02 Result:Outflow
Run:Run100 Element:W4-SUB02 Result:Baseflow

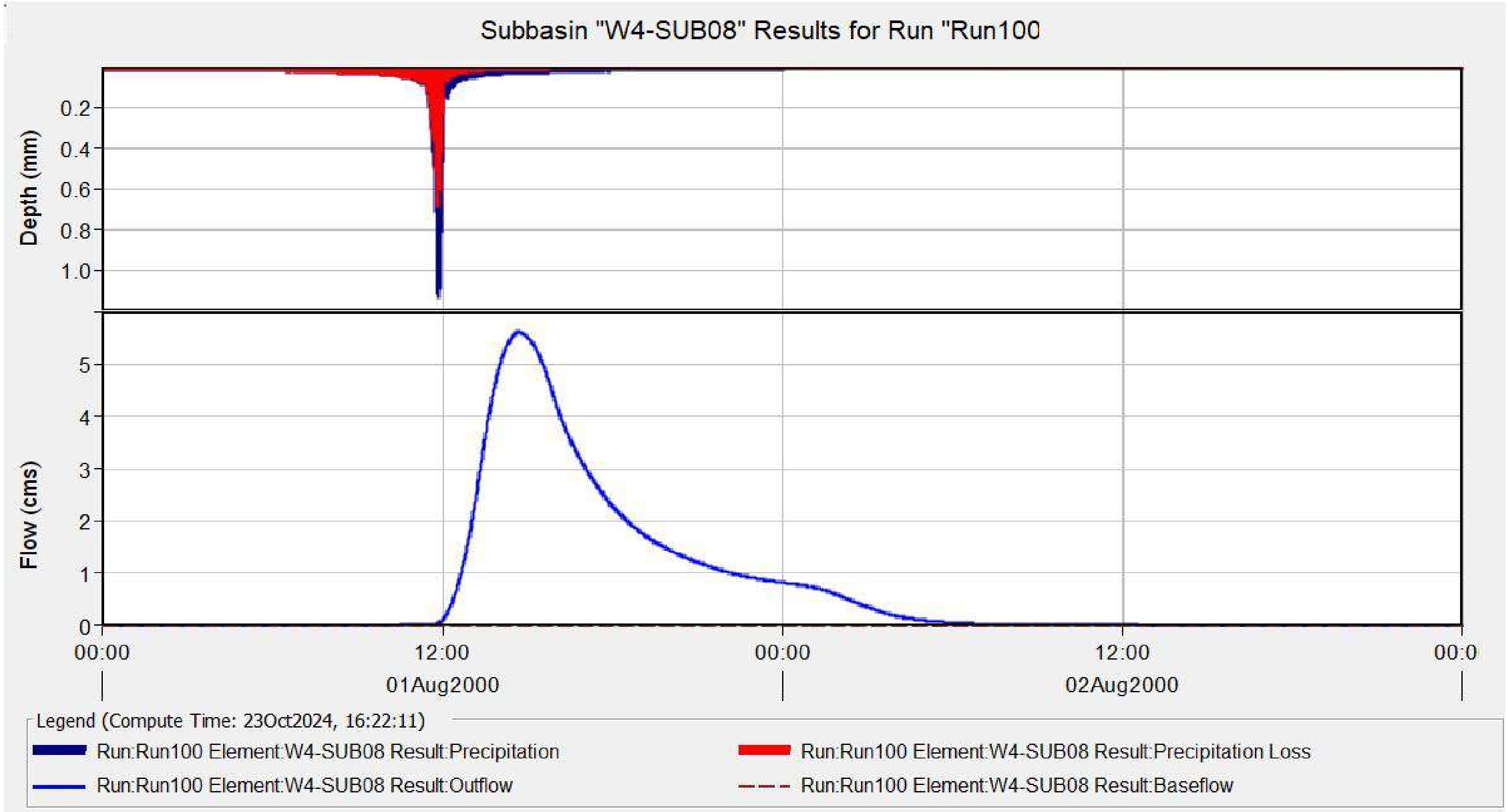

Subbasin "W4-SUB03" Results for Run "Run100"
Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Flow (cms)
10
8
6
4
2
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 16:22:11)
Run:Run100 Element:W4-SUB03 Result:Precipitation
Run:Run100 Element:W4-SUB03 Result:Precipitation Loss
Run:Run100 Element:W4-SUB03 Result:Outflow
Run:Run100 Element:W4-SUB03 Result:Baseflow

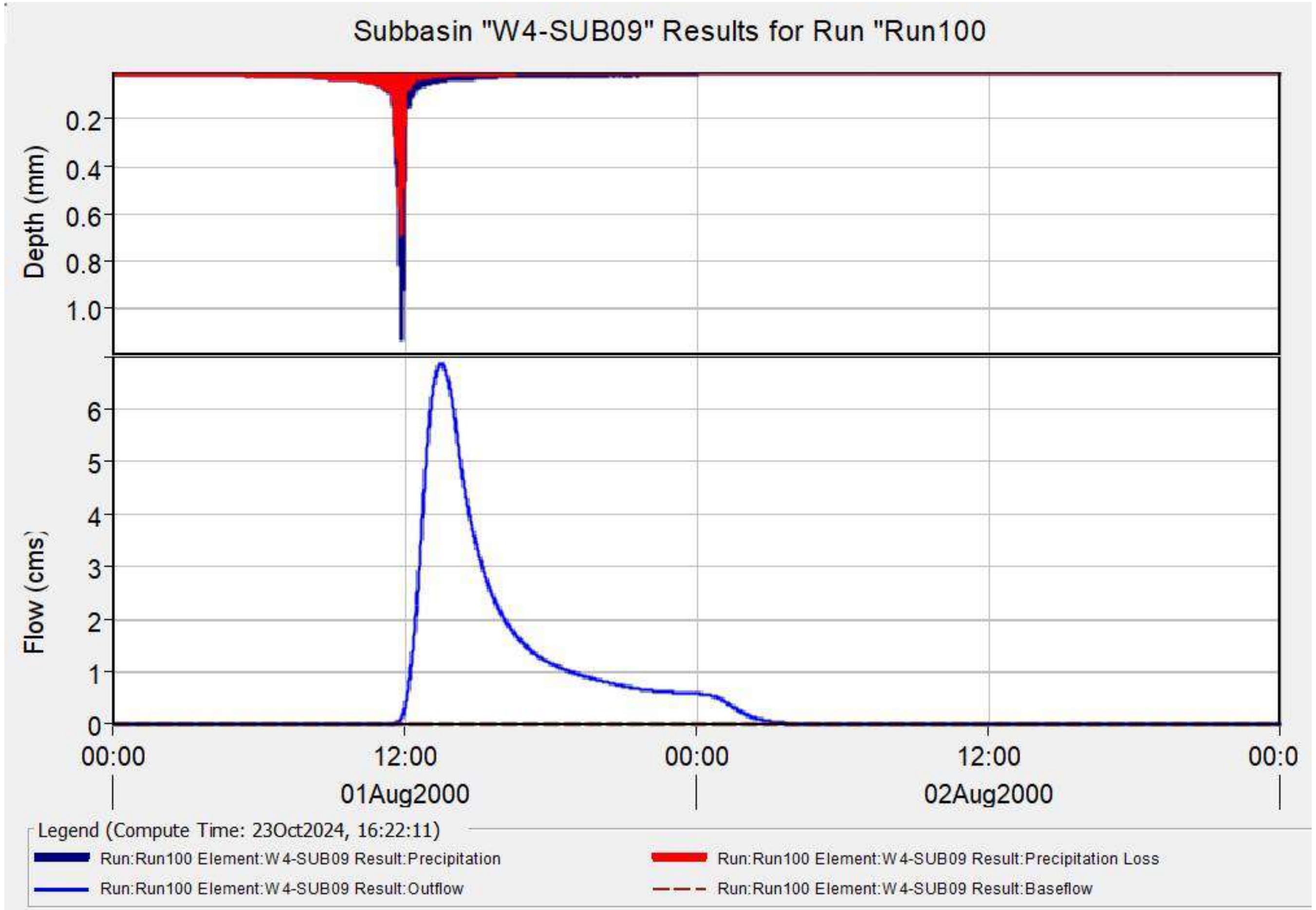

Subbasin "W4-SUB04" Results for Run "Run100
Depth (mm)
0.2
0.4
0.6
0.8
1.0
Flow (cms)
12
10
8
6
4
2
0
00:0(
12:0(
00:0(
12:0(
00:0
01Aug200
02Aug200
Legend (Compute Time: 23Oct2024, 16:22:11)
Run:Run100 Element:W4-SUB04 Result:Precipitatio
Run:Run100 Element:W4-SUB04 Result:Precipitation Los
Run:Run100 Element:W4-SUB04 Result:Outflo
Run:Run100 Element:W4-SUB04 Result:Baseflo

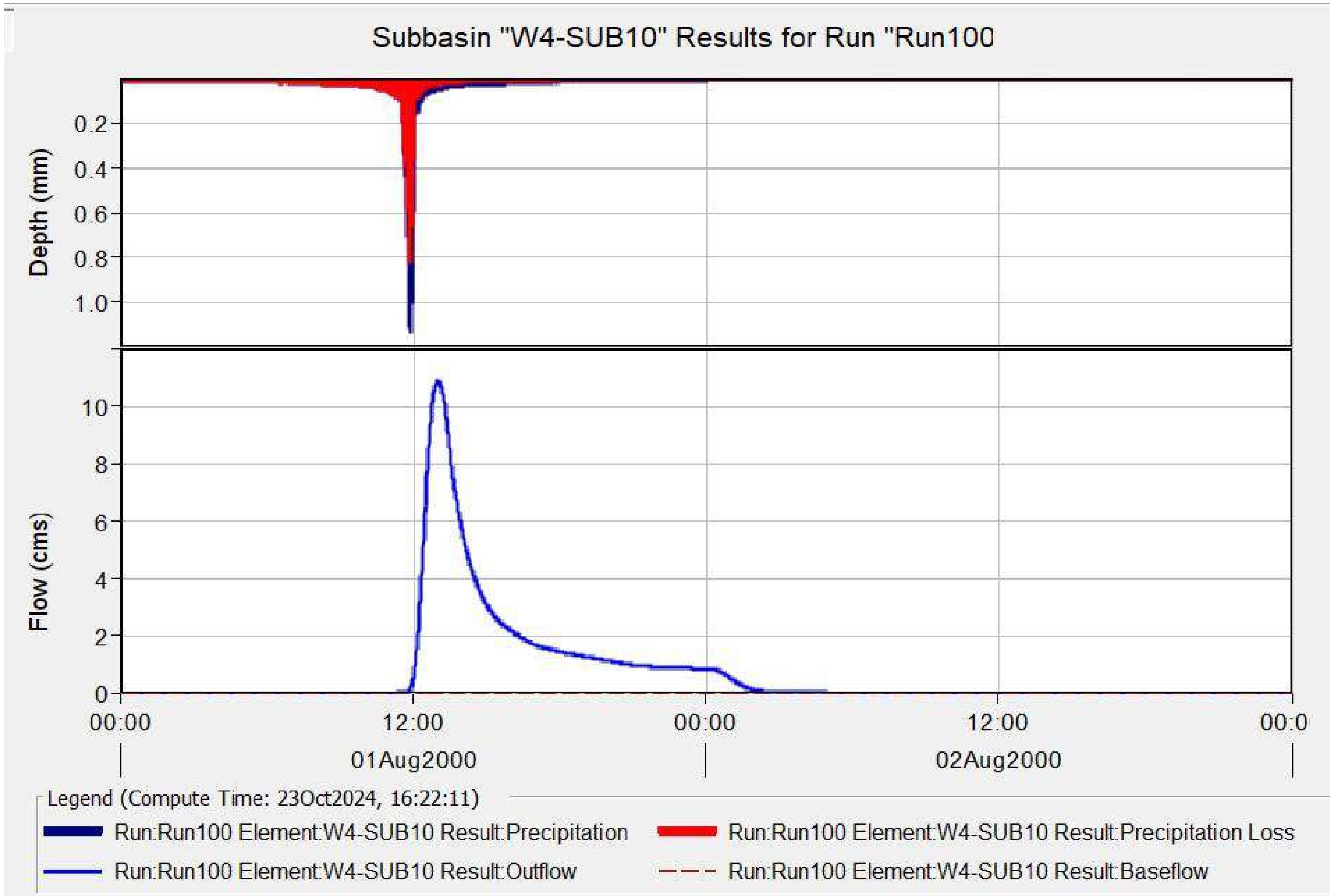

Subbasin "W4-SUB05" Results for Run "Run100
Depth (mm)
0.2
0.4
0.6
0.8
1.0
Flow (cms)
6
5
4
3
2
1
0
00:00
12:00
00:00
12:00
00:0
01Aug200
02Aug200
Legend (Compute Time: 23Oct2024, 16:22:11)
Run:Run100 Element:W4-SUB05 Result:Precipitation
Run:Run100 Element:W4-SUB05 Result:Precipitation Loss
Run:Run100 Element:W4-SUB05 Result:Outflow
Run:Run100 Element:W4-SUB05 Result:Baseflow

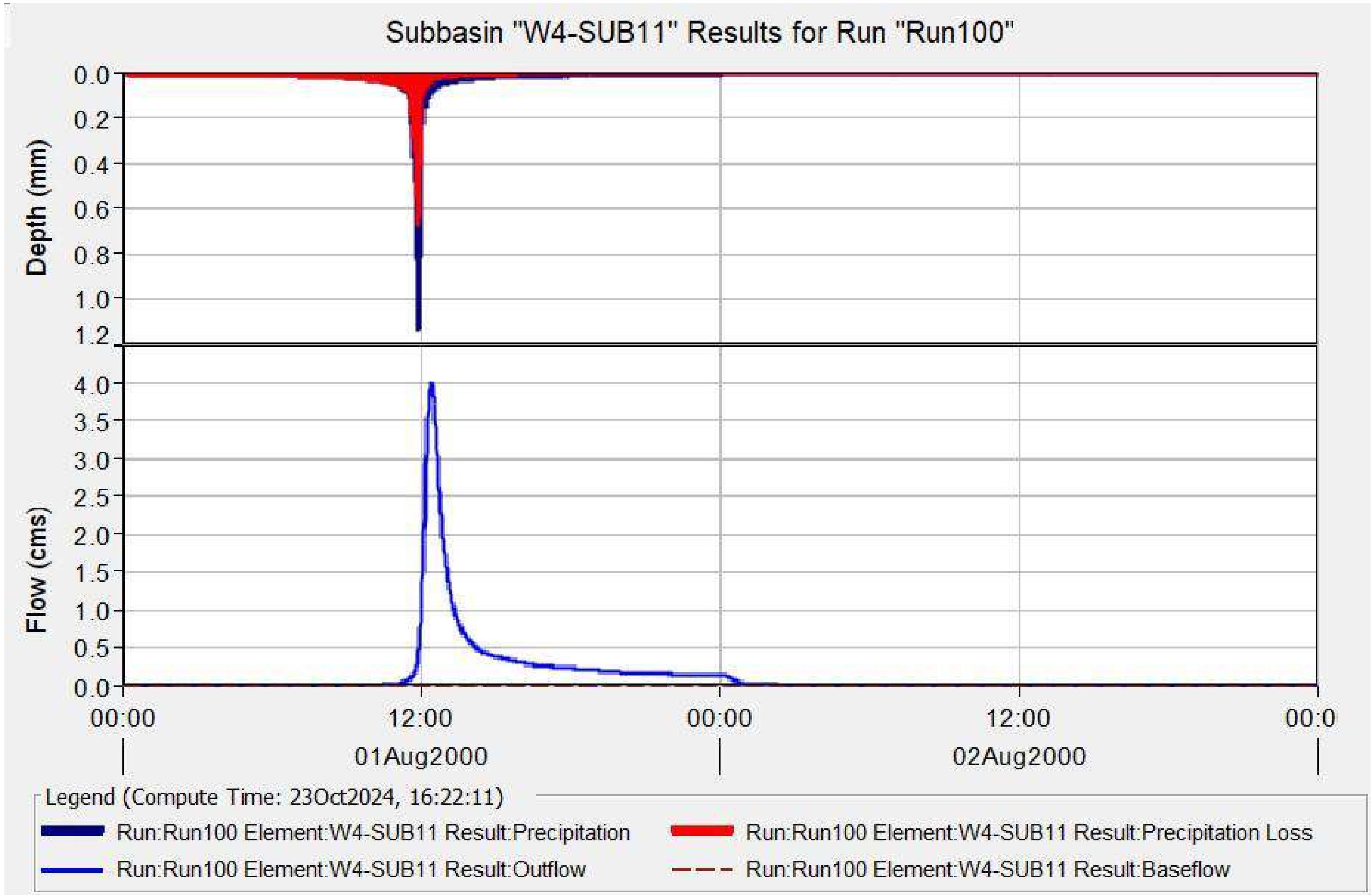

Subbasin "W4-SUB06" Results for Run "Run100
Depth (mm)
0.2
0.4
0.6
0.8
1.0
Flow (cms)
5
4
3
2
1
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 16:22:11)
Run:Run100 Element:W4-SUB06 Result:Precipitation
Run:Run100 Element:W4-SUB06 Result:Precipitation Loss
Run:Run100 Element:W4-SUB06 Result:Outflow
Run:Run100 Element:W4-SUB06 Result:Baseflow

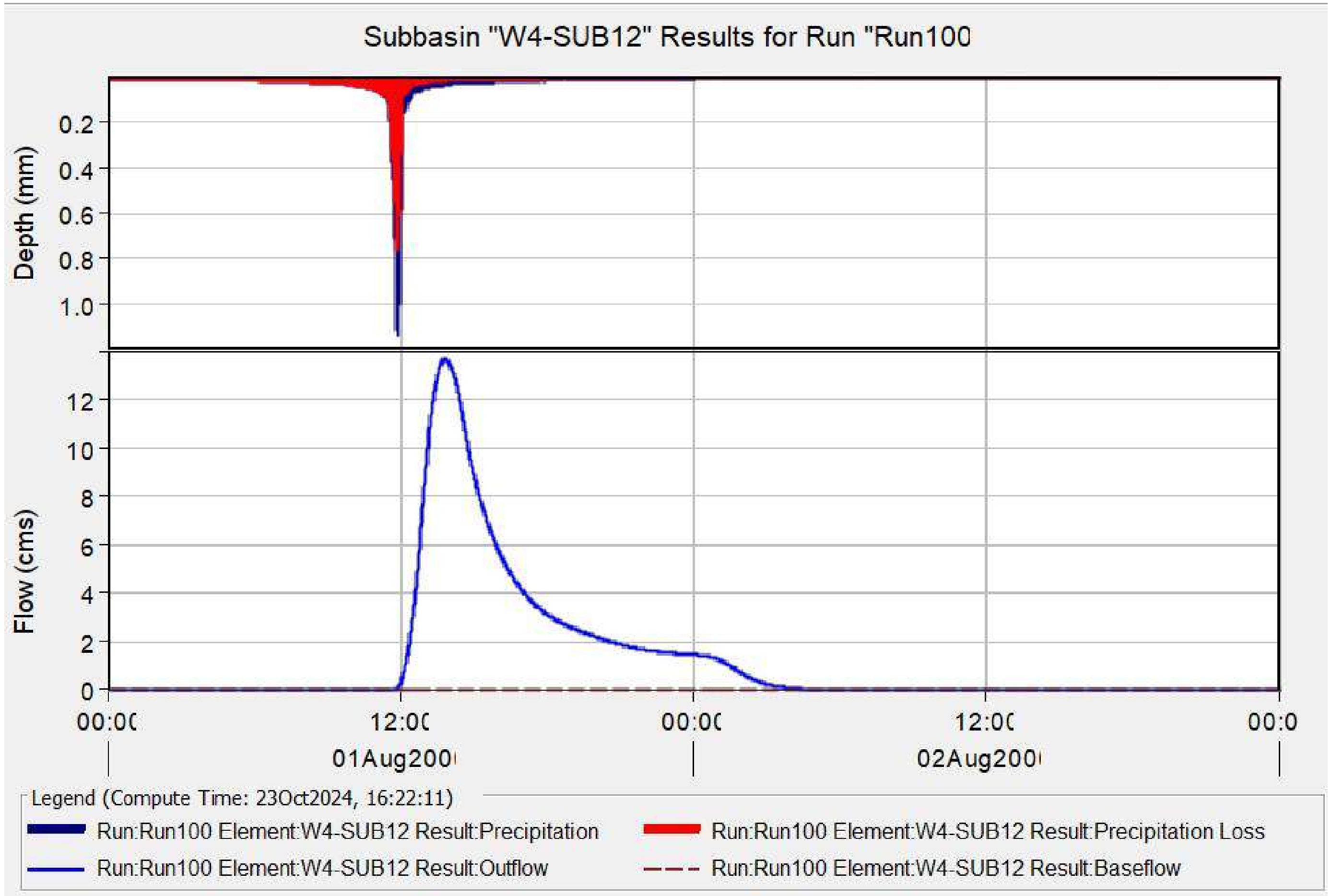

Subbasin "W4-SUB07" Results for Run "Run100
Depth (mm)
0.2
0.4
0.6
0.8
1.0
Flow (cms)
7
6
5
4
3
2
1
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 16:22:11)
Run:Run100 Element:W4-SUB07 Result:Precipitation
Run:Run100 Element:W4-SUB07 Result:Precipitation Loss
Run:Run100 Element:W4-SUB07 Result:Outflow
Run:Run100 Element:W4-SUB07 Result:Baseflow

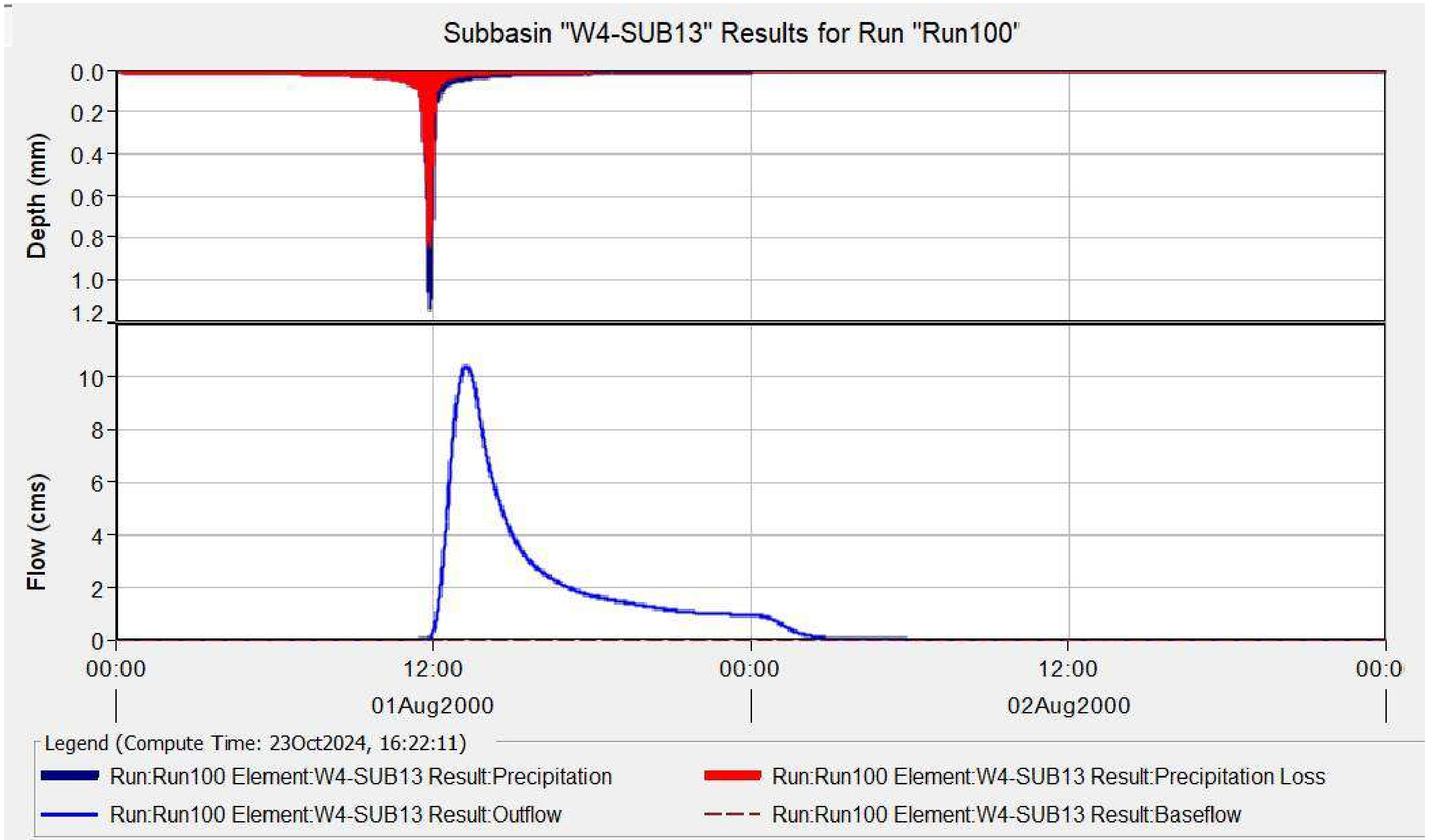

Subbasin "W4-SUB08" Results for Run "Run100
Depth (mm)
0.2
0.4
0.6
0.8
1.0
Flow (cms)
5
4
3
2
1
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 16:22:11)
Run:Run100 Element:W4-SUB08 Result:Precipitation
Run:Run100 Element:W4-SUB08 Result:Precipitation Loss
Run:Run100 Element:W4-SUB08 Result:Outflow
Run:Run100 Element:W4-SUB08 Result:Baseflow

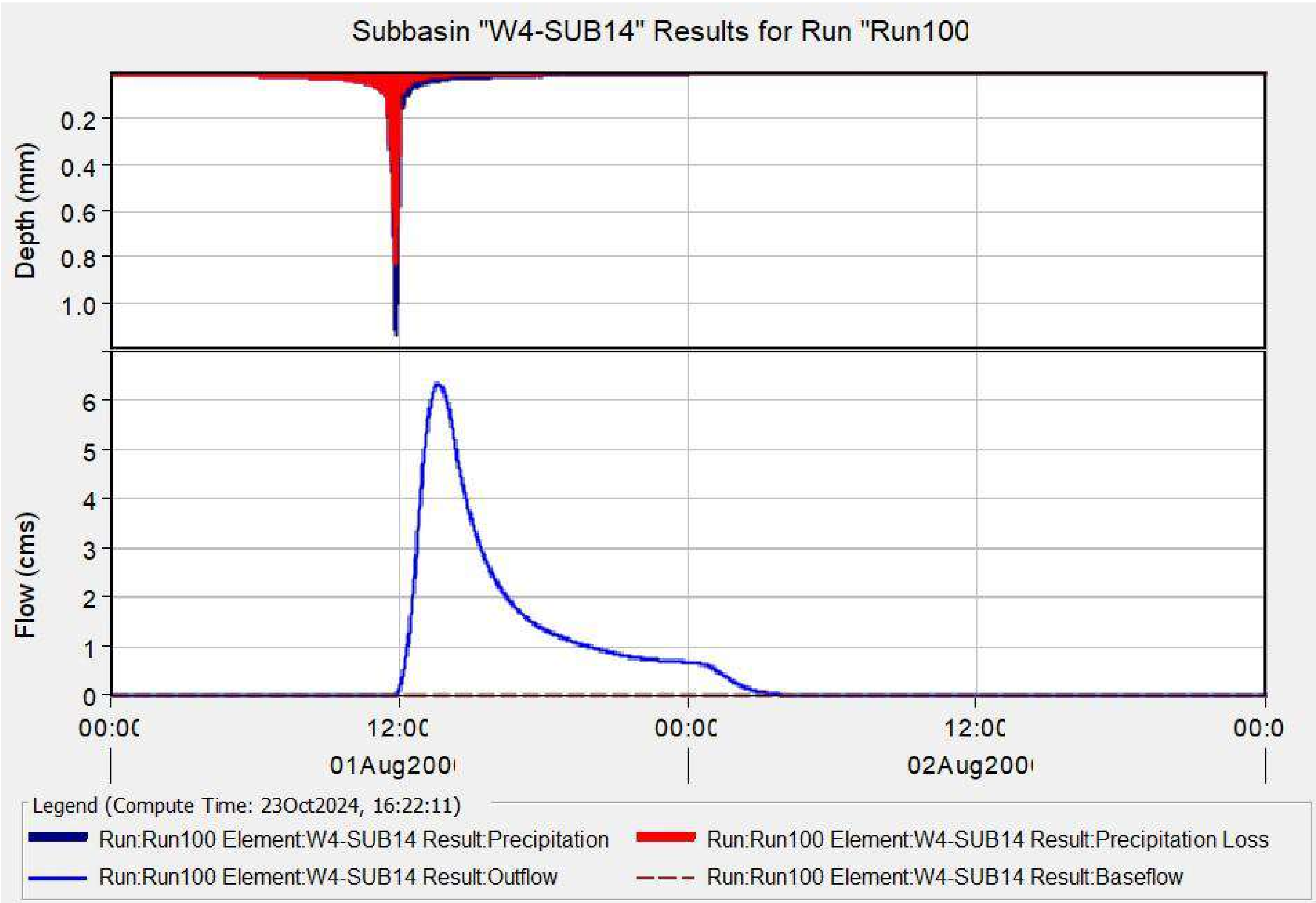

Subbasin "W4-SUB09" Results for Run "Run100
Depth (mm)
0.2
0.4
0.6
0.8
1.0
Flow (cms)
6
5
4
3
2
1
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 16:22:11)
Run:Run100 Element:W4-SUB09 Result:Precipitation
Run:Run100 Element:W4-SUB09 Result:Precipitation Loss
Run:Run100 Element:W4-SUB09 Result:Outflow
Run:Run100 Element:W4-SUB09 Result:Baseflow


Subbasin "W4-SUB10" Results for Run "Run100
Depth (mm)
0.2
0.4
0.6
0.8
1.0
Flow (cms)
10
8
6
4
2
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 16:22:11)
Run:Run100 Element:W4-SUB10 Result:Precipitation
Run:Run100 Element:W4-SUB10 Result:Precipitation Loss
Run:Run100 Element:W4-SUB10 Result:Outflow
Run:Run100 Element:W4-SUB10 Result:Baseflow


Subbasin "W4-SUB11" Results for Run "Run100"
Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Flow (cms)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 16:22:11)
Run:Run100 Element:W4-SUB11 Result:Precipitation
Run:Run100 Element:W4-SUB11 Result:Precipitation Loss
Run:Run100 Element:W4-SUB11 Result:Outflow
Run:Run100 Element:W4-SUB11 Result:Baseflow


Subbasin "W4-SUB12" Results for Run "Run100
Depth (mm)
0.2
0.4
0.6
0.8
1.0
Flow (cms)
12
10
8
6
4
2
0
00:0(
12:0(
00:0(
12:0(
00:0
01Aug200
02Aug200
Legend (Compute Time: 23Oct2024, 16:22:11)
Run:Run100 Element:W4-SUB12 Result:Precipitation
Run:Run100 Element:W4-SUB12 Result:Precipitation Loss
Run:Run100 Element:W4-SUB12 Result:Outflow
Run:Run100 Element:W4-SUB12 Result:Baseflow


Subbasin "W4-SUB13" Results for Run "Run100"
Depth (mm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Flow (cms)
10
8
6
4
2
0
00:00
12:00
00:00
12:00
00:0
01Aug2000
02Aug2000
Legend (Compute Time: 23Oct2024, 16:22:11)
Run:Run100 Element:W4-SUB13 Result:Precipitation
Run:Run100 Element:W4-SUB13 Result:Precipitation Loss
Run:Run100 Element:W4-SUB13 Result:Outflow
Run:Run100 Element:W4-SUB13 Result:Baseflow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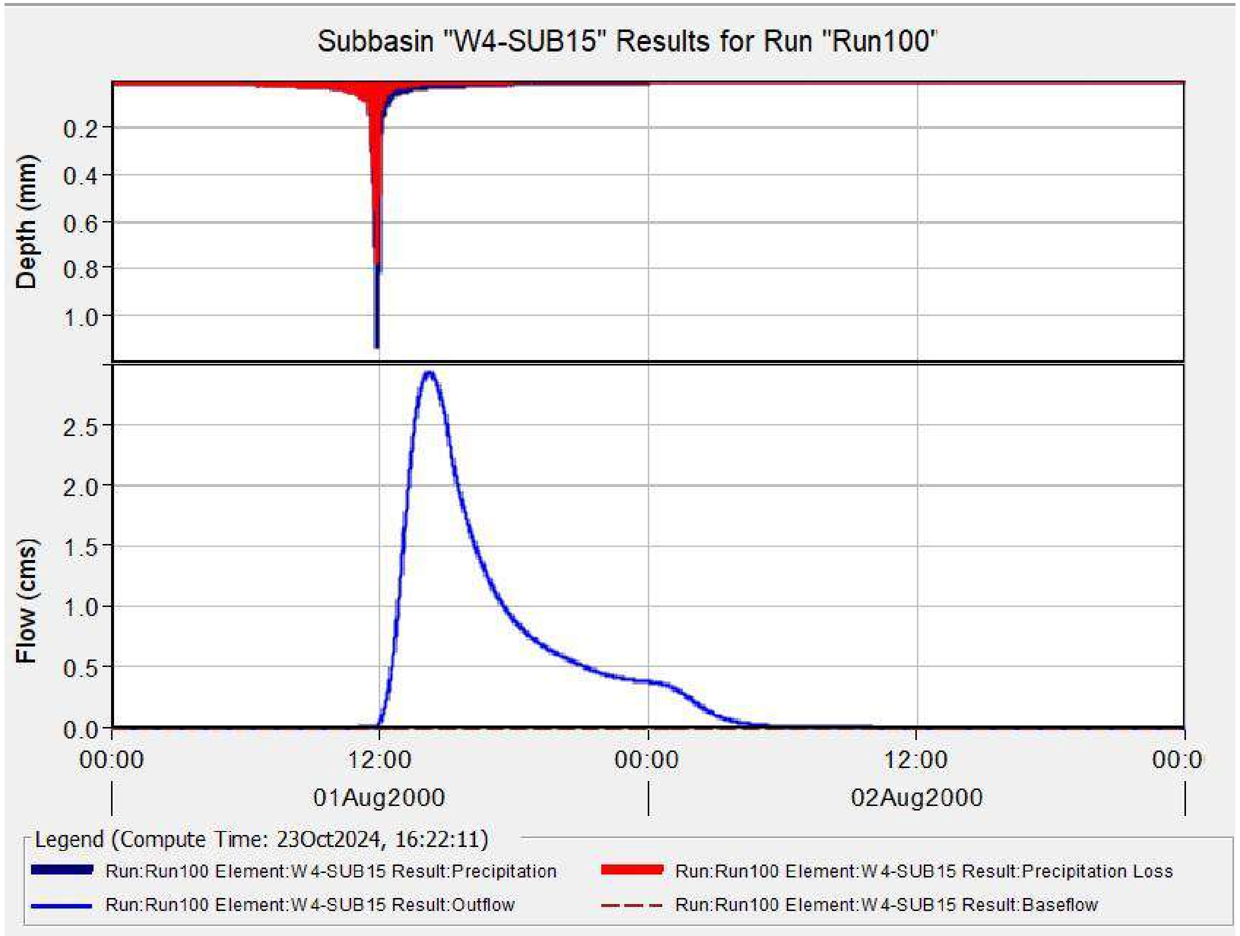
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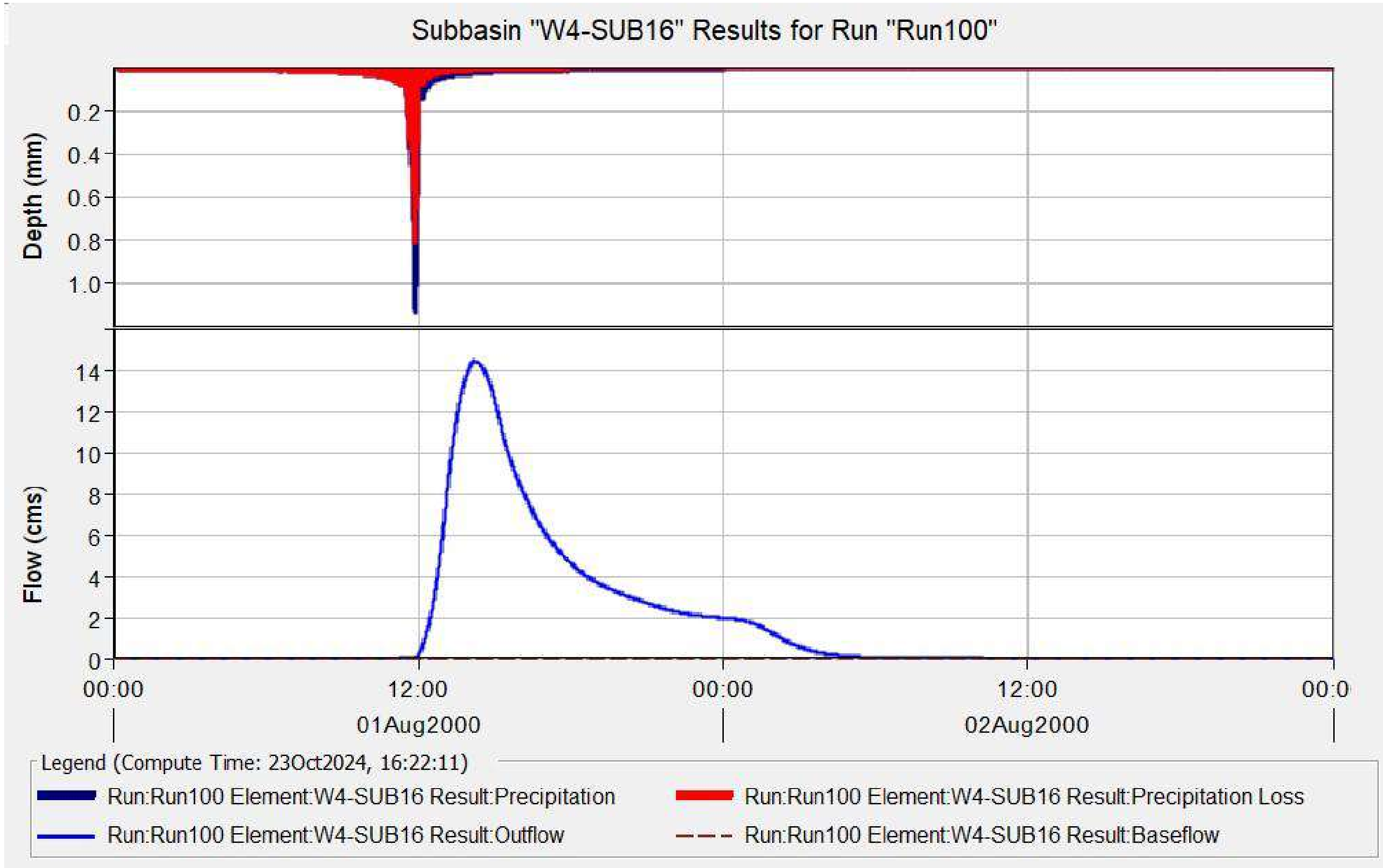

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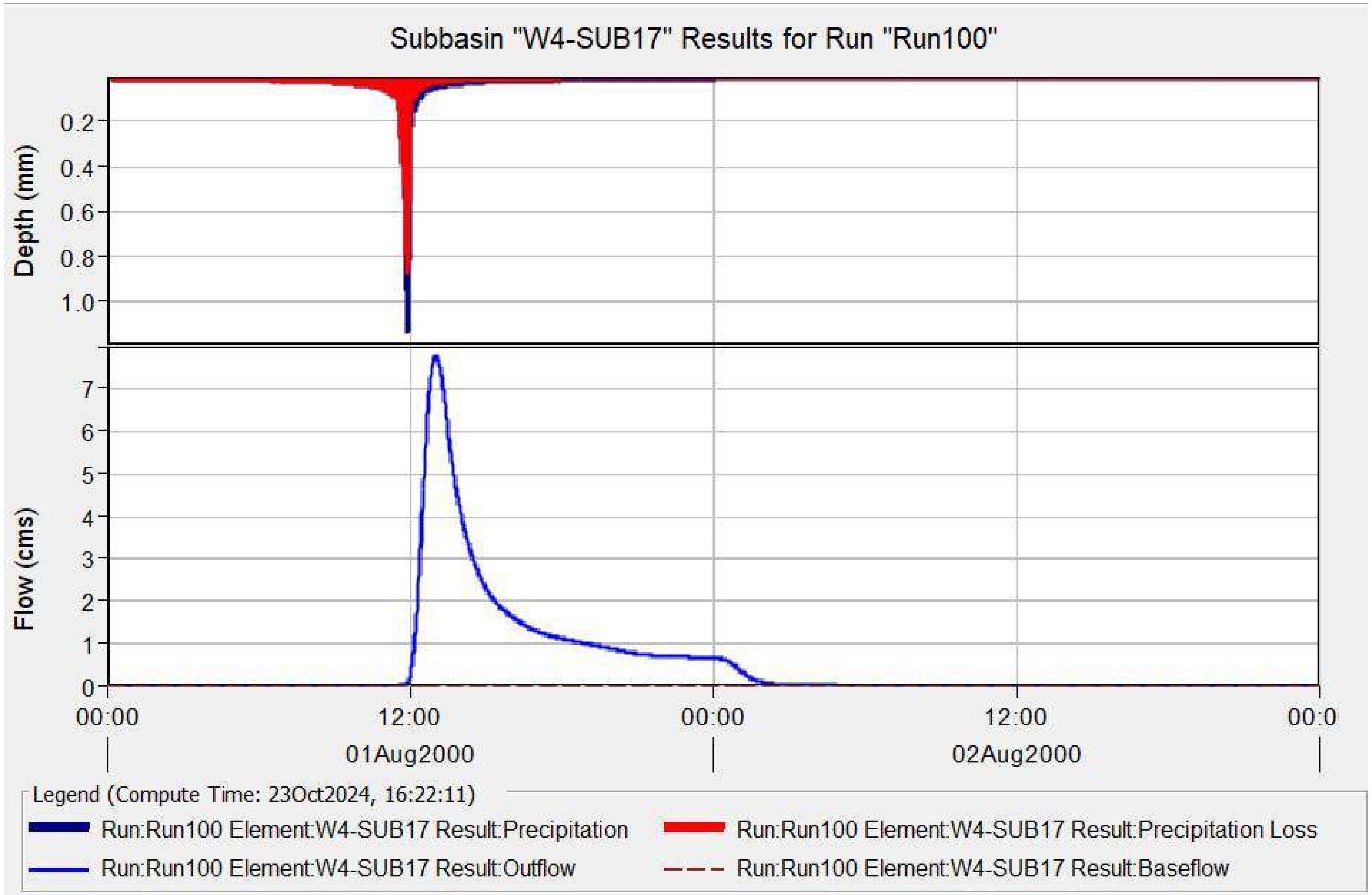
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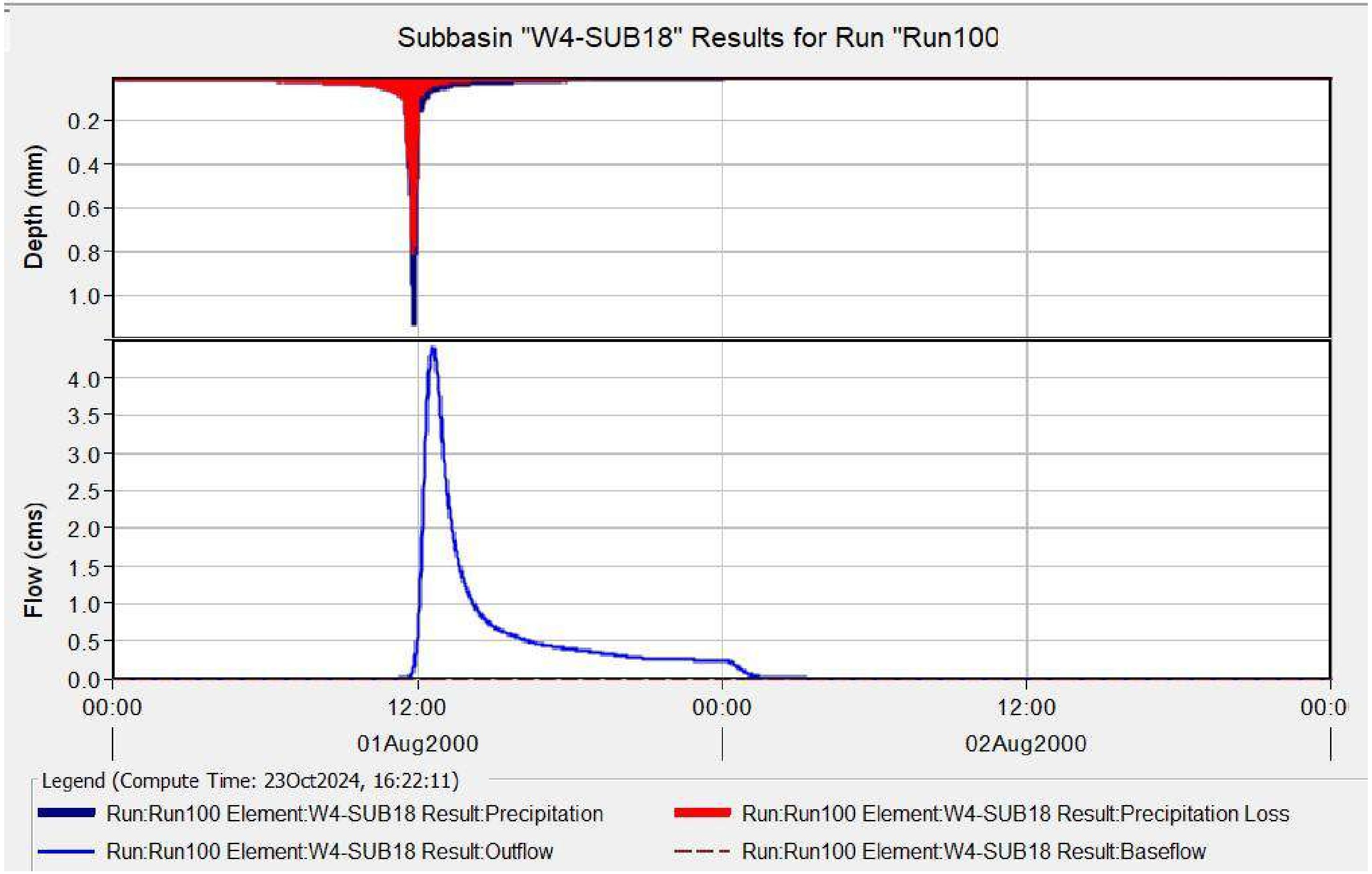
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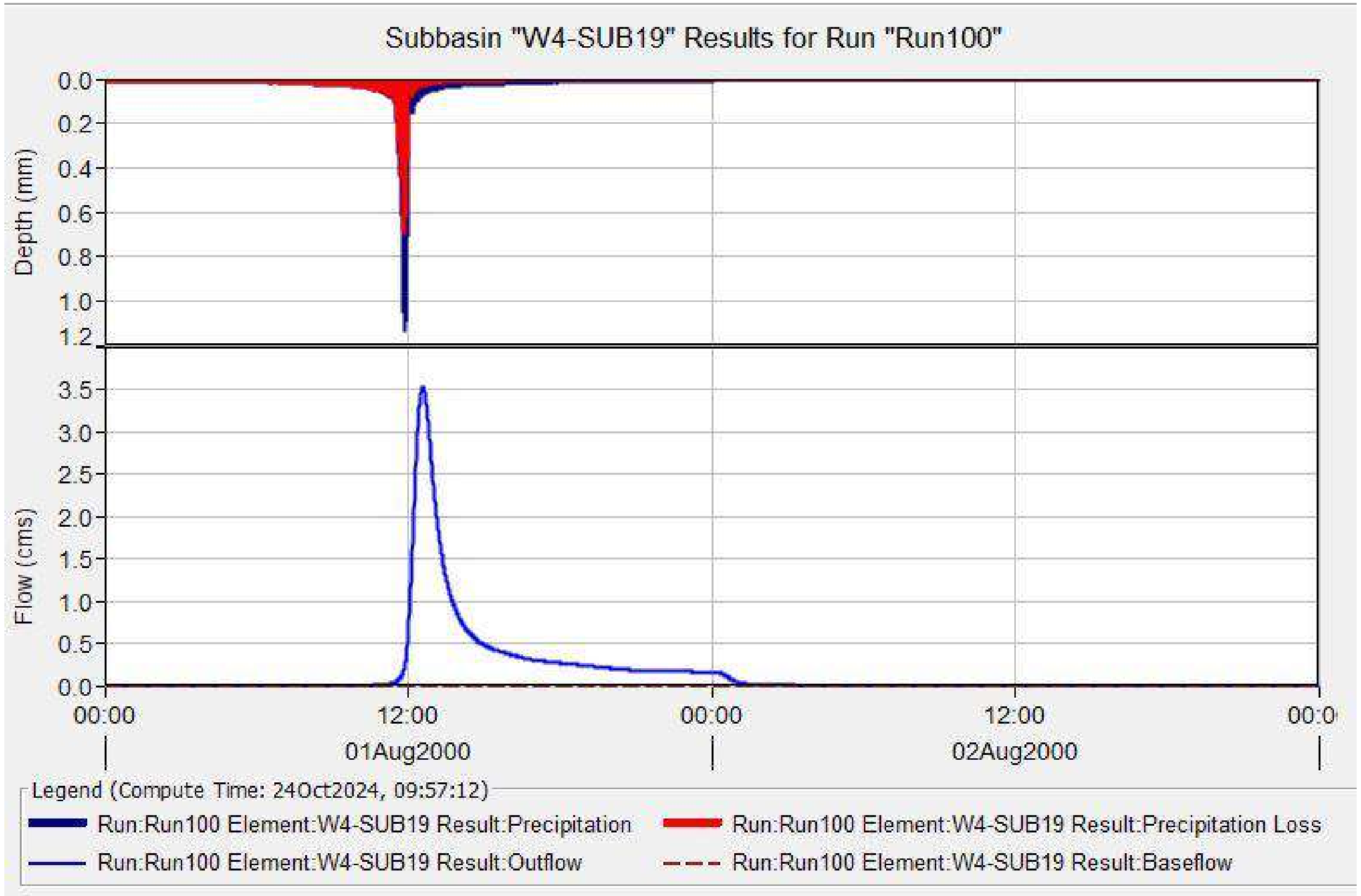
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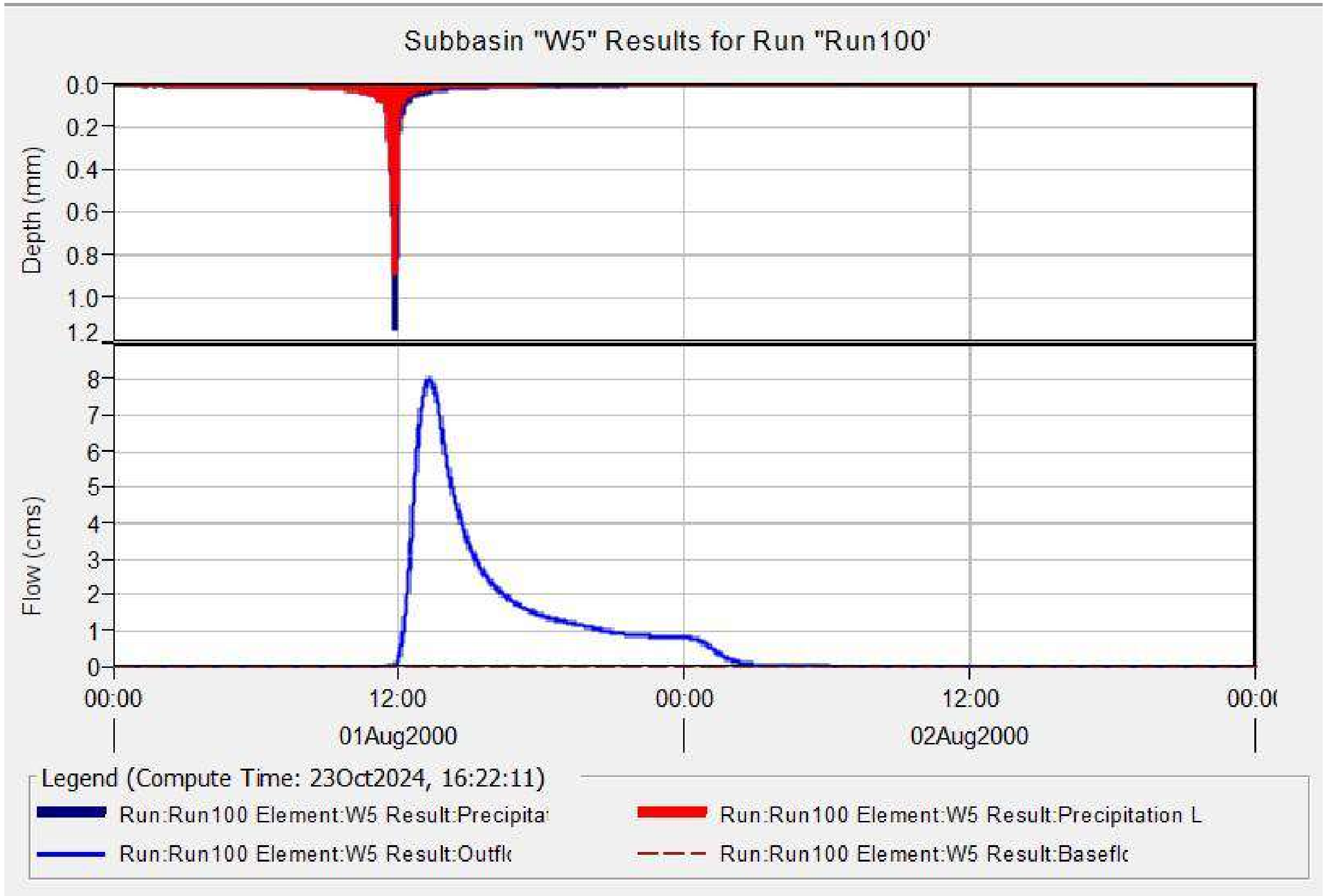
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Annex 3: Stakeholders MoM

Stakeholders Scoping Meeting – 1St October 2024

Governor meeting

The meeting took place in the governorate building of Qena in the 1st of October, 2024. The meeting included attendees from various relevant governorate/authority entities as presented in the list below.

List of attendees:

Scatec ASA

- Mohamed Amer – Country Manager and EVP Green Hydrogen
- Mohamed Taha – E&S Manager
- Mohammed Khairy – E&S Advisor
- Ahmed Abdel Nasser – Security Manager

Qena Governorate

- Dr. Khaled Abdel Halim – Governor of Qena
- Colonel, Mohamed Magdy, General security manager (مدير مكتب الأمن العام)
- Dr. Hazem Amr, Deputy governor of Qena
- General, Hossam Hammouda, Secretary General (السكرتير العام)
- General Ayman El Saeed Abdel Baki, Assistant Secretary General
- General, Magdy, Security Head of North Qena Sector (حكمدار قطاع شمال محافظه قنا)

The project team first presented the project details, ESIA schedule, and activities. The attendees expressed their interest in the project and expressed their willingness to provide facilitation for the achievement of the ESIA process.

Governorate identity

The governor stated that the project is aligned with the governorate's vision regarding its core and visual identity, as a sustainable and green governorate aiming at pollution prevention and addressing impacts of climate change through the reliance on renewable energy. This also includes the involvement of community development and value creation for the local communities.

Public Disclosure Process

The governor clarified that the governorate has experienced arrangements of previous public meetings and are willing to assist the project as required. The governor also stated that they comprehend the requirements of the World Bank and IFIs. The governorate is assigning a contact person to coordinate any required arrangements for the public consultation meeting planned in October 23rd. The public consultation invitation announcement to the local community and governorate entities takes place usually through their conventional channels, as their social media pages, city council, the local unit centre, etc.

Land ownership

Upon the project team inquiries regarding the land ownership status, the governorate confirmed that the project area is State-owned and no risks are perceived in regards to potential land ownership claims. Unlike other areas in Egypt, there are no local settlers claiming ownership of the project's land.

Security requirements

The project discussed the security requirements for the area during construction and operation with the Governorate officials assigned from the Ministry of Interior. The latter confirmed they shall support the project by supplying all the necessary security requirements including provision of patrolling, a stationary police unit, and ongoing communication with the private security company to be assigned. They also mentioned securing the transportation of equipment and project components.

Sensitive receptors

The project team inquired about any sensitive receptors that should be considered. None were identified by the governorate. In fact, the project is expected to be welcomed by all relevant stakeholders.

Transportation considerations

The governorate promised to provide advice and support for the transportation routes of the project components. Furthermore, the governor confirmed that the project does not intersect with the planned fast-train route.

Local hiring

The project team stated they shall maximize local hiring during construction and O&M phases and asked the governorate to suggest potential local communities and contractors from which the hiring can take place. The governorate team elaborated that local communities possess various resources as construction contractors, and promised to provide assistance to identify local resources, as relevant.

Community value creation

Discussion took place on potential CSR projects aiming at supporting the community. The governorate is already involved with various NGOs on different projects, as the 1 million trees development – carbon credits project and is willing to liaise with the project in due time.

Female leadership opportunity

The project team inquired if a female Community Liaison Officer is perceived acceptable and appropriate by the local community, and Governor stated this is highly appreciated and that they shall propose candidates suitable for this position.

Conclusion

The project team provided the governorate a list of specific inquires regarding labor sourcing, transportation, vulnerable groups, local community value creation, local labor law, security, accommodation, utilities, and agriculture in the area. The meeting was concluded by the governor stating that the project is considered a partner of success and an opportunity for the governorate to promote and support clean energy in the region.

Meeting at the Hiw Industrial Area

Hew Industrial Area

Eng. Mohamed Shabaan – Manager of the Industrial Area

Scatec

Mohamed Taha

Mohammed Khairy

The meeting started by presenting a brief of the Solar+BESS project and its requirements.

Labour sourcing

Eng. Shabaan reported that Hiw village has almost 20,000 residents and is a potential source of various types of labour.

Labour accommodation

Engineers could be accommodated in Baraka village that can take up to 5000 persons. Labour could be accommodated in Hiw and Naga Hammadi.

Utilities

The area is equipped with governmental utilities for domestic wastewater (sewage) reception, electricity connections, and domestic water provision. A domestic water tank of 4000 m3 already exists and a new tank of capacity 10,000 m3 is under construction.

Flash floods

Eng. Shabaan stated he has never witnessed any flash floods or heavy rains and that he has been in the area for 20-25 years.

Transmission lines

The team inquired regarding the process that took place while building OHTLs in agricultural lands north of the project area. Eng. Shabaan said that these OHTLs were built many years before legalizing land ownership of these lands. He doubts that this issue could be problematic.

Additional stakeholders to consider

Eng. Shabaan recommended consulting the head of Hiw village council, Mohamed Radwan, in regard to understanding community needs, including identifying vulnerable groups.

Female leadership opportunity

The project team inquired if a female Community Liaison Officer is perceived acceptable and appropriate by the local community, and Eng. Shabaan confirmed this is a positive initiative by the project and shall be effective in identifying any potential issues.

Land ownership

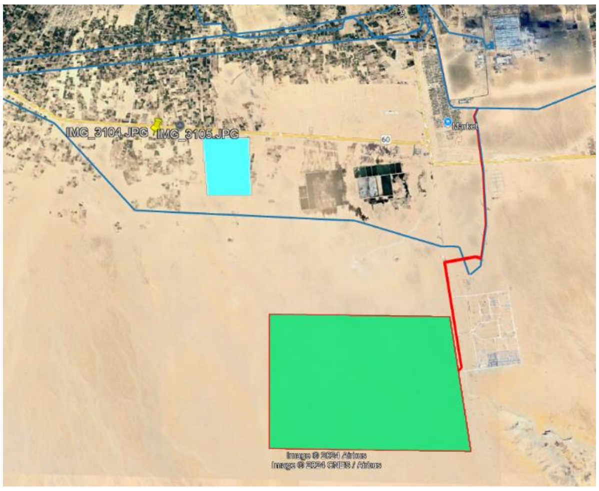
Eng. Shabaan confirmed that there are no ownership claims in the project area, and no tensions. However, he reported that four families in Hiw generally demand the security services of any development projects in the area. He clarified that he failed to unite their interests in providing this service by inclusion of members from all families. He advised to use a private/legally registered security company.

Individual meetings with local farmers North of the Site

Those meetings included:

Mr. Mohamed Ahmed Yousef

Mr. Sayed Abdalla



Local crops

The interviewed farm owners confirmed the grown crops are wheat, corn, alfalfa, tomatoes, onion, and cane.

Project influence

Upon introduction of the project activities and purpose, the farm owners expressed their excitement about the establishment of such a nationally significant project and offered their potential support and possible services regarding labour/equipment sourcing and accommodation facilitation.

Groundwater

The reported water table depth is 43 meters, reaching 250 m close to the mountains in the south, with specific areas nearby the mountains reported to be of no groundwater availability. The groundwater was also reported to be suitable for agriculture. As observed, all farmlands utilized solar panels for groundwater pumping.

Public disclosure location

A farmland owner stated that there is a suitable large hall in the Baraka village for the public consultation.

Labour sourcing

Proposed labour from the Hiw village, followed by El Manasra, and El Batha.

Flash flood potential

Farm owners confirmed they have not witnessed flash floods, while they were at least 15 years in the area.

Meeting with Egypt Alum

Egypt Alum
Dr. Mahmoud Abd El-Alim Agour

Scatec
Mohamed Amer
Mohamed Taha
Mohammed Khairy

Wastewater treatment
The project team was particularly interested to better understand the process at an area labelled as wastewater treatment plant, approximately 4km north of the site. Dr. Agour confirmed it is used for waste water treatment by utilizing ponds as settling basins. The governorate wastewater trucks collect sewage from septic tanks in the villages and sends it for treatment in this area. No further information was provided.

Transmission lines and farmlands
Dr. Agour reported that farmlands through which overhead transmission lines are intersecting are leased by usufructs with the government, and that the entirety of the land in the area from the Hiw industrial zone till the Naga Hammadi substation are state-owned.

Meeting with the workers in Water pumping station

Mr. Hazem Zahran

Water pumping power and capacity
Mr. Zahran stated that pumping power from this station, located 1.5 km to the north from the project site border, is almost 90 liters/second. The current station has a 6000 m3 capacity tank. Furthermore, he clarified that water is sampled and analyzed upstream after Nile water treatment in the main water treatment station in Naga Hammadi.

Community
Mr. Zahran reported that Hiw has almost 25,000 voters and 120,000 residents. He also confirmed that the city has labour available for construction works. Local construction contractors are also available for providing services though their machinery and equipment, as tankers/trucks etc. He also offered to assist the project team with providing local workers for construction. Mr. Zahran also added that such development projects are very welcomed in this area and no current community tensions around the project area exist; such as vendetta (الثأر).

Accommodation
Mr. Zahran stated that El Baraka city south of the EgyptAlum Plant has several available options for rental, along with El Sheikh Ali village.

Other risks
Mr. Zahran reported he has not witnessed any floods in the area since 2010 nor any agricultural claims or plans.

Meeting with a farmland owner in vicinity of Naga Hammadi Substation

Farmer: Osman Ahmed

Transmission lines

Upon inquiring about the history of the transmission lines crossing the farmlands, Mr. Ahmed stated that the overhead lines were established between the Mid 1960s and Mid 1970s; before farming took place in the area. He reported that the land were owned by individuals who were compensated at the time of the OHTL construction dates, and which were for the purpose of powering the EgyptAlum facility initially, then for powering the industrial area in the south adjacent to the project's area.

Crops and agriculture

Mr. Ahmed reported they grow onions, tomatoes, and cane as they have limited range of crops to grow due to the saline nature of the groundwater. He also reported tha the farmers' basic needs are mainly treated water for drinking.

Meeting with a guard at the new sewage treatment facility

Guard

Mr. Hessien Abdel Maguid Abdel Mawgood

Sewage treatment facilities

The security guard from Hiw reported he works for El Mokhtar contractor company handing over the wastewater treatment plant to the governorate. The WWTP should serve Naga Hammadi in the north and the industrial area in the future and is composed of settling basins.

Mr. Hessien reported that the other settling basins north of the project site is serving EgyptAlum and El Baraka city.

Consolidated Conclusion

None of the stakeholders met reported any concern from the project or that anyone could be negatively impacted by the project activities. In fact, they expect that the project is beneficial for the country in terms of addressing energy deficiency gap, and for the local community in terms of providing job opportunities and general economic growth. None were aware of specific vulnerable groups but feedback is awaited from the Ministry of Solidarity and the Qena Governorate.

Disclosure Meetings

A number of meetings were carried out on 23 and 24 of October to disclose and discuss the results of the project's ESIA. This was a follow up on the communication with the community and officials starting during the scoping stage. The meetings included:

1. The Industrial area management, investors, and employees. This was necessary as the closest activity to the project.
2. The closest farms to the projects, to investigate whether there are perceived impacts that might have been overlooked.
3. Local Women specifically targeted as opportunities for their participation in public meeting might be limited.
4. The health unit of El-Baraka village as a critical service provider in the closest residential settlement tot eh project
5. The discussions that commenced with Qena Governorate and relevant authorities during the scoping stage continued throughout the ESIA process

The selection of these meetings was focused on the vicinity of the project (see figure below) and were made in consultation with the head of the El-Hew municipality (under which El-Baraka falls), and the Governorate officials. This was capitalizing on contacts made during scoping.

Figure 1: Graphical presentation of focus group locations with respect to project location

The meeting with women was organized by a local NGO. Moreover, all meetings included representative of other NGOs and Charity organizations reflecting a high inclination to public service in the local community.

All meetings started with an introduction to the project, the environment assessment and the role of consultation, followed by a summary of the positive and irrelevant impacts as well as the significance of potential negative impacts and proposed mitigations.

The meetings was interactive, and participants were encouraged to interject whenever they have a query, clarification, or contribution to make. Printed colored simplified summaries were distributed (see Annex 1), these also included contacts in order to provide any follow up comments. The participants were encouraged to share these documents with others, particularly with local NGOs and charity organizations.

Meeting at the light industrial area, next to the site

October 23rd. 2024

Participants

1. Eng. Mohamed Shaaban – Nile Construction and Roads company (contractor) , Industrial Area Manager
2. Ramadan Saber – Security Officer – Local from Hew Village
3. Mostafa Abdel Mohamed Abdel Hafez Mady – Security Officer – Local from Hew Village
4. Hafez Mady – Security Officer – Local from Hew Village
5. Eng. Hassan Nazir – Investor – Concrete Batch plant + Contracting Company
6. Dr. Shaker Mohamed Shaker – Industrial complex managerى
7. Gamal Abdel Nasser – Security Officer – Local from Hew village
8. Hassan Youssef – Investor – Tea packing factory – local from Abu Tesht
9. Hani Aref Hassan – Investor – Batal Stone factory – Granite and Marble Factory - Local
10. Counceller Abou El Fadl El Dardir – Investor – Granite and Marble Factory
11. Dr. Mohamed Abd Allah Ahmed – Investor – Cosmetics and detergent factory and member of NGO “Ataa Bela Hodoud”, located in El Arky village Farshout

The contributions of the participants could be divided to the following categories.

Local Information/security

- The local villages include: El Bat'ha – Hew (including El-Baraka) – Shouraya – Ezrepten – El Raeeseyya – El Negmeya – El Gemana – Abou Ammoury
- There are approximately 10 main families (currently) actively seeking work in security – these could increase - some of these families are not interested in other type of work
- It is advised to get an external security company (such that no family dominates) and hire persons from these families as security officers.

Other local information

- The area is subject to days of dusty winds during the spring months of the year – It was advised to plant trees surrounding the facility to reduce impact of wind blown dust
- Groundwater table is at approximately 65m depth

Possible Synergies

- The police and firefighting services are available in the industrial area and their services could be extended to the project
- On the other hand, the industrial area lacks an ambulance

Comments on the project

- The project is highly welcomed and the impacts are insignificant – the main impact being noise during the construction phase
- It is not expected that the construction period would cause any congestion in traffic. However, it was advised to consider that most factories start work at 8:00 am, and this timing could be avoided when planning the project shifts.

Concerns

- There are fears that leasing, apartment prices and general living costs would increase as a result of influx
- Whether these types of projects will further increase the price of electricity, and it was clarified that on the contrary, it might contribute to reducing the pace of increase, as electricity will be provided by the company for a fixed price over 25 years.
- It was proposed that instead of fueling form the surrounding gas stations which could cause pressure on the resources, equipment could be fueled on site by securing the supply of fuel in the site
- The excavation and cut/fill permit: A meeting took place with Brigadier Maged Abdel Rahim, a major and two engineers, all from the Egyptian Company for Mining and Quarry Exploitation and management which was established a few years ago under the "national service agency" of the Military forces. The company was established to manage quarries on the national level, which used to be managed by the local administration.
- They informed the necessity to acquire a permit from the said Company. The Permit application includes provision of engineering drawings and topographic survey indicating cut and fill volumes.

Local employment

- There is a keen interest of all attendees in Local job opportunities and provision of supplies. It is important to provide job opportunities to locals. The area includes workers, engineers, technicians and other support jobs such as security, clerks, etc…
- It was clarified that the employer should, in principle have the same interest, as local employees also save resources e.g. in terms of travel and accommodation. However, this is conditional of having the right credentials for the applicants.
- Scatec has had a successful precedent in this respect in Benban and it is likely that the population in Nagaa Hammadi and the wider Gena Governorate would provide a larger pool of possibilities.
- The industrial area management has access to local resources and Dr. Shaker, its manager, advised that regarding local workers, resources and supplies: They are always receiving local requests for jobs and can provide resumes

- Moreover, Dr Mohamed Abdallah (of the detergent company) has clarified that he can also provide workers and supplies
- In response to these offers, it was clarified that the company will recommend to its contractor to use multiple channels to announce job opportunities to ensure fair access to all interested.

Follow up

- The participants were requested to share the ESIA summary in hand
- They were also invited to provide other comments to the WhatsApp number and emails provided.
- Dr. Mohamed Abd Allah Ahmed (01008441429) was requested to share the ESIA summary with the local NGO “Ataa Bela Hodoud” and provide the project contact information for any comments

Meeting with farmers

October 23rd, 2024

Participants

1. Mr. Ahmed Mohamed Youssef, owner o the farm where the meeting took place
2. Mr. Mohamed Ahmed, son of the owner
3. Mr. Emad El Din Hamdy, owner of a neighboring farm
4. Mr. Ahmed Abdel Mawgood, owners of a neighboring farm - (also a member of NGO “Moaasaset Al Nedaa El Khaireya” (01066336024)

Local Information

- It is advised to plant trees around the project to reduce impact of the wind/dust
- Groundwater has relatively high salinity
- El Baraka village is a good choice for accommodation of the project employees

Expectations

- Local job opportunities and provision of supplies
- Looking forward to manufacturing of solar panels in Egypt instead of importing them

Comments on the project

- The project is important on the country level and will provide employment opportunities to locals, and will enhance the local economics through purchase of supplies
- There is no foreseen negative impact from the project. There was no impact from the industrial area (which is at the same distance from the farm) during its construction or operation. The location of the project is far from any communities and no impacts are anticipated

Follow up

- The participants were requested to share the ESIA summary and to provide other comments to the numbers and emails provided.
- Mr. Ahmed Abdel Mawgood was requested to share the ESIA summary with the local NGO "Moaasaset Al Nedaa El Khaireya"and provide the project contact information for any comments

Meeting with local women

24 October 2024

The meeting was organized by Ms Mervat El-Shanawany of the CDA of Elderb , but was convened on the premises of the NGO “Hesset-El-Kheir”

Attendees:

A total of 42 women participated in two consecutive meetings (as the available space did not allow for a single meeting). The names of the attendees are listed in Annex 2

Expectations

- A widow expressed her need to be able to work independently and support her family – community projects are needed. It was clarified that community investments are typically undertaken during the life time of the project
- Jobs for local community
- Community investment projects

Comments on the project

- The project will help solve the problem of electricity cuts, particularly during summer months
- NGOs were proposed to be the best option for finding local workers

Chaannels for local Employment

- Mr. Mohamed Kassem (01099329334) is active in providing local workers from Halfeya Bahary village
- A lady of the attendees suggested the aluminum factory as a perfect venue to place a banner requesting job candidates. The advantage of this venue is that workers that come daily to the factory will spread the news in their own communities

Baraka Family Health Unit & Baraka Charity Organization

24 October 2024

Attendees (All are locals)

1. El Ameer Begama – Statistics technician
2. Ebada Mohamed Ebada – Baraka Charity Organization
3. Yehya Rasheed – Store Keeper
4. Buthaina Ibrahim – Rural community officer
5. Halla Khalaf – Rural community officer
6. Eman Abdel Hamid – Social specialist
7. Hanaa Abdel Maoboud – Nurse
8. Nahed Kamal – Nurse
9. Ezzat Sayed – Nurse
10. Ahlam Sabry – Nurse
11. Salma Mohamed – Doctor

Local Information

- There are many apartments available for lease in Baraka, more than Nagaa Hammadi
- This is the closest health unit to the project, where first aid for emergencies could be provided. There is a general hospital in Nagaa Hammadi at a distance of about 15km – there is also a central hospital with more specializations, as well as other hospitals in Qena
- The decision to direct the case to any of these options is taken by the paramedics of the ambulance service located at 1.5 km from the industrial area, and thus the project.

Expectations

- Employment for the local population.
- Stray dogs are a problem because of an existing dump site – open burning also takes place – locals look forward that the project could help improve management of the dump site .
- Maintain a percentage of workers of special needs. National laws expect a 5% percentage.

Comments on the project

- Transportation must be provided to workers
- What are the project benefits to our community: job opportunities – services – country level benefits; energy availability
- Is the government a partner in the project: The project sells electricity to feed the grid
- The local community will benefit a lot from the project. Baraka village is seen to greatly prosperous as a result of the fast train project, the industrial area and the current solar project
- Fears that the project could lead to rising prices of commodities, leasing and houses

Other stakeholders

- One of the attendees "Mr. Ebada Mohamed Ebada (01021705351) leads the "Baraka Village Charity Organization". He offered to help in finding local workers

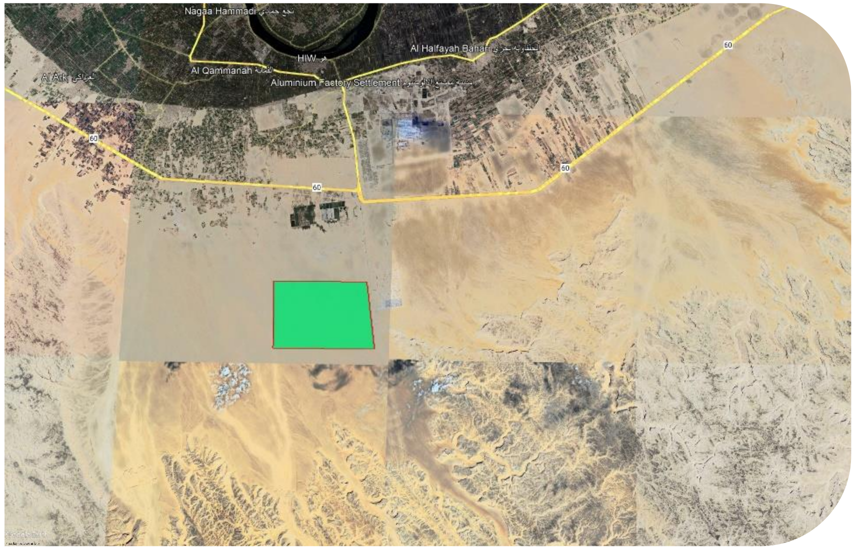
Annex 1

Brief on project and Environmental and Social Assessment

نبذة عن تقييم الأثر البيئي والاجتماعي لمشروع "أوبليسك" للطاقة الشمسية

المشـــــــروع

مشروع "أوبليسك" للطاقة الشمسية مشروع وطني بجوار منطقة الصناعات الخفيفة بنجع حمادي، وينتج حوالى ١ جيجا وات من الطاقة الشمسية المزودة بتكنولوجيا تخزين الطاقة بالطاريات (٢٠٠ ميجا وات ساعة) على مساحة ٣٨٨٨ فدان. وذلك بمساندة من القيادة السياسية لسرعة ادخال قدرات من الطاقة الجديدة والمتجددة لمجابهة الطلب المتزايد على الطاقة الكهربائية. المشروع يقع بجنوب نجع حمادي



أهدافه ومساهمته الوطنية

المشروع يهدف لانتاج الطاقة النظيفة والمستدامة لمدة ٢٥ عام، ويساهم في تقليل الاعتماد على الوقود الاحفوري في مصر ولا ينتج عنه أي انبعاثات أو تلوث للهواء، بل يتم الاعتماد كليا على الطاقة الشمسية وتتبع اتجاهها خلال اليوم. ويسهم أيضا في تحقيق التزام الدولة بالتزاماتها البيئية المقررة والتي تهدف لانجاز ٤٢٪ من توليد الطاقة الكهربائية من مصادر جديدة ومتجددة بحلول ٢٠٣٠.

فوائده المجتمعية – التوظيف

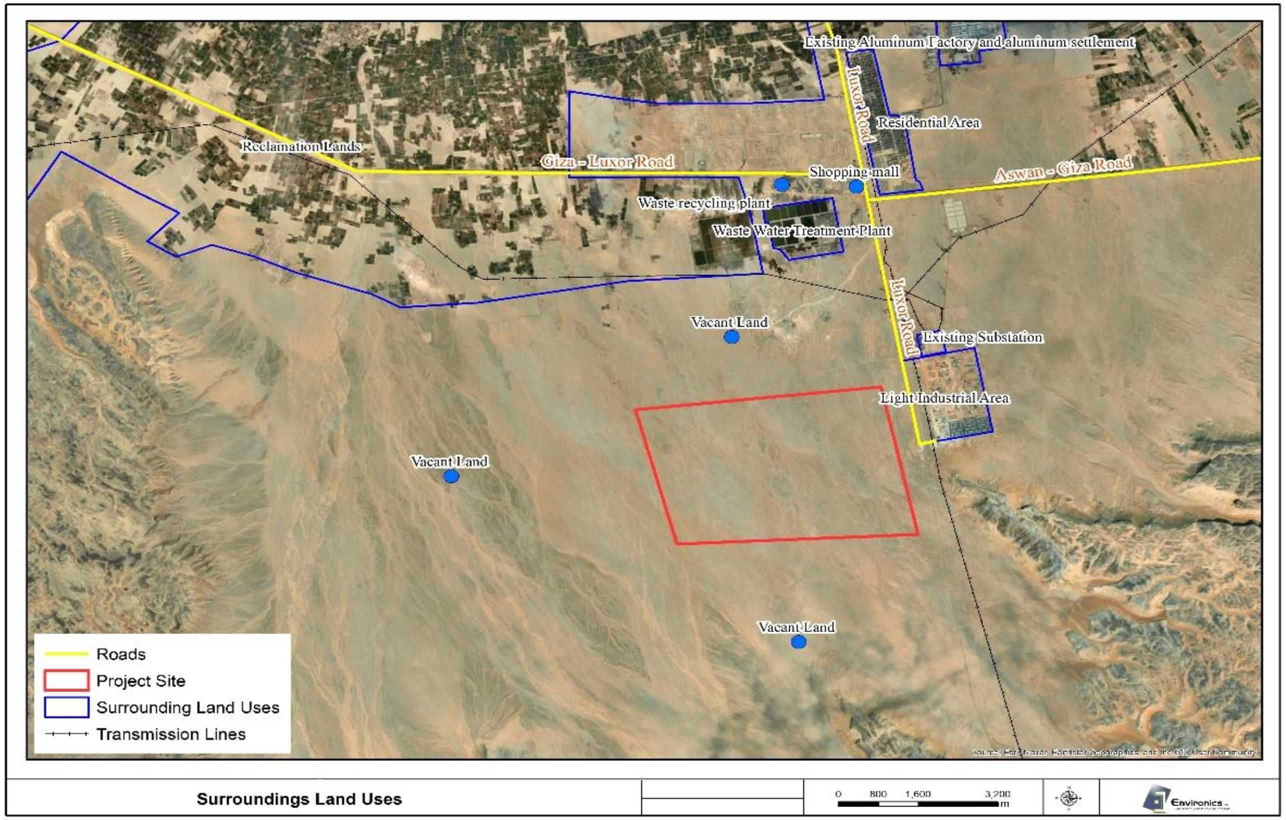
سيتطلب المشروع قوة عاملة ضخمة تصل لأكثر من ٥٠٠٠ عامل (تكون الاولوية فيها للمجتمع المحلي) خلال ذروة مرحلة. وينتج عن ذلك انتعاش كبير اقتصادى واجتماعى. الانشاء، ومن المتوقع أن تتعدى قوة العمل ١٠٠ عامل خلال مرحلة التشغيل والصيانة كما ان المشروع سيحرص على إستمرار التولصل مع المجتمع المحلي من خلال مسؤول الاتصال المجتمعي وآلية للشكاوى فعالة.

الدراسة البيئية والاجتماعية

المشروع الآن في مرحلة دراسة تقييم التأثيرات البيئية والاجتماعية، وحيث أن الدراسة حاليا في مرحلة الانتهاء من مسودة الدراسة فيهمنا معرفة رأيكم فيما وصلت إليه:

موقع المشروع

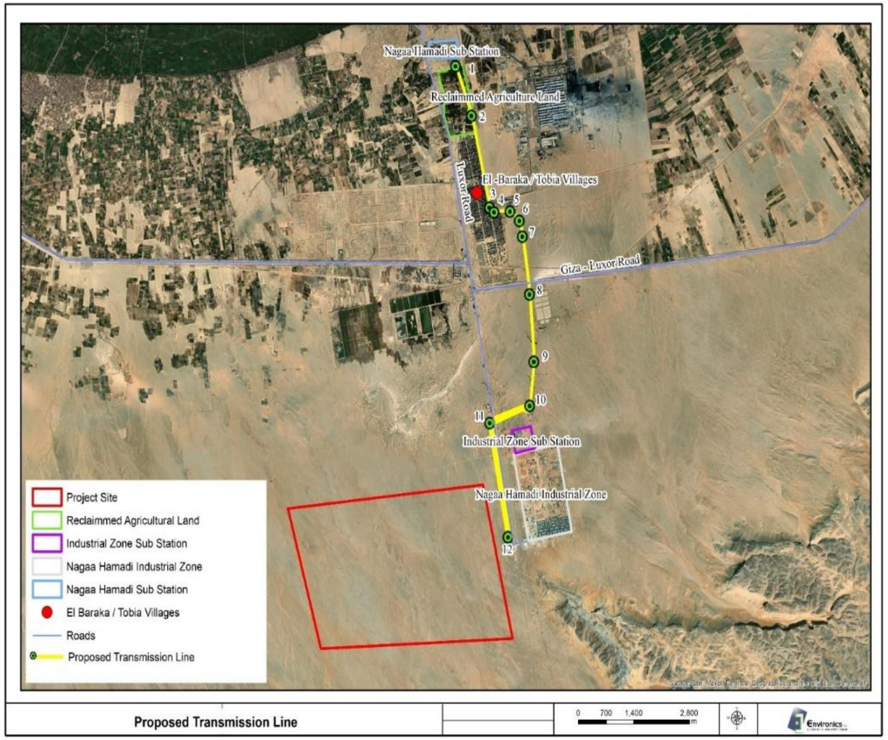
- **يقع المشروع** على بعد حوالي ٥٠ كم جنوب غرب مدينة قنا، و١٥ كم جنوب شرق مدينة نجع حمادي.
- **يتبع موقع المشروع** إداريا مركز نجع حمادي ، محافظة قنا.
- **مساحة المشروع:** تبلغ مساحة المشروع حوالي ٣٨٨٨ فدان أو ما يزيد على ١٦ كم^{2}.
- **أقرب منطقة سكنية لموقع المشروع:** تقع على بعد حوالي ٥.٥ كم شمال الموقع.



مكونات المشروع

المكونات الرئيسية:

- حقل الطاقة الشمسية بقدرة ١ جيجا وات
- سيتم استخدام ألواح شمسية عالية الكفاءة من السيليكون أحادى البلورة وأنظمة تتبع أحادية .
- المحور يتضمن المشروع نظام تخزين الطاقة بالبطاريات(BESS) باستخدام وحدات بطاريات
- أيون الليثيوم. محطة محو ات لرفع جهد الكهرباء المنتجة لجهد الشبكة القومية ليتم الربط على الشبكة الموحدة عن طريق خط نقل كهرباء يصل إلى محطة محو ات نجع حمادى.



الاحتياجات المادية للمشروع

الاحتياجات المادية تكون أساسا في مرحلة الانشاء حيث أن:

- خلايا الطاقة الشمسية لا تحتاج لمدخلات من البيئة بخلاف ضوء الشمس
- احتياجات العمالة أقل كثيرا.
- أعمال نظافة الخلايا ستكون بالطريقة الجافة.
- مرحلة الإنشاء

إمدادات المياه والتخزين:

- سيتم توفير المياه للأنشطة والأغراض الصحية بواسطة الشاحنات وتخزينها في خزانات. في الموقع
- من المتوقع أن يكون الاستهلاك اليومي ٨٠-١٢٠ م^3/يوم خلال ذروة التشييد والبناء،

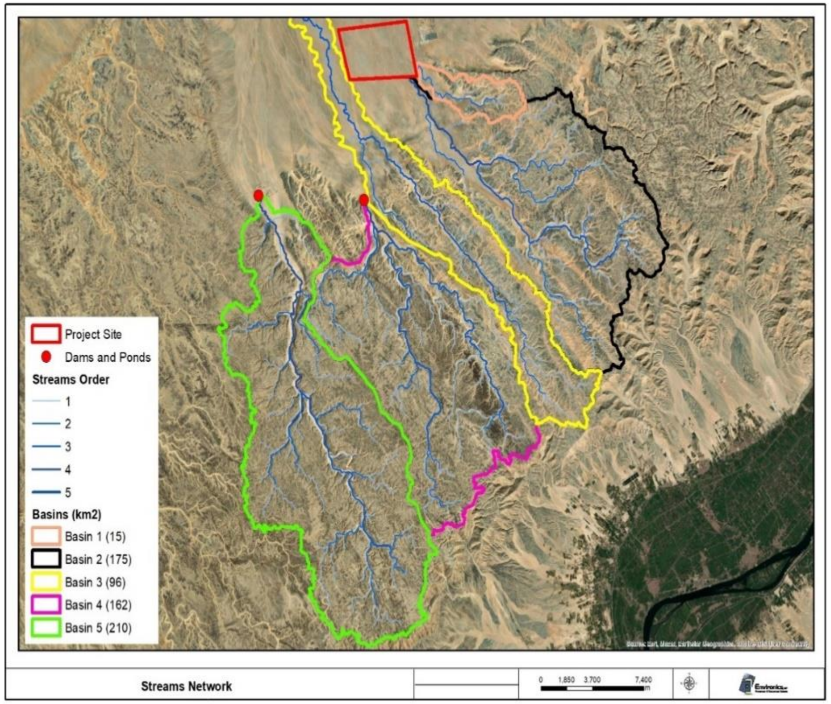
مياه الصرف الصحي

- تقدر كميات مياه الصرف الصحي بـ ٤٠-٦٠ م^3/يوم. من المرافق الصحية،. سيتم استخدام خزانات الصرف الصحي للتجميع ثم تكسح إلى محطة معالجة الصرف الصحي شمال الموقع على بعد حوالي ٦كم.

امدادات الديزل والوقود:

- استخدام الديزل فى تشغيل المولدات لأعمال الإنشاء والتشغيل ومتطلبات الطواريء أثناء التشغيل.
- يتم الحصول عليه من محطات الوقود القريبة.

الخصائص البيئية لمنطقة المشروع



البيئة الفيزيائية

المناخ

- تقع منطقة المشـــروع في محافظة قنا، التي تتميز بتباين كبير في درجات الحرارة وهو ما ينتج عنه صيف شديد الحرارة وشتاء بارد مع أمطار نادرة للغاية.
- تستقبل المنطقة كمية كبيرة من الاشعاع الشمسي، خاصة في فصل الصيف.
- تقع محافظة قنا في منطقة مناخية جافة تتسم بالحرارة والجفاف وندرة الأمطار

السيول

- تم ملاحظة بعض مسارات السيول خلال زيارة الموقع.
- يوجد سدود على مسارات السيول باتجاه الغرب خارج نطاق موقع المشروع

البيئة البيولوجية

- يعتبر موقع المشـــــروع فقير من حيث الغطاء النباتي وتكون الحياة النباتية في الغالب موســــمية (سنوية) ومحدودة بسبب اعتمادها على فرص تساقط الأمطار المنخفضة.
- منطقة المشروع لا تفتقر إلى الموائل المناسبة للبحث عن الطعام فحسب، لكنها أيضا تشهد بالفعل اضطراب بسبب التواجد والأنشطة البشرية. بالتالي، من المستبعد وجود تنوع حيوانى بالموقع.

البيئة الاجتماعية

- استخدام الأراض الوحيد القريب من المشروع هو المنطقة الصناعية
- أقرب تجمع سكنى (البركة) على بعد أكثر من ٥ كم من موقع المشروع
- الموقع متصل بشبكة الطرق المؤدية إلى نجع حمادى والمحافظة مما يسهل الوصول إليه.

تصنيف التأثيرات

التأثيرات الإيجابية	التأثيرات السلبية المحتملة	التأثيرات غير ذات الصلة
– توفير فرص عمالة – توفير مصادر للطاقة للتنمية – الحد من غازات الاحتباس الحرارى	التأثيرات المحتملة أثناء مرحلة الإنشاء – التأثيرات على نوعية الهواء ؛ – الضوضاء ؛ – التأثيرات على التربة؛ – البيئة البيولوجية – الصحة والسلامة في بيئة العمل. – الضغط على الموارد المحلية – تدفق العمالة – المرور التأثيرات المحتملة أثناء مرحلة التشغيل – الهواء – التأثيرات على التربة؛ – الصحة والسلامة ببيئة العمل؛ – الضغط على الموارد المحلية	– المياه السطحية العذبة – التأثير على الطيور المهاجرة – التأثير على التراث الحضارى – المياه الجوفية

مصفوفة تقييم التأثير لمرحلة الإنشاء

الجانب البيئي	التأثيرات المتوقعة	ملخص تدابير التخفيف	التأثيرات المتبقية
مرحلة الإنشاء			
• **جودة الهواء**			
• أعمال تسوية الموقع • المعدات	ضئيلة	• الصيانة الدورية لمركبات ومعدات البناء لتقليل انبعاثات العوادم. • تنفيذ سياسات لتقليل أوقات التوقف للمركبات والمعدات. • ضمان وعي العمال بالممارسات الجيدة في استخدام الآلات. • إجراء قياسات دورية لمداخن مولدات الكهرباء لضمان امتثالها لقانون ١٩٩٤/٤.	غير هامه
• **الضوضاء المحيطة**			
• الآلات معدات دق الخوازيق • حركة المركبات • مولدات الطاقة	ضئيلة	• ضمان الصيانة الدورية للمعدات وآلات الإنشاء لتقليل الضوضاء؛ • جدولة الأنشطة ذات الضوضاء العالية لتجنب العمليات المتزامنة التي قد تزيد من مستويات الضوضاء؛ • توفير واقيات الأذن للعمال المعرضين لمستويات ضوضاء عالية؛	غير هامه
• **التأثيرات علي التربة**			

• إدارة مياه الصرف الصحي،
• تخزين المواد والمخلفات،
• الانسكابات العرضية.
	ضئيلة	• إجراء صيانة للمركبات والشاحنات ومعدات الإنشاء ؛
		• الحفاظ على ممارسات النظافة الجيدة لضمان موقع بناء نظيف ومنظم؛
		• جمع ونقل مياه الصرف الصحي بواسطة مقاولين معتمدين لضمان التخلص السليم ؛
		• **النفايات الصلبة غير الخطرة:**
		  • جمع النفايات في نقاط جمع محددة وتخزينها في حاويات مناسبة وفقًا للوائح.
		  • التعامل مع مقاولين مرخصين لجمع والتخلص من النفايات غير الخطرة
		• **النفايات الخطرة:**
		  • إنشاء مناطق تخزين محددة ومفصولة عن النفايات الخطرة.
		  • التعامل مع مقاولين مرخصين لجمع والتخلص من النفايات الخطرة.
		  • إرجاع بطاريات الليثيوم في نهاية عمرها الافتراضي إلى الموردين
			غير هامه

• **التأثيرات علي البيئة البيولوجية**			
• جذب الافات	غير هامه	• تطوير وتنفيذ وتحديث خطة إدارة النفايات الصلبة لتشمل جمع النفايات وتخزينها ونقلها والتخلص منها بطريقة مستدامة بيئيًا لتجنب جذب الآفات.	غير هامه

الجانب البيئي	التأثيرات المتوقعة	ملخص تدابير التخفيف	التأثيرات المتبقية
• **التأثيرات علي البيئة الاجتماعية**			
الضغط على الموارد المحلية	غير هامه	سيقوم المقاول بتوريد المياه من منشأة مياه معتمدة. وسيتم وضع خطة شاملة لإدارة المياه. سيقوم المقاول بالاتفاق مع محطات الوقود القريبة لزيادة توريد الوقود طبقا لبرنامج الانشاء	غير هامه
• تدفق العمالة	متوسطة	• إعطاء الأولوية لتوظيف العمال المحليين لتقليل عدد العمال الوافدين وتقليل الاضطرابات الاجتماعية.	ضئيلة
• **البنية التحتية**			
• المرور والنقل	متوسطة	• طورت شركة Scatec إجراءات إدارة النقل التي تنطبق على مشاريع Scatec وعملياتها وكذلك على مقاوليها والمقاولين الفرعيين. تحدد هذه الإجراءات الحد الأدنى من متطلبات السلامة لأنشطة النقل الخاصة بشركة Scatec. • عدد شحنات نقل مكونات المحطة كبير لذلك سوف يتم التنسيق مع إدارة المرور على توقيتات النقل والمحاور المناسبة للاستخدام.	ضئيلة
• **الصحة والسلامة المهنية**			
• التأثيرات علي صحة وسلامة القوي العاملة	متوسطة	• سوف يتم إعداد خطط إدارة متكاملة للسلامة والصحة المهنية يتم الالتزام بها من كافة المقاولين. • ضمان التدريب المناسب للعمال، الصيانة الدورية للمعدات، وتنفيذ بروتوكولات السلامة. • تقييد سرعة المركبات بحيث لا تتجاوز الحد الآمن داخل موقع العمل (١٥-٢٠ كم/ساعة). • سيتم فحص جميع المعدات قبل بدء العمل لضمان سلامة العمال.	ضئيلة
مرحلة التشغيل			
جودة الهواء			
الانبعاثات الصادرة عن مولد الطوارئ	ضئيلة	• تحسين تشغيل المولدات الاحتياطية لتقليل الاستخدام والانبعاثات.	غير هامه
• **الضوضاء والاهتزاز**			
• • تشغيل المحولات، أنظمة تخزين طاقة البطاريات (BESS) • المولدات الاحتياطية عند الحاجة	ضئيلة	• سيتم تصميم الآلات والمعدات التي تولد الضوضاء المحتملة لتلبية اللوائح القانونية المتعلقة بالضوضاء. • سيتم تزويد العمال الذين يعملون على الآلات والمعدات المولدة للضوضاء بمعدات الوقاية الشخصية المناسبة.(PPEs)	غير هامه

الجانب البيئي	التأثيرات المتوقعة	ملخص تدابير التخفيف	التأثيرات المتبقية
• **التأثيرات علي البيئة الاجتماعية**			
• الضغط على الموارد المحلية	غير هامه	• المياه اللازمة لمرحلة التشغيل تعتبر ضئيلة وبالرغم من ذلك سوف يتم تطبيق خطط إدارة المياه	لا يوجد أثار متبقية
• **التأثيرات علي الصحة والسلامة المهنية**			
• التأثيرات على بيئة العمل	غير هامه	• الامتثال لمستويات الانبعاثات المحددة في اللوائح ذات الصلة. • الالتزام بخطة الإدارة البيئية الموضحة في هذا الفصل. • توفير معدات الحماية الشخصية المناسبة (PPE) للعمال.	غير هامه

للتواصل مع مسؤولي الدراسة: واتساب: ٠١٠٦٥٥٣١٦٧٩

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mohamed.taha@scatec.com

Annex 2

Attendees in women’s meeting

مسلسل	الاسم باللغة العربية	الاسم باللغة الانجليزية
.١	سلوى سعيد فؤاد نور الدين	Salwa Saeed Fouad Nour El Din
.٢	سميرة سعيد فؤاد نور الدين	Samira Saeed Fouad Nour El Din
.٣	شربات فؤاد عبد الحفيظ على	Sherbat Fouad Abdel Hafeez Ali
.٤	شيماء خالد عبد الله سلطان	Shaima Khaled Abdullah Sultan
.٥	منى عونى فؤاد نور الدين	Mona Awni Fouad Nour El Din
.٦	هيام يونس حسن مخلوف	Hiam Younes Hassan Makhlouf
.٧	رجاء مغربى الضبع اسماعيل	Raja Maghribi El Dabaa Ismail
.٨	هبة حمدى ابو الحمد جاد	Heba Hamdy Abu El Hamad Gad
.٩	صابرين احمد عبد الستار عبد الكريم	Sabreen Ahmed Abdel Sattar Abdel Karim
١٠	هناء صفوت ابو المجد محمد	Hanaa Safwat Abu El Magd Mohamed
١١	لطيفة حسين احمد محمود	Latifa Hussein Ahmed Mahmoud
١٢	ياسمين احمد عبد الراضى احمد	Yasmine Ahmed Abdel Rady Ahmed
١٣	زينب عثمان فراج جهلان	Zainab Othman Farag Jahlan
١٤	مديحة هاشم محمد امين	Madiha Hashem Mohamed Amin
١٥	ايمان عبد الوهاب همام احمد	Iman Abdel Wahab Hamam Ahmed
١٦	ايمان احمد محمود احمد	Iman Ahmed Mahmoud Ahmed
١٧	نورهان سعيد محمد محمد	Nourhan Saeed Mohamed Mohamed
١٨	تيسير عبداللة حسين احمد	Tayseer Abdullah Hussein Ahmed
١٩	نعمة عبد الستار عبد الساتر محمد	Neema Abdel Sattar Abdel Sater Mohamed
٢٠	منال احمد حسين مصطفى	Manal Ahmed Hussein Mustafa
٢١	منجة قط همام احمد	Munja Qat Hamam Ahmed
٢٢	سهير عزباوى على توفيق	Sohair Azbawy Ali Tawfiq
٢٣	شادية عبد الوهاب همام احمد	Shadia Abdel Wahab Hamam Ahmed
٢٤	رضا عبد الرازق عبد الرسول امير	Reda Abdel Razek Abdel Rasoul Amir
٢٥	سحر على محمد على	Sahar Ali Mohamed Ali
٢٦	شيريهان سعيد محمد محمد	Sherihan Saeed Mohamed Mohamed
٢٧	منال عبد النعيم ابراهيم احمد	Manal Abdel Naeem Ibrahim Ahmed
٢٨	رضا عبد الملك مكى عيسى	Reda Abdel Malek Mekki Issa
٢٩	ورده سعيد محمد محمد	Warda Saeed Mohamed Mohamed
٣٠	سعيده جمعه عبد المبدى اسماعيل	Saeeda Gomaa Abdel Mobdi Ismail
٣١	فاديه على فهيم محمد	Fadia Ali Fahim Mohamed
٣٢	تيسير موسى محمد على	Tayseer Moussa Mohamed Ali
٣٣	سحر عوض الله احمد محمد	Sahar Awad Allah Ahmed Mohamed
٣٤	نها عامر محمد خليل	Noha Amer Mohammed Khalil
٣٥	فتحيه جاد محمود ابراهيم	Fatehia Gad Mahmoud Ibrahim
٣٦	سهير عباس محمد مختار	Sohair Abbas Mohamed Mokhtar
٣٧	منى ابو الوفا على خليل	Mona Abu Al-Wafa Ali Khalil
٣٨	سلوى عبد الله حسين احمد	Salwa Abdullah Hussein Ahmed
٣٩	نورهان عبده فراج احمد محمد	Nourhan Abdo Farag Ahmed Mohamed
٤٠	جهاد عمر محمد محمد	Jihad Omar Mohamed Mohamed
٤١	سهام سعيد محمد محمد	Soham Said Mohamed Mohamed
٤٢	سعيده منصور عبد الهادى بربرى	Saeeda Mansour Abdel Hadi Barbary